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The Effect of Emotional Valence on Memory Quality and Confidence Judgements

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ABSTRACT

In the present study, our aim was to investigate how emotional valence influences the recollective experience and confidence judgements of memory. We also investigated if subliminal manipulation can have a valence dependent effect on the realism in confidence judgements. In Experiment 1, the first phase involved participants being shown pictures and asked to select the pictures that had either negative or positive valence. In the test phase, participants decided first if the picture was “old” or “new”, after which they made confidence judgements of their responses. Pictures reported as “old” was finally appraised on the quality of the memory trace; if subjects “remembered”, “knew” or “guessed” that they had previously seen the picture. Experiment 2 was conducted in the same fashion, with the exception of a subliminal presentation preceding each picture in the test phase, which was expected to cause an increase in “know” responses. The results were partly in line with previous research. Significant results were obtained for the confidence variable, showing that subjects were more confident in their responses with negative images. Albeit not significant, the results showed that recollective experience was somewhat higher for negative valence than for positive. It is also discernable that subliminal manipulation of fluency lead to an increase in familiarity, although it did not influence realism in confidence judgements.

Introduction

Memory is made up by many different parts, such as emotions, affects and the processing of stimuli. There are different types of stimuli, and they are both processed and stored in different ways and to various degrees. A distinction is often made between knowing and remembering, where the former is a memory based on familiarity, i.e. when you have a feeling of having seen a person, item, event etc before, but not much more. Remembering, on the other hand, reflects a feeling of recognition, where you do not just remember the item itself, but for example also associations that you made when you first saw it or you remember things that were also present at the time. Such memories are more detailed, and therefore experienced as more certain. Is it possible that there is a difference in negative and positive stimuli, in that they are processed differently and that the resulting memories differ in phenomenological quality? And if such a difference exists, what factors affect the various ways of encoding? Research conducted by Dahl, Johansson and Allwood (2003) have shown that pictures with negative valence result in higher degree of recollection when compared to positive images. The same study also found that negative images elicit a higher degree of confidence in recognition memory, i.e. subjects were more confident in their memories of an image being previously presented. Other research, as the study made by Yonelinas (2001), also found a strong relationship between recollection and higher degrees of confidence.

The study of these phenomena is important, not least from a forensic point of view. It can for example be used to gain more insight into the reliability and accuracy of an eyewitness. A witness does not only have the memory of the witnessed event, but he/she also has a certain level of confidence in this memory being correct. By studying the relationship between recognition memory and confidence judgements, we can better understand what makes an eyewitness report that he/she is "absolutely sure about what happened", and how much credibility there is in such a statement.

If emotional valence has been shown to affect recollection and confidence judgements, what other factors could also have an influence? Jacoby and Whitehouse (1989) found that unconscious perception can have an impact on recognition memory and lead to higher degrees of familiarity. They exemplify this with the well-known concept of Déjà vu, where a quick glance over a street can result in feelings of familiarity when one finally crosses.

This study was designed to examine the possible difference in memory quality between positive and negative valenced pictures, partly asking similar questions as previous research has done. However, whereas both Yonelinas (2001) and Dahl et al. (2003) did not let subjects make remember/know responses as well as confidence judgements, the present study will

examine if such a task will yield similar results. It also examines if subliminal presentations of images can affect the different types of memory qualities and the realism of confidence judgements, i.e. to what degree a subject's confidence judgements tally with their actual responses.

Theories on Memory

Memory in itself is a concept that scientifically is researched from many different perspectives. Among the many views that exist on memory, there are for instance the neurobiological, developmental and cognitive perspectives. For this essay, the latter field of research is most relevant, and it will subsequently be in focus in this theoretical background text.

One of the main themes of the cognitive model of memory presented by Tulving (1985) has to do with the memory being treated as a set of systems, rather than as a single, stand-alone cognitive system. Tulving argues his hypothesis through a number of comparisons. For instance, he means that it is impossible to make generalisations about memory as a whole, but that it is perfectly possible to make general statements on certain kinds of memory. Furthermore, due to the large variety of memory types that seem to work so different compared to each other, it is difficult to imagine such widely differing cognitive workings as being part of one and the same system. Tulving also compares memory to other psychological functions, which have been shown to be made up of several systems working together, and argues that memory should be no different. Evidence has been found to suggest that separate brain functions associated with vision exist; one dealing with recognising objects and another mediating their location in space, so the idea that memory is subdivided in a similar manner is not at all implausible. Finally, Tulving argues that memory is the result of a very long evolutionary process. It cannot reasonably be expected to have evolved over a smooth, continuous line, but rather through shifts, jumps and turns, and as such it is likely to assume that the structures of memory are different functions that have evolved over time (Tulving, 1985).

According to the cognitive model presented by Tulving (1985), memory can be divided into three different categories, namely *procedural memory*, *semantic memory* and *episodic memory*. Procedural memory can briefly be described as a repository of skills, as it is this type of memory that retains learned connections between stimuli and responses, and can be described as memories that are used for doing rather than describing. For this reason, procedural memory is often classified by some theorists as an *implicit*, or *non-declarative*

memory. In contrast, semantic and episodic memories are *explicit* (or *declarative*), since they besides being overt also can be expressed through covert, internal cognitive processes. The semantic memory is characterised by Tulving by its "additional capability of internally representing states of the world that are not perceptually present" (p. 387). It is an organised knowledge about the world and language, i.e. impersonal and general knowledge that includes schemas and scripts which make up the foundation for behavioural situations, such as the routines that are followed at a visit to a restaurant or dinner party. Episodic memory, finally, facilitates the forming and retention of personally experienced events, and how they subjectively relate temporally and spatially to the individual.

These three types of memory are, according to Tulving (1985), arranged *monohierarchically*. The monohierarchical arrangement means that each higher subsystem is supported by and depends on its lower system or systems, but has unique and special capabilities that the lower systems does not. This model suggests that the procedural memory constitutes the lowest level of the hierarchy, and has the semantic memory as its single, specialised subsystem. Subsequently, the semantic memory has the episodic memory as its subsystem. The different systems each work on different levels of consciousness, labelled *anoetic*, *noetic* and *autonoetic* consciousness. Anoetic (non-knowing) consciousness involves an organism's ability to sense and react to external stimuli, and is associated with the procedural memory. Noetic (knowing) consciousness is associated with the semantic memory, and facilitates an introspective awareness of the internal as well as the external world. Autonoetic (self-knowing) consciousness is an aspect of the episodic memory. This is what makes an individual aware of his or her own identity, and can see his or her existence from a perspective of subjective time. Autonoetic consciousness is what makes it possible for an individual to have memories of the past from a subjective point of view (Tulving, 1985).

Another difference between the procedural, semantic and episodic memories has to do with how knowledge is expressed from them. Whereas the procedural memory can only express knowledge in conditions like those that existed at the time of learning, knowledge in the semantic and episodic memory can manifest itself under conditions that are not necessarily similar to those of original learning and the expression of knowledge does not have to be overt. Indeed, with episodic memory the typical expression of knowledge is recollective experience, i.e. when the individual is retrieving subjective memory (Tulving, 1985).

Tulving's Remember – Know Paradigm. Since the publishing of Tulving's article (1985), there has arisen a paradigm that explores the phenomenology of retrieval experience (Rajaram, 1996). In studies based on this paradigm, subjects are given a memory test and asked to determine the nature of the retrieval experience that accompanies every recognized item. If an item is remembered vividly, i.e. consciously associated with e.g. a certain feeling that the subject experienced during the initial presentation, or detailed memories on the item's appearance or placement during the test, the subject is to give a *"remember"* response. If, on the other hand, the subject is certain of having been presented with the item earlier but does not have a conscious recollective experience of it, a *"know"* response is to be given. With this in mind, it is feasible to connect this with Tulving's (1985) noetic and autonoetic states of consciousness, where a "remember" response would be a product of the autonoetic level, and a "know" response would stem from the noetic consciousness. Also, it has been shown that all that is necessary for encoding into the semantic system is some initial awareness, however fleeting, of an event. But encoding into the episodic memory requires a more conscious elaboration of events (Gardiner & Richardson-Klavehn, 2000).

Studies have shown that "remember" and "know" responses are dissociable in rather predictable and systematic ways. There is even evidence to suggest that remembering and knowing are functionally independent from each other, since studies have examined many possible relations between the two states of awareness (for reviews, see Gardiner, Ramponi & Richardson-Klavehn, 1998; and Yonelinas, 2002). Variables have been identified that influence "remember" responses but not "know" responses, and vice versa. Furthermore, some variables have been shown to have opposite effects on "remember" and "know" responses, while other variables have turned out to affect the two states of awareness in similar ways. In their study, Gardiner and associates (1998) collected transcripts of expressions of recognition experiences that subjects reported during a memory test. In line with the remember/know paradigm, "remember" responses were accompanied by either inter-item or personal associations, "know" responses had little or no indication that they involved any specific contextual memory. Furthermore, other findings reviewed by Gardiner and Java (1993) suggest that measures of "remember" and "know" responses will reveal functional dissociations within recognition memory that are very similar to dissociations that have been observed when comparing explicit and implicit memory tests.

When "remember" and "know" are the only options for the subject, it is possible that the latter includes various judgemental strategies (or inferences) with the subject that does not involve any awareness of a selected item being part of the study list. For this reason, in later

years the possibility of "guessing" has been added to the remember/know paradigm as a good solution to this problem (Gardiner & Richardson-Klavehn, 2000). In such designed studies, it has been found that "guess" responses does not reveal any memory for studies items, unlike "remember" or "know" responses. A general finding is also that "guess" responses to studied words do not exceed the number of "guess" responses to unstudied words (Gardiner et al., 1998).

It is also important to note that studies have shown that subjects in memory tests are able to distinguish between the two states of awareness, i.e. "remember" and "know", which makes it possible to study the phenomenon through subject reports on their experiences (Gardiner & Java, 1993).

Dual-process Models of Recognition. Tulving's theory about recognition memory performance reflecting the operation of different memory systems has much in common with so-called dual-process models (see Yonelinas, 2002, for a review). Tulving's model stipulates that the semantic memory and its noetic consciousness give rise to the experience of "knowing", or in other words the feeling of familiarity in the absence of explicit remembering. "Remembering", i.e. conscious recollection, is in turn associated with the episodic memory and autonoetic consciousness, where the memory includes more personal and subjective information (Gardiner & Java, 1993). One of the main arguments for the dual-process models is that experiments have shown that certain types of stimulus during a memory task might affect the level of familiarity but not recollection, and vice versa, much like in the remember/know studies mentioned earlier. This can be referred to as a functional dissociation of tasks (Tulving, 1985). Some models, as those proposed by e.g. Atkinson and Mandler, claim that recollection and familiarity reflect conceptual and perceptual processes respectively (Yonelinas, 2002). Tulving, as already mentioned, treats familiarity as a result of the semantic memory that contains abstract knowledge. Tulving (1985) claims that implicit (non-declarative) memory relies on the procedural system, which is separate from the systems supporting recognition memory, i.e. the semantic and episodic systems. Subsequently, "remember" and "know" responses thus measure autonoetic and noetic consciousness respectively (Gardiner et al., 1998).

Yonelinas' model suggests that recollection ("remember") and familiarity ("know") differ in terms of the type of information that they provide. Yonelinas further argues that recollection and familiarity are different in the extent to which each process influences recognition confidence. Familiarity is then assumed to reflect *quantitative* memory strength

information, of which there can be different degrees. Recollection, on the other hand, reflects a threshold retrieval process through which *qualitative* information about an item or event is retrieved. There are no various degrees of recollection; you either experience it or you do not. In other words, Yonelinas claims that for a remembered item or event, a number of different aspects can be retrieved. However, if there is no qualitative information to retrieve, the memory quality falls below the recollective threshold and results only in familiarity (Yonelinas, 2002). Furthermore, Jacoby argues that familiarity is influenced by conceptual and perceptual fluency, and as such it might be related more closely to conceptual implicit memory (Yonelinas, 2002). In order to follow this argument, however, we need to look closer at the concept of fluency.

As described by Whittlesea and Leboe (2000), fluency is based on how the easily or efficiently a stimulus is processed. Having seen an item before naturally facilitates fluency, and a subject can thus use the fluency of a memory performance to decide whether an item has been encountered earlier. Or, simpler put, subjects can reach the conclusion that they have seen an item before if it is processed fluently. This causes a sense of familiarity, but without any real contextual information, and is therefore associated with "knowing". Although a person can experience this as a very strong and true memory of an item, it is not a satisfactory state due to its lack of information on the nature of the prior experience (Whittlesea & Leboe, 2000).

Rajaram (1996) has developed a concept known as the distinctiveness/fluency framework, within which the assumption is that "remembering" is influenced by conceptual knowledge and "knowing" by perceptual knowledge, i.e. object-specific information. Indeed, early results showed that changes in conceptual variables had an effect on "remember" responses, and perceptual variables affected "know" responses (Rajaram, 1996). Although later studies have revealed more complex relations, where conceptual variables have been found to have an impact on "know" responses and perceptual variables affecting "remembering", the scope of this essay is focused on how object-specific information can influence the experience of familiarity. We will return to the issue of perceptual fluency in Experiment 2 of the present study.

Confidence Judgements

Each and every day we make judgements about our own and others' beliefs. This can happen in many different situations and for several reasons. For example, when someone asks if Sigmund Freud wrote the book "The Interpretation of Dreams", you decide on an answer and

make an explicit or implicit confidence assessment of the certainty that your answer is correct. A *confidence judgement* is the assessed degree of certainty of our own beliefs or assertions regarding reality. Confidence can be expressed in several ways, for example with a percentile, "I am 100% sure" or in a more general statement like "I am absolutely sure".

The research on confidence judgements has many of its roots in forensic psychology from the early twentieth century (see Granhag, 1996). The certainty of a witness belief is an important issue when trying to determine how to make witness evaluations. Systematic research regarding the confident assessment of one's own memory is only some thirty years old. There are two major fields of research; one focuses on confidence judgements on retrospective tasks, such as statements that can immediately be judged as true or false, whereas the other major field concerning confidence judgements involves predictions about future outcomes (Granhag, 1996). The most profound finding in the field of confidence judgements has been the universal overconfidence that seems to apply almost everywhere. But before going into this, we need to have a look at the concept of realism in confidence judgements.

Realism in Confidence Judgements. Realism in confidence encompasses a methodology for measuring the match between confidence and its basis in reality. Realistic people have a good assessment capability of their own ability to make confidence judgements. A person is said to be realistic if his/her confidence judgements over time equals the proportion of correct answers. Other terms for realism in confidence are *external validity*, *calibration* and *appropriateness of confidence* (Lichtenstein, Fischhoff & Phillips, 1982). Confidence judgements that are not perfectly in line with reality shows that a person is more or less calibrated and either *over-* or *underconfident* in their judgements. The calibration measurement is an overall measure of the relation between correct answers and confidence judgements. Calibration measures both overconfidence and underconfidence and aggregates this to positive number. A perfectly calibrated person has a score of 0 on calibration while a less perfect person would have a higher score. The calculation of under/overconfidence uses the same principles as calibration but can be of both a negative and a positive score yet still have a score of 0 as a perfect confidence level. Studies show that people are overconfident in general when making judgements. The overconfidence phenomenon is a finding that has shown to be strong and can be seen in both predictive and retrospective tasks (Granhag, 1996). Overconfidence has been shown for tasks involving either semantic or episodic memory. Studies show that subjects are overconfident in areas where they have no expertise

such as general-knowledge questions of moderate to extreme difficulty (Lichtenstein et al., 1982). Experts, on the other hand, seem to be well calibrated. This only applies to areas where their expertise is applicable; in other areas, experts are of course as calibrated as the general population. This has been shown in several studies (Lichtenstein et al., 1982).

The level of overconfidence seems to increase with the level of difficulty of the task. This is the so called *hard-easy effect*. Several attempts to remove the hard-easy effect, including extensive training, monetary incentives and extensive information, have not shown any significant results. Extreme overconfidence is shown when the task is almost impossible such as picking winners in six horse races (Lichtenstein et al., 1982). As the difficulty of the assigned task is lowered, the level of confidence seems to follow the decline. Studies show that in very easy assignments, even a degree of underconfidence can be measured. Lichtenstein et al. (1982) suggest that these effects come from the subjects' inability to assess the level of difficulty of their assignment. This is supported by an unpublished study made by Philips and Chew cited by Lichtenstein and associates (1982), where no correlation could be found between the difficulty of a completed test and the percentage of right answers.

There have been several theoretical suggestions to why people seems to be overconfident. Two traditions are clearly discernible amongst the theories. The cognitive bias tradition focuses on problems in the internal processing while the other, here represented by the ecological model, points toward methodological problems.

As reported by Lichtenstein et al. (1982), Pitz suggested that because of the limitations of the information-processing capacity and working memory, complex problems such as calculating probabilities are processed serially. This would lead to the tendency of ignoring uncertainties in the early problem solving stages because of the need to reduce complexity in the later stages of the calculation process. Subsequently, this leads to results that are too tightly distributed, and over/underconfidence in probabilities is achieved. Two other theories have been presented by Slovic and Tversky and Kahneman (Lichtenstein et al., 1982). By using a special heuristics (because of the limited processing abilities), called *anchoring and adjustment*, the distributions are too tight. Anchoring and adjustment suggest that once a first estimate has been made it becomes an anchor that has a too dominating influence on the later adjustment that we make.

The *strength and weight theory* proposed by Griffin and Tversky (as described in Granhag, 1996) can also be used to explain the phenomena of overconfidence and the hard-easy effect. This theory focuses on the two concepts of strength and weight where strength is the "force" or "extremeness" of an evidence and weight describes the "predictive validity" or

the chance that a piece of evidence actually is true. This model makes the assumption that a confidence judgement does not use both concepts equally, strength has a bigger impact than weight in the confidence judgement process. Using this model to predict confidence result will get results in line with research.

The three stage model as presented by Koriat, Lichtenstein and Fischhoff (1980) divides the judgement process into three stages. When confronted with a confidence judgement an initial search of the memory is done to arrive at an answer. The second stage is a gathering of evidence for this position and an assessment of its correctness. The third stage involves a translation of this assessment into a judgement of for example numbers or a general statement. Studies show support for locating the overconfidence bias in any of the three stages (Granhag, 1996).

Other theories have different explanations of the confidence judgement process and therefore a different possible explanation for the overconfidence phenomena. The Ecological model as reviewed by Granhag (1996) assumes that people are adapted to their environment to the extent that they can pick up frequencies of occurrences in their surroundings. These frequencies are stored in different classes and then used to assess different probabilities and make probability judgements in the appropriate situation. The proponents of this theory claim that people are well calibrated in general but instead the questions asked in the major studies on confidence are the source of error. The experiments ask questions that are not a representative sample of the class being used according to this view and therefore we cannot expect a good calibration.

Research with focus on confidence and emotional valence seems to be a somewhat neglected area, although Dahl and associates (2003) have found that pictures with negative valence are associated with higher levels of confidence when compared with positive images. We will return to this in the experiments of the present study.

Theories on Emotion

What is an emotion? This can be a very difficult question to answer, and depending on which theory one turns to, several different answers are likely to appear. Lazarus (1991) reviews several suggestions, but reports that all theorists agree that it is a state of excitement or perturbation which is marked by strong feeling, and usually an impulse towards a certain form of behaviour. Emotions are usually tied to an object and connected to a certain situation, i.e. behaviour resulting from an emotion is often directed towards e.g. an item or person. When it comes to measuring or observing emotions, Lazarus (1991) suggests that the actual response

to or result of the emotion should be in focus. If a stimulus triggers an emotion, the emotion will in turn result in some form of response. This response is what should and can be observed and/or measured, because it occurs when the individual is experiencing an emotion. The response can manifest itself through e.g. a facial expression or a biological response such as increased heart rate. More extreme reactions like fighting or running away are also responses, as is a verbal report from the individual (Lazarus, 1991). Closely related to emotions is the concept of *affects*, which can be described as a description of solely the actual response to an emotion. More specifically, the term "affect" can be used to describe the evaluation process during which an emotion is subjectively assessed as positive or negative for the individual (Lazarus, 1991). This process of evaluation is the focus of the *appraisal theory*.

The Appraisal Theory. The evaluation process of a stimulus is based on if it is positive or negative in relation to the survival and well-being of the individual. It is largely an automatic and unconscious process, and serves to help coping with traumatic experiences and protecting the ego and identity of the individual (Scherer, Schorr & Johnstone, 2001).

According to Lazarus (1991), the process of appraisal consists of two basic stages, namely *primary* and *secondary appraisal*. Primary appraisal involves an assessment of an experienced event, and can be subdivided into three forms. The first, *goal relevance*, has to do with assessing if the experienced event will have any effect on the individual's well-being. It is only if an event is appraised as relevant to the individual that a stressful response is triggered. If so, the process of appraisal moves on to the second phase; *goal congruence/incongruence*, which refers to how well the event matches what the individual wants. Goal congruence, i.e. when the event goes together with the individual's goals, leads to positive emotions and goal incongruence thus leads to negative emotions. However, the third phase of primary appraisal also plays a role in determining the specific emotion. *Type of ego-involvement* reflects the evaluation of how the ego is affected by the event. This can involve how the individual's self-esteem, moral values or ideas relate to the event (Lazarus, 1991).

Similarly, secondary appraisal can also be seen as a process of several phases. Rather than evaluating the event itself, secondary appraisal is the assessment of possible actions and how it will affect the individual's well-being (Lazarus, 1991). The first stage is *blame or credit*, and has simply to do with finding who is responsible for the event. *Coping potential* refers to the evaluation of different actions that the individual can take to cope with the situation, and *future expectancy*, finally, deals with how the event is likely to make things psychologically better or worse for the individual (Lazarus, 1991).

Lazarus (1991) also includes a third stage of the appraisal process, namely *reappraisal*. This is because the world around us and our encounters and interactions with it is in a constant state of flux, and as a result our emotions are constantly changing as well. Reappraisal is quite simply the process or going through the appraisal process again and again, as an adaptation to our dynamic surroundings.

Lazarus' theory has much in common with Scherer's *sequential check theory* (Scherer et al., 2001), which was conceived to show how the difference between various emotional states can be explained as the result of how a specific stimulus is appraised. In this theory, Scherer defines the term emotion as the point where an organism's subsystems are synchronised to assess how the situation will affect its well-being. Much like Lazarus' ideas, Scherer and associates suggest that a stimulus is evaluated in four ways in order to appraise how and to what extent it will affect the individual: *Relevance detection* determines if a stimulus is pleasant or unpleasant as well as evaluating its congruence with personal goals. The second stage, *implication assessment*, is the most central of the four and deals with to what degree the stimulus or situation will have an impact on survival and environment adaptation. *Coping potential determination* constitutes the third stage, and is the process where the individual assesses to what extent he/she can influence the outcome of a situation and how he/she can adapt to factors that are beyond control. The fourth and final stage is labelled *normative significance evaluation*, during which the individual evaluates how a social group will react to the given situation. The situation or stimuli is assessed from the viewpoint of both personal values and the values of the social reference group, i.e. the expected values and morals of society. Like Lazarus, Scherer emphasises that appraisal is an ongoing process, within which the different stages always follows a set order. If the first stage determines an event as relevant to the individual, the subsequent three stages will follow in turn (Scherer et al., 2001).

Positive and Negative Stimuli. Many studies have shown evidence of the asymmetric effects negative and positive stimuli respectively can have on memory. Dahl (2002) reports three empirical studies that all support the theory that negative stimuli initiate more thorough processing than positive stimuli. Others, such as Robinson-Riegler and Winton (1996) have also found that the role of recollection was lower in recognition of positive items than in recognition of negative items. As reviewed by Robinson-Riegler and Winton (1996), it has been shown that negative stimuli produce more cognitive activity and more complex cognitive representation than positive stimuli do. It seems as if negative stimuli is generally

given more attention than positive stimuli, and this can be tied to Taylor's *mobilisation-minimisation hypothesis* (Robinson-Riegler & Winton, 1996), which assumes that negative stimuli produce stronger initial responses than positive stimuli do and that there will be a decline in the impact of negative events after some time has passed. In this theory, the first step is the actual encoding of a stimulus. If the stimulus is appraised as a threat to the organism, i.e. negative, a mobilisation of the individual prepares it to respond in a way that will facilitate survival. The second phase reflects the long-term effects of such negative stimuli, and how the individual is affected by them. Through various coping strategies (Lazarus, 1991), the individual is able to minimise the effects over time, thus protecting his/her well-being. Furthermore, it has been suggested that negative stimuli are so influential that they may draw attention via an unconscious and pre-attentive process designed specifically to discover threats. Then, once identified, such stimuli are given specific, conscious attention (Robinson-Riegler & Winton, 1996).

EXPERIMENT 1

The aim of the first experiment was to investigate the impact of emotional valence on the level of confidence and recollective experience of recognition memory. Previous research conducted by Dahl et al. (2003) have shown that pictures with negative valence, compared with positive, are associated with increased recollection (remember responses) and a higher degree of confidence in recognition memory. However, Dahl and associates did not have subjects give both remember/know responses and confidence judgements; these were each performed by separate test groups. Yonelinas (2001) used a similar design, where each participant was tested on one test procedure only, to eliminate the possibility of the different procedures influencing each other. Based on these results, we wanted to examine if Experiment 1, in which subjects performed both tasks, could confirm such a relation, with negative pictures resulting in a higher degree of recollective experience and elicit a higher degree of confidence than positive valenced pictures.

Method

Subjects. Thirty students, twenty-one men and nine women, participated in the experiment. The mean age was 22.77, (SD = 1.76). All subjects participated in the study without any compensation being given.

Material. The stimuli consisted of a total of 200 pictures, all taken from I.A.P.S. (International Affective Picture System, Lang, Öhman & Vaitl, 1988), a picture set with a standardised valence measure on each picture. There were 40 negative, 40 positive and 120 neutral pictures. Positive pictures could e.g. be pleasing to the eye, showing a beautiful sunrise or a flower, or something with positive connotations, such as a child eating ice cream. The negative pictures could depict a crying child, automobile accidents or – in the most extreme cases – a bloody or severely injured person.

Design and Procedure. The experiment consisted of two phases; an acquisition phase and a test phase. Both phases were conducted on a PC, using the software e-Prime 1.0. In the acquisition phase, pictures were presented in groups of four (in a 2 x 2 pattern), containing either a positively or a negatively valenced picture plus three neutral pictures serving as distractors. The picture selection and placement on the screen was done by the software, with one picture randomly picked from a pool of either positive or negative pictures, and three images randomly selected from a pool of neutral pictures. The pictures were then presented on the screen as a group of four, with the placement of each picture decided at random to ensure an even distribution of the target images (i.e. negative and positive pictures) over all four possible positions throughout the experiment. The groups were each displayed for 800 milliseconds. The response keys, situated on the numeric keyboard, were marked 1, 2, 3 and 4 respectively to correspond with the placement of the pictures on the screen. Another set of response keys were placed on the alphabetic keyboard, marked -3, -2, -1, +1, +2 and +3. There was no limit on the response time. The task was for the subject to subjectively assess which of the four pictures in each group was either more negative or positive than the other three, and use the numeric keys to give his/her response. The order was such that a group of pictures were first displayed, followed by a grid (corresponding to the 2 x 2 image pattern) and a request for the subject to report his/her selected picture, followed by an on-screen request for the subject to use the scale response keys (ranging from -3 to +3) to indicate how he/she perceived the valence of the selected picture. This response procedure followed every group of pictures displayed. In all, 40 picture groups were shown during the acquisition phase, amounting to 120 neutral, 20 positive and 20 negative pictures. The acquisition phase began with a short practice section, with five picture groups.

In the subsequent test phase, pictures were presented one by one, for 800 milliseconds. The stimuli now consisted of the 20 positive and 20 negative images from the acquisition phase, along with 20 positive and 20 negative images which the subject had not seen earlier.

The response keys were marked “gammal” (old) and “ny” (new). Another set of keys were marked 50%, 60%, 70%, 80%, 90% and 100%, and finally three keys on the numeric keyboard were marked “kommer ihåg” (remember), “vet” (know) and “gissar” (guess).

When a picture had been displayed, an on-screen request for the subject to report if he/she had seen the presented image in the acquisition phase (old/new) appeared. If the subject recognised a picture, it was reported as “old”; if the picture was not recognised, the response “new” was given. This task was followed by a request to report on how sure the subject was on their answer being correct (the percentage-marked keys), with 50% meaning that they just guessed and 100% meant that they were absolutely certain. In addition, if the subject had recognised a picture (i.e. selected it as old), another request appeared, prompting him/her to report on what sort of recollection he/she experienced (remember/know/guess). This response procedure followed every image displayed. There was no limit on the response time.

Before starting the experiment, each subject was welcomed and given a short presentation of the study. They were told that the collected data was to be used in a psychology essay for a bachelor’s degree, and that we were studying various memory functions. The instructions to the acquisition phase were explained briefly, and the subject was told that detailed instructions would be given in writing on the screen before the test would begin, and that there would be a short practice section before the actual experiment. However, they were not told that a memory test would follow after the initial phase. Furthermore, the subject was informed of the sometimes intense nature of the negative pictures, and assured that they could abort the experiment at any time if they felt that these pictures were too unpleasant. Before the experiment began, the subject was also told that there was no measurement of time, so they did not need to feel stressed during the test, but that we nevertheless wanted them to follow their initial impulses as much as possible, and not linger too long before responding to the pictures.

After having read the instructions on screen, the subject had the opportunity to ask any question they might have had. The practice section followed, and once that was completed the subject initiated the actual experiment when they felt ready by pressing SPACE on the keyboard. When the acquisition phase was completed, the subject was given the instructions to the following test phase on written paper. Again, the subject could ask questions if anything was perceived as unclear. Furthermore, we always made sure that the subject had fully grasped the meaning of a difference between “know” and “remember”. The subject then started the second phase by pressing SPACE.

Once the test phase was completed, we thanked the subject for his/her participation. There was also a short debriefing, where we talked about how the subject had experienced the experiment and made sure that they had not found the negative pictures too unpleasant.

Results

We analysed our collected data in terms of six variables, calculated for negative and positive valence separately. *Old/New* is simply a measure of how well a subject performed on the memory task, i.e. how many pictures he/she correctly reported as old or new. The equation used was Old/New = Hits – False Alarms. *Recollection* gives the proportion of "remember" responses given, i.e.

$$\text{Remember} = \frac{\text{RememberHits}}{\text{HitsTotal}}$$

Familiarity was calculated the same way, but of course with "know" hits as the numerator. The *Confidence* variable reflects the subjects' reported confidence on their responses; the mean confidence of hits and false alarms. *Overconfidence* gives us the difference between the mean confidence and the proportion of correct hits;

$$\text{Overconfidence} = \text{Confidence} - \frac{\text{Hits}}{(\text{Hits} + \text{FalseAlarms})}$$

Calibration, finally, is overconfidence squared and reflects the overall relation between the level of the confidence ratings and the accuracy. The results achieved in Experiment 1 are presented in Table 1 below.

For all the measured variables, we performed pair-wise t-tests between positive and negative valence, to test the statistical significance of the results. Only one pair yielded a significant result; confidence, $t\,(29) = 3.73$, $p < .001$. We can therefore say with certainty that confidence increases with negative valence, which is in line with previous research. In the present study, however, emotional valence did not have any significant effect on recollection, as Dahl et al. (2003) have found evidence for.

Table 1. Means (and standard deviations) of the memory performance, memory quality and realism in confidence judgements.

	Valence	
Measure	Negative	Positive
Old/New	.442 (.207)	.429 (.199)
Recollection	.511 (.238)	.455 (.213)
Familiarity	.333 (.231)	.327 (.189)
Overconfidence	.107 (.086)	.074 (.087)
Calibration	.019 (.017)	.013 (.016)
Confidence	.829 (.074)	.789 (.077)

Discussion

As noted earlier, Dahl et al. (2003) have shown that pictures with negative valence are associated with increased recollection as well as with a higher degree of confidence in recognition memory. In the present study, the Old/New variable in Experiment 1 showed very little difference between the positive and negative valenced pictures. This was expected, since we did not expect any difference in the subjects' ability to recognise either a positive or negative image. The expected difference concerned the memory quality of negative and positive pictures respectively, as well as the subjects' confidence in their answers. The higher degree of confidence shown for negative pictures was in line with our expectations, based on the research of Dahl et al. Recollective experience, however, did not yield a significant result. Familiarity showed almost no differences at all, but it is possible to discern a tendency towards a higher degree of recollection with negative pictures. Although the latter is not a significant result, it is in the expected direction and in line with previous research. Also, Experiment 1 showed no signs of emotional valence affecting the realism in confidence judgements (i.e. overconfidence and calibration). In their study, Dahl et al. (2003) did not find any such indications either. The absence of difference in realism between negative and positive images will be in focus in Experiment 2 of the present study.

EXPERIMENT 2

In previous research (Dahl et al., 2003) and in Experiment 1 of the present study, there are no indications of emotional valence having an effect on realism in confidence judgements. For Experiment 2, our aim was to influence the perceptual fluency variable in order to examine if it has a mediating effect. Jacoby & Whitehouse (1989) have shown that the illusion of memory can be produced with the means of unconscious perception. In an experiment they found that by subliminally showing a word immediately before its presentation for a recognition memory test, it might produce the illusion that the test word was one of the words presented in an earlier list. The unconsciously registered object-specific information led subjects to more fluent processing during the recognition task, which in turn resulted in experiences of familiarity. This made subjects more inclined to report a word as "old", thus increasing the number of false alarms, but it also influenced the number of "know" responses (Jacoby & Whitehouse, 1989). Following this study, we expected an increase in fluency processing to yield more answers of the "know" type and consequently an increase in familiarity along with decreased realism in the confidence judgements of positive valenced pictures compared with negative. To increase the fluency we added a subliminal presentation

moments before the evaluation of the picture. We predicted that this would result in an increase in familiarity, but we did not expect the manipulation to have an effect on recollection because of the unconscious nature of the presentation. As in experiment one, we expected a higher degree of confidence and an increase in memory quality on pictures with negative valence than on the positive ones.

Method

Subjects. Thirty students, twenty men and ten women, participated in the experiment. The mean age was 23.3 (SD = 2.88). All subjects participated in the study without any compensation being given.

Material. As in Experiment 1, the stimuli consisted of a total of 200 pictures, all taken from I.A.P.S. (International Affective Picture System, Lang, Öhman & Vaitl, 1988).

Design and Procedure. Experiment 2 consisted of two phases; an acquisition phase and a test phase, as in Experiment 1. The acquisition phase was identical to Experiment 1, but there were slight differences in the test phase. The pictures were again presented one by one, but preceded by a subliminal presentation of the same picture in advance. The presentation process for each picture was as follows; first a set of hashmarks (#) filling the screen were displayed for 40 milliseconds, in black font on a white backdrop. Then the picture was displayed for 20 milliseconds (the subliminal presentation), and followed by another set (the same amount) of hashmarks, but in white font on a black backdrop, for 300 milliseconds. Finally, the picture was again displayed, this time for 800 milliseconds. The sets of hashmarks were included to mask the subliminal presentation of the image for the subject. In all other aspects, the second experiment was conducted as the first.

We followed the same procedure as in Experiment 1, but with a slightly different debriefing because of the different test phase. Once the test phase was completed, we thanked the subject for his/her participation. During the debriefing, where we talked about how the subject had experienced the experiment and made sure that they had not found the negative pictures too unpleasant, in this experiment we also asked every subject if they had been aware of the subliminal presentations during the test phase. None of the 30 participants reported having seen the pre-screening of the images.

Results

For Experiment 2, we used the same six variables as in Experiment 1, calculated for negative and positive valence separately. The results are presented in Table 2 below.

In our paired samples t-test, the only significant result was in the analysis of confidence judgements. The result on the pair-wise t-test was well within margins; t (29) = 3.32, $p < .005$. The confidence in the negative pictures was expected to be higher and the results clearly show that it was indeed the case. The projected increase in familiarity from the subliminal presentation was not significant.

Table 2. Means (and standard deviations) of the memory performance, memory quality and realism in confidence judgements.

	Valence	
Measure	Negative	Positive
Old/New	.417 (.255)	.389 (.322)
Recollection	.479 (.221)	.425 (.225)
Familiarity	.356 (.208)	.368 (.193)
Overconfidence	.120 (.115)	.092 (.138)
Calibration	.027 (.030)	.027 (.032)
Confidence	.829 (.079)	.787 (.093)

Discussion

The results in Experiment 2 were similar to those in Experiment 1. There was very little difference between negative and positive stimuli in the old/new variable, as expected. As in Experiment 1, the only significant result was achieved in the confidence variable, which shows that pictures with negative valence elicited a higher degree of confidence. The higher degree of recollection associated with negative stimuli as found by Dahl et al. (2003) is not significant but moves in the right direction, as in Experiment 1. However, the expected effect of the fluency manipulation did not manifest itself. There is no significant difference between negative and positive valence, neither in familiarity nor in realism of confidence judgements. These results will be discussed further in the general discussion below.

General Discussion

Our study was designed to investigate how emotional valence influences the recollective experience and confidence judgements of memory. The results we achieved were partly in line with previous research, but the predicted higher degree of recollection associated with negative valence did not appear. Experiment 1 showed no effect of emotional valence on realism in confidence judgements, which was also in line with previous research. In Experiment 2, however, we also investigated if subliminal manipulation of perceptual fluency

can have a valence dependent effect on familiarity and the realism in confidence judgements. However, the achieved results did not show any evidence of fluency having such an effect on neither familiarity nor realism. In the present study, we only reached significant results in the confidence variable. In addition, significant results for confidence were obtained in both experiments. This supports previous research that claims that subjects are more confident in their recognition judgements of negative stimuli being correct. The absence of significant results in the other variables was surprising, in that much of the research that has been done shows that there are differences in how negative and positive stimuli are recollected. Accordingly, we had expected at least the degree of recollection to increase in negative responses. This did occur, both in Experiment 1 and 2, but unfortunately not to the degree that a significant result was obtained. Therefore we cannot confidently say for sure that negative images trigger more "remember" responses than positive ones, as previous research suggests (Dahl et al., 2003). A possible explanation to that we did not get a significant result is that the subjects in our study gave remember/know/guess responses as well as making confidence judgements. In the study made by Dahl and associates, these responses were given in separate experiments. In order to test if remember/know is interfered by a preceding confidence judgement, a between-subjects design could be carried out. In such a study, condition 1 would involve an old/new task along with remember/know responses. Condition 2 would consist of an old/new task, remember/know, plus confidence judgements. Such a study could reveal if making confidence judgements interferes with giving remember/know responses. Furthermore, we could not see any significant differences between negative and positive stimuli in the degree of familiarity, in either of the two experiments.

Our attempt to increase the number of "know" responses in Experiment 2 by using a subliminal fluency manipulation did not yield the expected results. We anticipated the fluency manipulation to increase familiarity as well as the realism in subjects' confidence judgements, but we found no evidence of such an effect. Looking at the results of the familiarity and recollection variables in the two experiments, we see that the recollection responses for both negative and positive stimuli are somewhat lower in Experiment 2 compared to Experiment 1, while familiarity at the same time is higher, roughly with the same proportion. Although it is not very telling to compare two, independent experiments, this might be taken to that the fluency manipulation might have had an effect on the degree of familiarity, albeit not a very large one. It is possible that the relatively low increase in familiarity in Experiment 2 can be attributed to the short span between the subliminal exposure and the conscious presentation of the picture. The delay of 300ms might have been too short to get the wanted effect.

In the old/new variable, we quite simply measured to what degree the subjects responded correctly. This was never expected to differ very much; the difference was predicted to occur in remembering and knowing, as well as in confidence judgements. However, it is interesting to note that there were more false alarms in Experiment 2, both with negative and positive stimuli. It is possible that the subliminal presentation, or rather the quick flash of the distracting set of hashmarks that the subject could consciously see, caused the subjects in Experiment 2 to give more false alarms.

Looking at overconfidence and calibration, based on previous research, we did not expect to find any differences in Experiment 1. Experiment 2 was designed to examine if perceptual fluency could have a mediating effect on realism in confidence judgements, by increasing overconfidence and calibration with negative pictures. However, the test did not yield any significant results to support that theory. Comparing the two experiments with each other again, there are slightly higher numbers for both overconfidence and calibration in Experiment 2. This is interesting to connect to old/new, which indicates that while the subjects in Experiment 2 produced more false alarms, they were more confident in their responses being correct. Returning to the theoretical concept of the hard-easy effect, it could be possible that the subjects in Experiment 2 experienced the test as more difficult that the group that participated in Experiment 1. Here we must also point out the fact that the subjects did not all do the test in the same room. During Experiment 1, we were able to perform the experiment in the same room for 26 of the subjects. The remaining four, as well as the thirty subjects participating in Experiment 2 did the test in three other rooms. Although these were not very different from each other, it is possible that such external factors as noise level could have affected subjects in Experiment 2 to find the test more difficult.

Finally, a few words on the design and material of the experiments: During the study, we came to question the -3 to +3 scale used for reporting the valence of the presented images. For one thing, the thought occurred to us that the practice session preceding the acquisition phase was too brief, and did not give the subject enough material to understand what sort of images fit into the different levels of the scale. This might sometimes have forced them to re-evaluate the levels when they encountered new pictures that were more positive or more negative than what they had previously seen. Furthermore, there were also some problems with the positive versus the negative end of the scale. While most subjects did not appear to have any problems appraising the picture of a mutilated hand as a -3 on the scale, we suspected that they did find it difficult to find positive images to fit the other extreme end; +3. The thought struck us that the subjects thought that if such a negatively valenced image was a

-3, you would need an almost euphoric picture to counterbalance it and qualify as a +3. While the valence as reported by the subject was not in focus during this study, the problems that they experienced might have interfered on their performance on the other tasks.

It would be interesting to study more closely the effect of the subliminal manipulation of fluency, and if different ways of conducting the manipulation would yield different results. As already mentioned, the time span between the subliminal presentation and the longer presentation of pictures could perhaps have been to brief in our experiment to have a strong enough impact on subjects. By prolonging the delay after the subliminal presentation, it may be possible to give the subject a little bit more time to encode the subliminal picture before the real presentation is made.

The aim of the present study was fulfilled in part. By getting significant results on the confidence variable in both experiments, we were in line with previous research. The expected differences in recollection, however, did not appear, which might have been caused by the subjects performing both a remember/know task and making confidence judgements on their responses. In Experiment 2 we wanted to examine if perceptual fluency could have a mediating effect on familiarity and the realism of confidence judgements, but no such relationship could be statistically supported.

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