



Understanding the Malleability of Emotional Memories

Dr Vanessa van Ast

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Dr Vanessa van Ast from the University of Amsterdam in the Netherlands is driving forward understanding of how and why our emotional memories change over time. As well as elucidating how our memories of specific events and emotions influence behaviour, her most recent work is unveiling the impact that different contexts may have on the storage and recall of memories.

How Emotional Memories Can Be Altered

We have all doubted our memory on occasion, especially when trying to recall specific details of a past event. But when it comes to reflecting on how we felt during that event, we are likely to be much more confident about remembering the associated emotions correctly. Nonetheless, our emotional episodic memories, which link our feelings to specific events, can change over time. Dr Vanessa van Ast from the University of Amsterdam has spent much of her career investigating how and why these alterations occur. This work is particularly important, not least because replaying or reconstructing emotional events can lead to mental health issues, including anxiety and depression. Conversely, successful psychotherapy outcomes also require retrieval-induced reductions in memory emotionality.

Eliciting Psychophysical Responses While Remembering

Our behaviour is often guided by past experiences, and specific episodic memories of the past can be used as a tool to harness such learning and direct our future actions. These memories are

particularly powerful in dictating the extent to which we wish to repeat or avoid certain behaviours. For example, if we have experienced joy in the past, we are likely to be motivated to repeat the associated behaviour or event again. Similarly, if we have felt sadness or fear, this would likely influence us to avoid similar situations in future.

It remains relatively uncertain whether we elicit appropriate psychophysiological responses when revisiting emotional episodic memories. Psychophysiological responses occur when there is an interrelationship between the mind and the body, and they can help us to prepare our behaviour for an upcoming situation. One example is that of heart rate increases when we experience fear – this response helps us respond quickly to any potential threats. Thus, psychophysiological responses correspond to elicited emotion, and stronger elicited emotions during memory retrieval may serve as more powerful drives in motivating subsequent behaviour.

For these reasons, Dr van Ast worked with colleagues and PhD student Sascha Duken to determine whether reliving emotional episodic memories



is associated with psychophysiological responding. In one study, young adults were shown movie clips classified as positive, negative, or neutral. One day later, they were asked to recall the clips and revisit these emotions. During the recollection, psychophysiological responses were measured through the facial responses of smiling or frowning, showing that recalling the positive movie clips led to more smiling than the neutral or negative movies. Conversely, study participants were more likely to frown when recollecting the negative rather than the positive movie clips (although this did not differ in comparison to the neutral clips).



These observations confirm that recollection of emotional episodes can indeed elicit corresponding emotional psychophysiological responses. The research team had further theorised that the emotional intensity of the original experience would affect the level of physiological response. For example, they predicted that if people had experienced a movie clip as very positive, they would smile more when remembering the clip in comparison to clips that were experienced as somewhat less positive. The results were unable to confirm this theory, but rather, suggest that memory retrieval is not a direct representation of the prior experience, suggesting that memory is, at least partly, reconstructive.

Dr van Ast nonetheless emphasises the importance of using psychophysiological measures when exploring emotional episodic memory: previous studies have relied heavily on self-report as the sole measure of emotional responses, but they are prone to experimental biases such as expectancy and demand effects and require conscious awareness. Psychophysiological measures, in contrast, index more automatic and unconscious emotional responses. For this reason, the present study paves the way to further investigate not only how emotional memories are expressed, but also how they may be changed in health and disease.

Understanding the Causes of Memory Distortions in Depression

A number of factors can interfere with our memories. Many of these are external and driven by cues relating to when our memories are formed or retrieved. However, in some instances, the content of autobiographical memories can become distorted. Our autobiographical memories provide a mental timeline of key events in our lives, and we relive moments of joy and sadness that can guide our future behaviours. In people suffering from dysphoria (more commonly known as low mood), memories can become distorted such that situations that were positive or neutral become associated with negative feelings. This can lead to altered mood, increased stress, and worsening of depression.

Dr van Ast and her research team including Sascha Duken, are currently working to understand the cause of these memory distortions. Currently, two main opposing theories attempt to explain memory impairments in dysphoria. The first is that of overgeneral memory bias, which emphasises individual differences in accessing specific episodic details of positive and negative autobiographical memories. This theory states that people suffering from dysphoria tend to recall general memories that lack episodic detail and that they struggle to bring to mind specific times and events. The negative bias theory offers an alternative perspective and suggests

that people who suffer from dysphoria have negative world views that bias their perception and interpretation of information. Therefore, they are more likely to retrieve negative information.

Both theories propose that there is a critical link between retrieved memories and emotional responses. Dr van Ast and her colleagues therefore also incorporate the assessment of emotional responses into their experimental protocol (such as using facial responses like in the previous study), as few previous studies to date have focused on this. This study protocol is accepted in principle as a registered report, which is the gold standard in open science for minimising publication research biases in hypothesis-driven research – which are unfortunately all too common. This work will undoubtedly provide valuable insight into emotional memory that may ultimately, support the development of therapeutic interventions for disorders such as clinical depression.

How Threat Learning May Affect Relational Memory

To enhance our learning experiences and predict future behaviours, our memories update regularly as new information is added to help us navigate the complex world we live in. This enhances our relational memory, which involves combining pieces of information from different events, to help us function in new situations. Although relational memory has been the subject of much recent research, often in efforts to unpick its underlying neural mechanisms, Dr van Ast and her colleagues noted that few studies have looked at emotional memories.

To address this gap, one of Dr van Ast's most recent studies focused on understanding the impact of emotional experiences – specifically, those relating to threatening events – on the subsequent ability to make inferences among these memories. Dr van Ast's PhD student Olivier de Vries and the research team hypothesised

that relational memories would be different in strength if they involved a memory of a threatening event. From an evolutionary point of view, it would be adaptive if such relational memories were strengthened because of their importance to survival. However, previous research had shown that emotion often weakens memory for associations within distinct events, and the same could be true for associations across several events.

Dr van Ast and the team found that when information from a previous threatening event needs to be recombined with another neutral memory, it actually weakens this process, whereas the neutral memory is strengthened. She proposes that our brains may have a mechanism that prevents the integration of negatively charged emotional events with unrelated, pre-existing memories. Ultimately, this may suggest that the brains of healthy individuals prevent the linkage of safe memories to threatening memories as a safeguard against overgeneralised fear and anxiety.

The Impact of Contextual Similarity

Dr van Ast and her colleagues noted that little research has focused on understanding the impact of spatial context on memory malleability. They believe that environmental conditions in which events occur can influence how similar memories are stored and recalled. However, there is an ongoing debate around whether memories of similar events can strengthen each other or conversely, lead to interference.

Over the last century, the most widely accepted theory states that creating memories in a similar spatial context at separate times can cause interference, meaning that memories might be recalled incorrectly or even be forgotten. More recently, contemporary memory integration theory suggests that the opposite may occur. Dr van Ast, her postdoctoral researcher Wouter Cox, and their colleagues have recently undertaken research aiming to critically test the classic theory and see whether different environmental conditions may in fact be more likely to provide interference, than when there is consistency in a person's surroundings.

The research team undertook a series of experiments that manipulated and controlled environments when specific events occurred. They found that memories strengthen each other's retrieval when they happen within the same spatial context. Conversely, they found that recall is more likely to be impaired when events occur across different environments. These observations are in line with integration theory.

However, when contextual cues are provided during recall, these patterns change and, in some cases, even seem to reverse. This finding reconciles classic interference theory and integration theory. Dr van Ast believes these results highlight the importance of spatial context during episodic memory encoding and retrieval, and this insight may help develop



strategies that optimise memory retrieval, for instance, in educational settings. More generally, contrary to a more common conception that memories are fixed in how they function (like a file drawer), the findings underscore the malleability of our episodic memories.

The Need for a New Framework

Further deciphering the conditions that initiate the integration of emotional memories can also have far-reaching consequences for understanding why our emotional memories are malleable and can modify over time. Even though many psychologists agree that it is upon memory reactivation that our existing memories become changed, most earlier studies (like the previous one) have focused on non-emotional and simple stimuli, therefore so far, no framework exists to explain how integration affects evoked emotions of real-life and complex memories.

Such a framework could hold great clinical relevance for emotional disorders caused by dysfunctional memories (e.g., posttraumatic stress disorder), since successful psychotherapy outcomes may require memory integration. However, even though the insights regarding the role of contexts are an important starting point, why memory retrieval does not always lead to integration and the consequences of these processes for evoked emotions, are unknown. This undermines the effectiveness of psychotherapies that rely upon retrieval-induced integration.

In the future, Dr van Ast and her colleagues are keen to uncover more about the mechanisms behind the process of integration, its consequences for evoked emotions, and ultimately, mental health disorders that are rooted in dysfunctional emotional memories. 'It is important to further develop and employ experimental approaches in the lab that are capable of indexing (mal)adaptive properties of personally relevant and real-life memories, since this is essential to bridge core insights from fundamental research and application in clinical science ("bench to bedside"). Such an approach will pave the way to employ this knowledge in effective interventions for emotional memory disorders', concludes Dr van Ast.



Meet the researcher

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Dr Vanessa van Ast is currently an Assistant Professor in the Clinical Psychology Department at the University of Amsterdam in the Netherlands, where she also completed her PhD. As part of her postdoctoral training at the Donders Institute for Brain, Cognition and Behaviour (at Radboud University Nijmegen), Dr van Ast helped to design and set up a large ongoing prospective study investigating the neurobiology of human defensive reactions and their role in the development of posttraumatic stress in police recruits. Since a well-functioning memory system is at the core of adaptive behaviour, Dr van Ast's recent research focuses on the neuroendocrinological, physiological and psycho-emotional mechanisms of memory formation and change. Debilitating emotional disorders such as posttraumatic stress disorder are thought to originate from dysfunctional memories eliciting disproportionate emotional responses. She has therefore specifically focused on explaining clinical phenomena such as overgeneralised fearful memories and intrusive memories. Dr van Ast utilises a wide array of methods and techniques in her research, including behavioural experimentation, psychophysiological assessment and advanced statistics.

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FURTHER READING

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