Perspectives on Memory Manipulation: Using Beta-Blockers to Cure Post-Traumatic Stress Disorder

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The human mind strives to maintain equilibrium between memory and oblivion and rejects irrelevant or disruptive memories. However, extensive amounts of stress hormones released at the time of a traumatic event can give rise to such powerful memory formation that traumatic memories cannot be rejected and do not vanish or diminish with time: Post-traumatic stress disorder may then develop. Recent scientific studies suggest that beta-blockers stopping the action of these stress hormones may reduce the emotional impact of disturbing memories or prevent their consolidation. Using such an intervention could, in principle, help people who suffer from post-traumatic stress disorder, but the idea of doing so is controversial. I shall here discuss memory manipulation in this perspective.

The Impact of Emotions on Memory Formation

Our sense of personal identity is closely connected to our memories: Who we are is largely a result of what we have or believe ourselves to have experienced. In daily life, almost everything we do depends on our memory systems working smoothly. However, not every memory is essential: The mind strives to maintain a healthy equilibrium between memory and oblivion, both quantitatively, allowing only a portion of our experiences to be stored as memories in the brain in order to prevent clogging[1] and qualitatively, by rejecting irrelevant or harmfully disruptive memories from being stored, at all or in a way that causes damage.[2]

Memory formation comes roughly in two stages. Incoming information is first translated into neural correlates involving no permanent changes to the brain's structure. Second, consolidation takes place with permanent structural changes in the brain; labile memories are then made persistent. When a consolidated memory is retrieved, it is again rendered labile and undergoes reconsolidation.[3]

The significance of an experience influences its memory: Emotions have an impact on memory formation.[4] This impact can work in contrary directions; emotions can either facilitate or prevent the consolidation of memories.[5] One locus of this effect appears to be the amygdala[6]: "Human-subject studies confirm the prediction of animal work that the amygdala is involved with the formation of enhanced declarative memory for emotionally arousing events" (294).[7]

Traumatic events can trigger strong emotions to the effect that memories of the event are not consolidated in the brain. Most people who experience

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trauma retain memories that become increasingly vague and decreasingly emotionally arousing as time goes by, permitting the person to live with the experience and function socially. However, in some cases, the neurological memory-controlling functions fail to operate. Extensive amounts of stress hormones released at the time of a traumatic event can give rise to such powerful memory formation that the traumatic memories do not diminish with time.[8] When the heightened memory associated with emotional arousal goes too far and the memory-prevention mechanism in the brain goes wrong, post-traumatic stress disorder (PTSD) may develop. The diagnostic features of PTSD include persistent reexperiencing of the traumatic event, persistent avoidance of stimuli associated with the trauma, and numbing of general responsiveness.[9] Only some people are predisposed to develop this prevalent, chronic, and disabling condition that is difficult to cure. There are different models of PTSD and, accordingly, varying methods to cure it.[10]

Stressful memory formations can be counteracted before or after the event that the (putative) memory is about or before or after the consolidation of this memory. One can either prevent the disorder from developing (before or after the event) or cure it once developed (necessarily after the event). The problem is not primarily the memory itself but the painful emotional *reactions* thereto. Prima facie, it is conceivable that these reactions can be appeased even if the memory in question remains and vice versa: Erasing the memory does not self-evidently liberate the patient from the symptoms of PTSD.

Erasing a consolidated human memory in the aim of curing PTSD would require the erasure of a complex set of remembrances. First, there is the remembering of the event that caused the original trauma. Second, there is memory of a series of associated events, such as subsequent occurrences of remembering. Remembrance is intellectually, emotionally, and perceptually complex, and it is therefore questionable whether, *even if* a consolidated memory can be erased, it is possible to do so in a manner that liberates the person from emotional reactions provoked by the event.

Remembering does not activate the brain alone but can involve the entire body that reacts with great perceptual complexity on memories of emotionally intense events, pleasant or unpleasant. Memories can trigger, or be triggered by, a wide range of perceptions, such as the smell of a perfume. Because of their connection by association, perceptions can provoke feelings similar to those of the direct memory of the event in question. This can be pleasant, if, say, a certain perfume gives rise to the tender feelings once inspired by a lover, or unpleasant, if the perfume was the one worn by a rapist. To get rid of the emotional pain that a traumatic event and subsequent memories of it cause, it is not sufficient to erase merely the direct memory of the event: We must also get rid of these associations. The identity criteria for each of these memories need to be sufficiently clear to allow singling out the right memory for erasure.

In addition to being perceptually complex, remembering is also reflexive, in the sense that we can remember a given event and then remember the remembering of this event, and so on. Each link in this chain can be related to strong emotional reactions; for example, the victim may have found himself or herself in a panic in socially disturbing situations. Accordingly, there is a chain of memories that needs to be erased for the person to be truly liberated from the emotional disruption that the original trauma caused.

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If we were to erase simply the direct memory (assuming that this is possible) and leave all associations and reflexive memories intact, the person might live the pain of remembering these associated events (when she or he panicked and so forth) without knowing why. Such unintelligible and adverse events can possibly be even more destructive than a focused fear of a known event. In the absence of understanding, one can believe oneself mad, become socially inhibited, and so on. The process of slow healing may also fill important functions that the more direct approach of erasure would cancel out.

However, recent scientific studies suggest that it may be possible to block the consolidation of the memories shortly after a traumatic event, thus preventing the disorder from developing, and that reconsolidation "offers the opportunity to manipulate memory after it is formed, and may therefore provide a means of treating intrusive memories associated with post-traumatic stress disorder (PTSD)" (267).[11]

Using Propranolol to Prevent Memory Consolidation or Reduce Emotional Impact

Preliminary experiments in rats have been performed aiming to make it possible to erase consolidated memories or block the emotional reactions to them. "To understand how the brain learns to feel safe, researchers have turned to extinction of classically conditioned fear" (125).[12] In extinction learning, animals are taught not to fear what they had previously learned to fear. For example, laboratory rats were trained to fear a tone. When they were prompted to reexperience that fear, retrieve and restore the memory, propranolol, a nonselective beta-adrenergic receptor blocking agent, was injected into their brains, blocking the formation of proteins necessary for memory storage. Consequently, the rats lost all their fear.[13] The question arises: Can *human* memory, or human fear, be similarly manipulated? According to memory researchers Debiec and Ledoux: "It is well established that post-training disruption of noradrenergic transmission by systemic administration of the beta-adrenergic receptor antagonist propranolol abolishes the enhancement of memory consolidation produced by emotional arousal in rats and humans. . . . If the present studies in rats are confirmed in studies with humans, propranolol may become a useful tool in treating recurring disruptive memories in post-traumatic stress disorder" (268).[14]

Human studies have been performed suggesting that propranolol can successfully reduce the symptoms of PTSD if it is administered shortly after the trauma.[15] A group of British scientists has performed an experiment in which streams of words were shown to a series of subjects on a computer screen.[16] Knowing that emotionally charged words are better retained than neutral ones, their aim was to see how the words adjacent to the emotionally charged words were retained. They found that the words preceding emotionally charged words were less well retained than words preceding neutral ones. Having previously established that emotion-associated memory enhancement is partly caused by the action of the stress hormone norepinephrine on the amygdala, they now questioned whether emotion-related memory loss could be caused by blocking this action. The experiments were therefore repeated with subjects who had been dosed with propranolol, a drug known to block the action of

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norepinephrine on the amygdala.[17] As expected, they found that these subjects remembered neutral and emotional words equally well, but they also found that memory for words preceding emotionally charged words was now improved. In other words, the impact of emotion on memory formation appeared reduced by propranolol.

These results receive support from two other, French and American, pilot studies conducted to see whether propranolol could prevent the onset of PTSD.[18] They postulated that memories take time to form and that stress hormones released through the experience of a trauma might be responsible for excessive memory formation. In the French study, medication was started after 2 to 20 h (mean 9.5), whereas in the American study intervention came within 6 h. Both studies used relatively high doses of propranolol (40 mg 3–4 times daily) for approximately 10 days, followed by an 8–12-days taper period. The results of these pilot studies support the hypothesis that a course of propranolol begun shortly after an acute traumatic event is efficacious in reducing PTSD symptoms 1 or 2 months later, or perhaps even in preventing the development of PTSD. The studies used small samples, but arguably constitute a proof of principle,[19] and larger, blinded, placebo-controlled trials are forthcoming.[20]

These human studies indicate the usefulness of propranolol to prevent symptoms of PTSD from developing. However, "in order to be useful to patients already suffering from PTSD, administration of propranolol or other drugs will have to be given in the context of traumatic memory reactivation. . . . [F]indings in rats indicate that systemic administration of propranolol in the context of memory reactivation blocks reconsolidation of aversive memory by specifically targeting amygdala. Propranolol may therefore be effective in the treatment of PTSD, which appears to involve the amygdala . . . even after the symptoms have developed" (272).[21]

Within the clinical perspective, we may note that propranolol is a drug widely used in treatment for high blood pressure or heart problems in patients that do not necessarily want to have either memories or emotions affected. The question of side effects arises: Does propranolol only affect emotions and memory functions in specific conditions?[22]

Four Arguments against Therapeutic Forgetting

Helping the brain forget in the aim of curing disorders caused by disturbing memories—so-called therapeutic forgetting—can be considered controversial. Four general objections[23] against therapeutic forgetting (hereafter abbreviated TF) argue that TF might entail (1) loss of personal identity, (2) mendacity, (3) stagnation, or (4) intolerance toward states of distress in oneself and others.

Each of these objections comes in a strong and a weak version. The strong versions aim to reveal problems that are *intrinsic* to TF. Intrinsic problems are those that concern qualities that TF has *in itself*, by virtue of its own nature independent of external circumstances and contexts. The weak versions aim to show *extrinsic* problems with TF. Extrinsic problems concern features that TF possesses *in relation to something other* than itself, to something outside its own nature, notably, uses and applications. Both versions can consider the problems either unavoidable (essential to the nature or practice of TF) or contingent

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(possible but, in principle, avoidable). In what follows, I describe the logical structure of these objections, arguing that none reveals any intrinsic problem. They do, nonetheless, express rational concerns about different ways in which TF might be misused, evoking a number of ethical, legal, and sociopolitical issues.

Identity Objection: Memories make us who we are: TF threatens *personal identity.*[24]

In its strong version, the objection needs to show that TF *intrinsically* threatens personal identity in a way that distinguishes it from nontherapeutic forgetting (oblivion that is not induced to cure a disorder) or abusive application of TF. This, however, is a difficult task, for everything we remember or forget adds an aspect to our identity, and we need both remembrance and oblivion in order to function well. Forgetting is not necessarily a threat but can also be an aid to developing and maintaining a personal identity. Is it, then, the *deliberate* destruction or obstruction of memories that causes worries? Yet we cannot retain a memory of every single experience in our daily activities but deliberately choose to remember those we consider especially relevant and forget others for various reasons. In constructing one identity, we destroy or obstruct others in deliberate and nondeliberate, conscious and unconscious processes. In that light, it is hard to see any intrinsic feature of TF posing problems for personal identity. In a weaker version, the objection expresses a concern that TF runs a high risk of being *abused* (for example, "wrong" or "too many" memories could be disposed of, or memories could be rejected for "wrong" reasons) and that, if abused, personal identity is an important value that could suffer.

Truth Objection: Like it or not, the disagreeable event took place: TF entails *mendacity.*[25]

There is a common maxim according to which one should learn to live with reality as it is and avoid the temptation of embellishment or other forms of deception. A mature adult must cope and not seek, for example, to escape unpleasant memories for the sake of well-being. Forgetting an event is not the same as denying that it occurred, but the objection need only say that after TF one lives *as though* the disturbing event had not happened, and that consistent oblivion of all disagreeable events would promote a mendacious *Brave New World*-view of life.[26]

However, is this problem specific to TF? And need it be a problem in all circumstances? We forget things daily and our nontherapeutic memory selections have close connections to our emotions that can be quite mendacious. We often deceive ourselves in some measure when we remember our experiences, especially where we played a central role. In the strong version, the objection needs to show that there is something intrinsic to TF that entails more or worse forms of mendacity than our everyday nontherapeutic memory selection does, which seems a difficult task. If this cannot be shown, the problem becomes a question of good or bad usage. But veracity is not the sole nor necessarily the ultimate value. Truth can have a price, and it is not self-evident that a person is always willing or able to pay it. For example, a person suffering from PTSD may well prefer a certain degree of truth denial to the symptoms from which she or he suffers.

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Development Objection: Memory is essential to development: TF entails *stagnation.*[27]

It is evident that both social and personal development presupposes historic and individual memory. It is equally evident, at least in the case of the individual, that development also requires selective oblivion. Accordingly, the value of memory to development is context related. The question arises: In what circumstances would TF lead to stagnation?

One of the cases suggested by advocates of memory blockers as justified for preventive individual intervention is the emergency worker who, going to a scene of a terrible accident, will most likely have disturbing experiences and subsequent memories of them.[28] It could be tempting to use propranolol preventively to not retain memories of the event, yet that could also illustrate how TF might lead to stagnation. An emergency worker needs to *learn* from experience and remember how she or he dealt with a stressful situation in order to not repeat mistakes but rather to note strong points so that professional skills may improve with time. A relevantly similar case would be the old-fashioned war correspondent confronting the horrors of war without military protection—the whole point of him or her being there is to *remember* to be able to tell the true story. Testimony about an event cannot be given without memory of it, a point that also has obvious legal and historic relevance. From a human rights point of view, the value of testimony can hardly be exaggerated. It is often the testimony of courageous individuals who refuse to participate in, say, torture who shatter the official pictures and tell the true story. Historic oblivion is a serious form of stagnation, though it appears unlikely that TF could ever compete with other causes in producing it.

On the other hand, how much confrontation can even the most courageous people survive? How much should we expect of them? Arguably, preventive or postevent use of TF could be justified in the relatively rare individual cases where there is a clear risk of PTSD developing. It can seem unreasonable to object to the use of propranolol to prevent the onset of that extremely serious disorder with reference to a general argument of stagnation.

Tolerance Objection: The ability to cope is necessary for the development of tolerance. TF would entail *intolerance* toward states of distress or shortcomings in oneself and others.

Tolerance is an ambiguous notion that can be understood as "acquiescence," or as "toleration" which means, approximately, "forbearance."[29] TF is closely linked to lack of forbearance as an extrinsic feature arising, for example, in connection with the motives one can have for desiring it. This connection is contingent: It is logically conceivable to induce TF for reasons other than lack of forbearance; however, it is reasonable to assume that TF would primarily be induced when the subject cannot, or will not, stand a given memory. This contingent connection between TF and lack of forbearance with a disagreeable memory could be strengthened with repeated employment: If a person were to use TF frequently she or he might not learn, or learn less well, the difficult task of coping with the negative aspects of life. Similarly, TF could also promote lack of acquiescence. In the absence of the capacity to cope with

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distress or shortcomings, a person could develop an increasing impatience with their presence, both in the self and in others. This could start a vicious circle, wherein lack of forbearance would enhance intolerance, which would then make forbearance still more difficult, and so on. Intolerance to the symptoms of suffering in others could also function as a social pressure to make them use TF as well, so the vicious circle could be both individual and social.

Questions of normality and tolerance of diversity naturally arise. How dramatically are we allowed to mourn, panic, or become infuriated before we are considered, or consider ourselves, dysfunctional, disordered, or simply "inconvenient"? The limits for normality are dynamic and if practices to medicate inconvenient feelings spread sufficiently, feelings that were previously considered normal may become conceived of as pathological.

Conclusion

A misuse objection is arguably trivial: We always have the ability to misuse science. Nevertheless, the context is nontrivial. For instance, where the lines between disorders and other painful conditions are drawn is not self-evident, nor are the lines between proper use and misuse. There are many memories that people may not want; who will decide legitimacy, and by what standards? Is TF only to be used to treat PTSD or would it be extended to cure other unhappy states as well? Some people worry about a widened use of memory blockers as a remedy against casual inconveniences. "It's not hard to imagine that it [propranolol] will end up being used much more broadly."[30] Indeed, the temptation to use a drug to forget, say, an embarrassing event could be strong, given availability. However, although availability tends to increase demand, there is no inevitable connection between existence and availability. The latter depends on factual conditions, such as social structures. Available techniques might be carefully monitored in one society and left to liberal market forces in another.

It has been suggested that therapeutic forgetting is interesting for military purposes, for example, to provide soldiers with propranolol before a battle.[31] A problem here is that if it helps them forget what they have been subjected to, it also helps them forget what they have done to others.[32] Imagining armies furnishing soldiers with beta-blockers is hardly a comforting perspective. People are capable of committing atrocities knowing that they will have to pay the price of remembering. What will they not be capable of doing if they no longer have to pay this price? An important question in this context is whether and (in particular) why national armies fund research on the effects of certain drugs on memory, and how this might affect the range and nature of applications.

The aim to gain control over memory functions in order to help people suffering from disorders is laudable, and, from a philosophical point of view, I can see no intrinsic problem with the development of methods to induce therapeutic forgetting. That is to say, the idea to develop such methods does not, in itself, appear objectionable. In contrast, it may encounter extrinsic problems if the techniques are abused. If controlled use of propranolol can cure people from or help prevent PTSD, that is laudatory. Whether

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this is sufficient to counterbalance the possible risks of (civilian or military) misuse here mentioned is an essentially sociopolitical question that natural and social scientists, philosophers, and policymakers must answer by joint efforts.[33]

Notes

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