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The Legal and Ethical Implications of Memory-Dampening Agents

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The formation and recall of memories are fundamental aspects of life and help preserve the complex collection of experiences that provide us with a sense of identity and autonomy. Scientists have recently started to investigate pharmacological agents that inhibit or "dampen" the strength of memory formation and recall. The development of these memory-dampening agents has been investigated for the treatment of posttraumatic stress disorder (PTSD). Currently, these agents are being tested in multicenter clinical trials and will likely soon be approved for the treatment of PTSD. With advancements in technology, more targeted memory-dampening techniques may be developed in the future. Accessibility to these agents will inevitably affect one's sense of identity and also one's sense of autonomy. Therefore, it is essential that the legal and ethical implications of using these agents be examined for governments and courts to appropriately address issues that may emerge.

Keywords: *memory; law; technology; ethics; PTSD; propranolol*

The formation and recall of memories are fundamental aspects of our lives and help us preserve the complex collection of experiences that provide us with a sense of identity. These memories, however, are not permanently fixed but are dynamically modified through subsequent experiences. As a result, we continuously evaluate our experiences and integrate them into a larger narrative, which helps us further shape and consolidate our identities.

Within the realm of psychology, the convergence of one's identity and one's memories creates autobiographical memories (Beike, Lampinen, & Behrend, 2004). Raz (1998) emphasized that an autonomous person is the maker or author of his or her own life, with the ability to independently plan into the future and carry out his or her goals. This autobiography is not believed to be an uninterrupted documentary but is in fact a selectively edited version of the collective and salient events that were experienced (McAdams, 1993). Therefore, one's life narratives are said to represent a disproportionate emphasis on particular periods or events of a person's life (Thompson et al., 1998).

Because of the importance of memory and its role in defining one's identity, researchers and pharmaceutical companies have developed pharmacological agents that purport to enhance or preserve different types of memory (Farah, 2004; Farah et al., 2004). Some of these agents are used to treat debilitating memory loss associated with certain illnesses, such as Alzheimer's disease. Some agents, however, can also be used to augment normal memory functioning and can be used to enhance the recall of factual information (Glannon, 2006).

More recently, scientists have started to focus on pharmacological agents that inhibit or decrease the strength of memory recall. These memory-dampening agents have been investigated for the treatment of posttraumatic stress disorder (PTSD). Contrary to memory-enhancing drugs, these agents purport to decrease or "dampen" the strength of involuntary recall and retrieval of vivid traumatic memories.

Currently, memory-dampening agents are being tested in multicenter clinical trials and may soon be approved for the treatment of PTSD (Marantz Henig, 2004). Once approved for use in persons with PTSD, advancements in technology may allow for targeted memory dampening techniques to be developed in the future. As a result, when these agents become available to the general public, some individuals may be interested in simply dampening "bad" memories (e.g., having a bad day at work), rather than life-shattering traumatic memories. The potential

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accessibility to these agents raises issues regarding their overall effects on individuals and on society. For this reason, the ethical and legal implications of using these agents will need to be addressed before these agents become available to the public.

In the present article, I first give an overview of (a) the interaction between autobiographical memories and identity, (b) the interaction between autobiographical memories and PTSD, (c) memory-dampening agents and PTSD, and (d) the potential health implications of using propranolol for memory-dampening purposes. I then address the legal implications that stem from using these agents, focusing on the issues of witness testimony and informed consent in receiving medical treatment. Finally, I discuss the ethical implications of using these agents by examining how manipulation of one's memories would affect one's sense of identity and also one's sense of autonomy.

Identity and Autobiographical Memory

McAdams's (2001) life story theory of identity builds on Erik Erikson's theory of identity. Erikson examined the importance of different social roles in the development of one's identity. He argued that an individual's identity, taken within the context of society, helps create psychological unity and also provides the framework necessary to set goals and purposes throughout one's lifetime (Breger, 1974).

McAdams's (2001) theory places the individual as the primary author of autobiographical narratives, which link the past, present, and future aspects of the self. McAdams's theory also emphasizes the importance of continuity that one's identity can provide over time. McAdams stated that individuals build their interpretations and understandings of the world on the basis of their autobiographical memories. Beginning in childhood, individuals craft personal life stories that identify important characters, significant turning points, and imagined future outcomes in their lives. These personal stories are not a result of their identities; rather, these stories constitute the primary means by which individuals understand and shape their identities (McAdams, 2001). The idea that individuals are the authors of their lives has also been addressed by Raz (1998), who asserted that a sense of autonomy is necessary to become the author of one's life story and set out three components required to establish autonomy: (a) Individuals must have the mental abilities to form future intentions and plan their execution, (b) they must have adequate options available to choose from, and (c) the choices must be made independently and must be free from manipulation.

In summary, the formation and recall of autobiographical memories is a significant factor in constructing our identities and how we view ourselves over time. If these autobiographical memories are manipulated because of a psychological disorder, such as PTSD, or a memory-altering drug, such as a memory-dampening agent, there will undoubtedly be a significant impact on one's sense of identity and autonomy.

Autobiographical Memory and PTSD

Memory. The study of memory function in animals and humans has been conducted in various domains of science. Three main types of memory have been established: procedural memory, semantic memory, and episodic memory (Conway, Rubin, Spinnler, & Wagenaar 1992). Procedural memories do not require any voluntary retrieval and represent cognitive information used in automatic behaviors, such as riding a bicycle. These memories are not consciously accessible, and once acquired, they are difficult to modify (Conway et al., 1992; Welzer & Markowitsch, 2005). Semantic memories provide information about different facts and concepts, such as the fact that bicycles have two wheels. These memories, unlike procedural memories, are consciously accessible and can be voluntarily modified (Conway et al., 1992).

The third and final type of memory is the recall of particular events or "episodes." Episodic memory, also known as autobiographical memory, is the recall of an experienced event, which contains a specific time and a specific location, such as falling off a bicycle 2 weeks ago. This type of memory is similar to semantic memory in that the acquired information about past states and facts is open to conscious inspection and modification (Conway et al., 1992; Welzer & Markowitsch, 2005).

Autobiographical memories, however, do not represent all the details of a particular event; they are not analogous to a film being continually recorded by the brain. These memories are more analogous to snapshots of certain salient events that are both voluntarily and involuntarily remembered (Baddeley, 1992). As a result, autobiographical memories incorporate unconscious errors and are accurate only to the extent that they represent personal meaning about a particular event. Therefore, as edited as they may be, autobiographical memories represent an individual's understanding of the world over time (McAdams, 2001).

Several studies have shown that the surrounding environment (e.g., mood, motivation, perceived environmental circumstances) at the time of memory formation is an important factor in determining the degree

of autobiographical memory formation and subsequent recall (Tulving & Markowitsch, 1998). As a result, these memories are recalled with varying degrees of accuracy and precision (Blank, 1998; Markowitsch, 2003). Surrounding external factors are given special consideration when evaluating extreme situations, such as chronic stress or severe traumas, because intense levels of emotions have been found to influence the formation and recall of autobiographical memories. (Bremner, 2002).

PTSD. PTSD is a psychiatric anxiety disorder that can develop in response to traumatic experiences. PTSD is unique among psychiatric disorders in that its symptoms are directly associated with particular memories of traumatic events (Vasterling & Brewin, 2005). One hallmark characteristic of the disorder is the alternation between reexperiencing and avoiding trauma-related memories; memories associated with traumatic events are said to appear involuntarily, often intruding into consciousness with high frequency (Emilien et al., 2000). In some cases, the recall of a traumatic event can be so debilitating that an individual can no longer function in society.

Epidemiological studies have found that the lifetime prevalence of PTSD in the United States is between 7.8% and 9.2%, and approximately 60% of these cases become chronic (Breslau, Davis, Andreski, & Peterson, 1991; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). The onset of PTSD typically occurs immediately following a traumatic event (Shalev, 2000). Although a subset of individuals recover within a few months, many go on to develop chronic PTSD symptoms, which can last for 3 months or longer. In some unfortunate cases, PTSD symptoms can last for decades or even a lifetime (Yule, 2001).

Several studies have shown that reexperiencing a past event is a defining feature of autobiographical memories (Baddeley, 1992; Wheeler, Stuss, & Tulving, 1997). Because the involuntary recall of traumatic autobiographical memories is in fact a criterion for diagnosing PTSD, researchers are investigating the function of autobiographical memories in the development of PTSD. According to Conway and Pleydell-Pearce's (2000) model of autobiographical memories, persons with PTSD selectively recall vivid memories related to traumatic events because the individuals are continuously worried about how the particular events will influence and affect their present lives. For example, individuals with PTSD may perceive themselves as vulnerable to future assaults because they persistently recall and reexperience memories involved with previous assaults. According to Bernsten (2001), traumatic memories become psychological landmarks, which become threatening reference points for future events in an individual's life.

In a study by Sutherland and Bryant (2005), trauma-exposed participants diagnosed with PTSD, trauma-exposed participants not diagnosed PTSD, and non-trauma-exposed control participants were asked to retrieve autobiographical memories they believed helped shape their identities. All participants were then asked to provide details about their major life goals. The results of the study revealed that participants who were diagnosed with PTSD reported more autobiographical memories that were trauma related compared with the other participants. Furthermore, the retrieval of trauma-related autobiographical memories was directly associated with the reporting of personal goals that were connected to their traumatic experiences.

The results of this study support the notion that traumatic events create autobiographical landmarks, which help define and shape an individual's sense of identity (Bernsten, Willert, & Rubin, 2005). Moreover, these results also reveal the importance of one's autobiographical memories in the formation of an individual's major life goals, in which each goal is connected with the recall of a particular traumatic event.

Current Treatments for PTSD

Two separate processes are involved in psychological recovery from traumatic experiences. First, the individual controls the vivid reexperiencing of the trauma; second, the individual evaluates the traumatic event and the impact it had on his or her life (Brewin, 2001). The application of different psychotherapies has played an important role in helping treat the debilitating symptoms of the disorder.

Currently, psychotherapy is considered to be the main form of treatment for individuals with PTSD. There are two types of psychotherapy used for its treatment, each corresponding to the two processes set out above. The first type includes prolonged exposure to the traumatic event, which focuses on the relief from flashbacks and nightmares. The second type includes cognitive therapy, which emphasizes how the individual interpreted the traumatic event within the context of his or her life. Although both of these methods have been demonstrated to be effective, not all patients become symptom free through the use of these therapies (Foa et al., 1999; Marks, Lovell, Noshirvani, Livanou, & Thrasher, 1998;

Resick, Nishith, Weaver, Astin, & Feuer, 2002). There are times when the distress and emotional pain associated with the recall of traumatic memories inhibit or impede recovery. As a result, drug treatment can be more successful and cost efficient in controlling vivid flashbacks, improving sleep, and treating the psychotic symptoms.

Pharmacological agents that are prescribed to treat PTSD range from antiepileptic drugs to antidepressant drugs (Friedman, 2005). The main type of medication prescribed to treat both the physiological and psychological symptoms of PTSD is antidepressants. Specifically, selective serotonin reuptake inhibitors, such as fluoxetine and sertraline, have been shown to significantly reduce the debilitating symptoms of PTSD compared with placebo (van der Kolk et al., 1994). However, there are currently no pharmacological agents approved by the U.S. Food and Drug Administration for the treatment of PTSD. Preliminary studies have shown, however, that certain drugs already prescribed for other ailments may be effective in dampening the recall of traumatic memories associated with PTSD.

Memory-Dampening Agents and PTSD

The severe stress and emotional pain associated with the involuntary recall of traumatic memories in persons with PTSD has generated research to develop a therapeutic means of dampening the recall of these memories. The development of pharmacological agents that could effectively prevent or alleviate the symptoms of PTSD will be among the primary medical benefits that scientists and researchers hope to achieve.

The formation of memories occurs in two steps: (a) Immediately following a new experience or event, there is a period of memory consolidation, when memories are encoded into the memory centers of the brain, and (b) strong emotional arousal triggered by the release of certain stress hormones influences how strongly that particular memory will be formed.

Research has shown in both animal and human studies that emotionally arousing experiences are better remembered than those that are emotionally neutral (McGaugh, 2006). The primary hormone released in the body in response to emotional arousal is adrenaline (Wortsman, 2002). Adrenaline is released in situations that require the body to fight against or flee from a real or perceived threat. The degree of memory formation has been found to be directly dependent on the extent of adrenaline activation in the body and in the brain (Glannon, 2006). Therefore, the use of a pharmacological agent that counteracts the effects of adrenaline may be effective in dampening the formation or consolidation of memories associated with a traumatic event. Because traumatic events normally results in extreme emotional arousal, these agents may help diminish the strength of memory recall of the particular traumatic event.

Propranolol is a beta blocker that is administered to lower the effects of adrenaline in the body and is already being prescribed for the treatment of hypertension. In the past, beta blockers have been administered to musicians for the treatment of stage fright (Lehrer, Rosen, Kostis, & Greenfield, 1987; Neftel et al., 1982). Therefore, these agents have already been proved effective in treating certain levels of anxiety and stress that stem from particular threats (e.g., making a mistake on stage) or a particular fear (e.g., the fear of performing in front of others).

Previous research has found in animal studies that the administration of adrenaline immediately following a memory task enhanced memory recall in rats (Ferry, Roozendaal, & McGaugh, 1999; Hatfield & McGaugh, 1999; Hui et al., 2004). On the basis of these studies, adrenaline is believed to play an important role in the consolidation of memories in rats. If this mechanism is analogous in humans, propranolol could be used to help dampen memory formation and could subsequently dampen the recall of painful and traumatic memories for persons with PTSD. Recent human studies using neuroimaging technology have shown that the administration of adrenaline increased the activation of brain regions associated with memory formation. A subsequent recall task showed that adrenaline enhanced the retention and recall of pictures that were induced by emotional stimuli. These effects were then blocked with the administration of propranolol (Strange & Dolan, 2004; van Stegeren et al., 2005).

Preliminary clinical trials have shown that the administration of propranolol prevented the development of PTSD symptoms in persons who experienced traumatic events compared with placebo (Pitman et al., 2002; Vaiva et al., 2003). In one study, propranolol was administered within 6 hours of a traumatic event and was then continued for 10 days. The results showed that the acute posttrauma administration of propranolol prevented the development of PTSD.

More interestingly, researchers have shown that propranolol can also blunt previously formed memories in rats (Debiec & LeDoux, 2006). This mechanism was found to be analogous in humans, in whom it was revealed that memories that had already been formed were still vulnerable to natural dampening over time

(Anderson, Wais, & Gabrieli, 2006). Therefore, the same biological mechanisms involved in consolidation are involved in reconsolidation. Recently, another clinical trial showed that propranolol was able to dampen the recall of past traumatic events (Brunet et al., 2008). In this study, all participants had been diagnosed with chronic PTSD and described their traumatic events during script preparation sessions. The participants were then randomly given either a 1-day dose of propranolol or placebo. A week later, they engaged in script-driven mental imagery of their traumatic events while their heart rates and skin conductance were measured. The results showed that memory recall was dampened in those participants who had received propranolol: Their physiologic responses were significantly smaller compared with those participants who had received placebo.

Collectively, these results suggest that emotional arousal allows for the retrograde enhancement of long-term memories and can determine which memories will continue to be remembered or eventually forgotten in the future. Upon recalling a previously formed traumatic memory, adrenaline is rereleased in the body, allowing for emotional arousal to take place. Consequently, the traumatic memory will become further consolidated. These results suggest that the use of propranolol and other beta blockers could possibly reverse the mechanism of memory reconsolidation and possibly retroactively dampen traumatic memories that have already been formed.

Potential Health Implications of Using Propranolol for Memory Dampening

Currently, beta blockers such as propranolol are used to diminish the cardiovascular responses triggered by adrenaline and are used mainly for the treatment of hypertension. Beta blockers are classified as antiarrhythmic agents because they can correct heart-rhythm abnormalities. However, these drugs can also have the opposite effect and can exacerbate arrhythmias and worsen cardiovascular problems in some individuals (Glannon, 2006). As a result, using these agents for the purpose of memory dampening may in fact result in causing heart problems for some individuals.

To limit the negative health consequences on both the brain and the body, the effects of propranolol need to be tailored to be site specific. One potential adverse effect of using propranolol to dampen the recall of traumatic memories is the collateral effects this drug could have on other memory systems, such as semantic and procedural memories. Different memory systems are interconnected through complex neural pathways, and neuroimaging studies have shown that regions of the brain associated with emotional memories are close in proximity to regions associated with factual memories (LaBar & Cabeza, 2006). Finally, the long-term effects of using propranolol for the dampening of traumatic memories are not yet known.

Legal Implications of Using Memory-Dampening Agents

Propranolol and the Law

Propranolol was developed in the 1950s and has been prescribed for the treatment of hypertension since the 1970s (Flamenbaum, 1989). The adverse effects of propranolol have been investigated, and studies have revealed that this drug causes mild but consistent memory impairment (McAinsh & Cruickshank, 1990; Muldoon, Manuck, Shapiro, & Waldstein, 1991; Waldstein, Manuck, Ryan, & Muldoon, 1991). In both volunteer studies (Frcka & Lader, 1988) and clinical trials (Blumenthal et al., 1988), the use of beta blockers was found to impair memory recall.

Interestingly, similar doses (120 to 160 mg/day) are prescribed for the treatment of hypertension and for memory dampening (Pitman et al., 2002; Prichard, McDevitt, & Shanks, 1976; Vaiva et al., 2003). The results of these experiments suggest that individuals who were prescribed propranolol for the treatment of hypertension may have been subjected to memory impairment, perhaps without their knowledge or consent. One concern to the legal system is that the reliability and accuracy of testimony given by individuals taking propranolol will be called into question. Although propranolol has been mentioned in previous Canadian judgments (e.g., *Fraser v. Beck*, 2006, para. 2; *Mercier v. Royal & Sun Alliance Insurance Co. of Canada*, 2003, *Doiron v. Haché*, 2003, para. 54), it has been mentioned only in the context of hypertension treatment, not in the context of potential memory impairment or how the drug may influence a witness's testimony.

Taking the Stand

The retention of accurate memories plays a crucial role in the mechanism of fact finding in the legal system. The information gathered through one's memories during trial testimony and police investigations can help establish the underlying facts of a particular case. One of the legal issues associated with using these memory-dampening agents is their potential

effects on trial procedures and, more specifically, on witness testimony. Traumatic events such as criminal assaults or motor vehicle accidents frequently lead to legal proceedings. The outcomes of these proceedings will depend on both accused parties' and claimants' retaining precise recollections of the particular events.

The stress of testifying in court, however, can compound the natural tendency to forget information stored in one's memory (Paciocco, 2005). Moreover, the use of witness testimony is becoming increasingly questionable as researchers reveal the inaccuracies associated with relying solely on human memories (Haber & Haber, 2000; Patterson, 2004). For example, research has found that the accuracy rate in identifying the perpetrator in a mock jury trial is approximately 50% (Lindsay, Wells, & O'Connor, 1989). Despite this high degree of error in memory recall and accuracy, courts continue to use witness testimony to ascertain the relevant facts of a case. As a result, any indication that a witness's memory is further compromised, perhaps with the use of a memory-dampening agent, may result in a court's giving less weight to that witness's testimony.

Overall, the use of memory-dampening agents will have a negative effect on the testimony given by both claimants and accused parties. If the victim of a traumatic crime decided to testify after taking a memory-dampening agent, his or her recall and accuracy of the particular event will be called into question. Upon calling an expert witness to explain the mechanisms of these memory-dampening agents to the court, it is likely that the witness will be rendered unreliable, and his or her testimony may not be given significant weight. In extreme cases, in which the witnesses taking the stand are victims of abuse or rape wanting to testify against their aggressors, these individuals may ultimately be revictimized. In addition to experiencing the severe traumatic events, these individuals may be prevented from testifying against their aggressors simply because they had taken memory-dampening drugs to ease their emotional pain.

These agents could also be taken by perpetrators of crimes. Individuals who have committed crimes, such as those involved in drinking-and-driving fatalities or those involved in murders, may take memory-dampening agents to cope with feelings of guilt and shame following their involvement in these crimes. As a result, if they are required to take the stand, they may be able to convincingly formulate stories about the events without experiencing the emotional pain or remorse of recalling the traumatic events. As a result, juries or judges may be misled into believing that they are innocent.

To address this legal issue, police officers and other government authorities may attempt to immediately record witnesses' testimony following crimes (i.e., before their memories becomes dampened with the use of these agents; Bernsten, 2001). Upon recording witnesses' testimony before trials, however, courts will still have to determine whether to admit this evidence at a subsequent trial.

In summary, when deliberating future cases, it will be important for Canadian courts to be mindful of the potential effects that propranolol and similar drugs may have on witnesses' memory and testimony. Furthermore, to ensure that individuals preserve the recollection of their memories, it will be necessary for the government to draft new legislation or amend existing legislation so that courts can fully benefit from the witnesses' untainted mental evidence.

Memory-Dampening Agents and Informed Consent

In Ontario, an individual's consent to medical treatment is regulated by statute: the Health Care Consent Act (HCCA; 1996). Other provinces in Canada have similar legislation to ensure that patients give their informed consent before receiving health treatment. The HCCA defines whether an individual is capable of consenting to medical treatment, whether an individual was deemed to have consented to treatment, and in what circumstances consent is not required to provide treatment. After experiencing a traumatic event, an individuals will likely be rushed to an emergency room to be treated for both mental and physical distress. In the emergency room, the attending physician may recommend treatment with propranolol to help minimize the chances of developing PTSD in the future.

Application of the HCCA to the scenario above strongly suggests that such an individual would likely not possess the capacity to understand or consent to the treatment being administered. Section 4(1) of the HCCA specifies the elements that are required to be capable to consent to a particular medical treatment. This section states that a person is deemed to be capable if (a) he or she is able to understand the information that is relevant to making a decision about the treatment and (b) he or she is able to appreciate the reasonably foreseeable consequences of that decision. According to section 10(1)(a) of the HCCA, a health practitioner is not allowed to provide treatment to a person unless he or she is of the opinion that the person is capable of consenting to the treatment.

Numerous studies have found that decision-making skills become significantly compromised during times of distress (Hammond, 2000). As a result, it is unlikely that distressed and traumatized individuals would be in a legitimate position to fully appreciate the foreseeable consequences of taking a memory dampening-agent, and they would not be deemed "capable" according to the HCCA. Consequently, health practitioners would not be allowed to administer propranolol to these patients following traumatic events.

However, there are exceptions whereby health practitioners are allowed to provide treatment in the absence of consent. These exceptions are applied in emergency situations and are described in section 25 of the HCCA. According to section 25(1) of the HCCA, an emergency is defined as a situation in which the person for whom the treatment is proposed is experiencing severe suffering or is at risk for sustaining serious bodily harm if the treatment is not administered promptly. Upon finding an emergency, sections 25(2)(a) and 25(2)(b) of the HCCA are applied to determine whether emergency treatment can be administered without consent to an incapable person. According to these sections, a health practitioner can administer treatment without consent only if (a) there is an emergency and (b) the delay required to obtain consent or refusal on the person's behalf would prolong the suffering the person is experiencing or put the person at risk for sustaining serious bodily harm.

In the scenario above, a doctor would not be in a position to know whether delaying the administration of propranolol would prolong the emotional suffering the patient is experiencing. Moreover, the doctor would be unable to adequately predict whether the patient would in fact develop PTSD without the administration of propranolol. As a result, there is no definite risk that the patient will sustain prolonged harm if propranolol is not immediately administered, and the doctor will not be in a position to know whether the patient will sustain serious bodily harm. Therefore, it is questionable whether the scenario above would be classified as an "emergency" according to the HCCA.

More important, even if individuals received propranolol, they would not have the option of withdrawing their consent following the administration of the treatment. Section 14 of the HCCA specifies that an individual is allowed to withdraw his or her consent at any time following treatment. Because the administration of propranolol may have permanent effects on memory consolidation, it is possible that the effects of memory-dampening agents are irreversible. Following treatment with propranolol, the memory of a particular traumatic event may be lost forever, even if the individual later realizes that the traumatic memory was an important psychological landmark in his or her life.

Application of the HCCA to the scenario above suggests that there is a loophole in the current statute for individuals being taken to hospitals following traumatic events. These patients will not be deemed "capable" to consent to treatment; yet at the same time, health care providers will be unable to provide treatment without consent, because the situations will likely fall outside the category of an emergency. To address this loophole, the government will need to draft new legislation or amend the current HCCA for these patients to be able to give informed consent and receive medical treatment.

Ethical Implications of Using Memory-Dampening Mechanisms

Effects on the Self and on Society

Some researchers argue that using memory-dampening agents for the treatment of PTSD will be advantageous because these agents could ease the emotional pain associated with the recall of traumatic memories and could help patients resume living normal lives (Illes, 2007). It is questionable, however, to what extent these agents would actually have a positive effect on individuals' identities and on society, once they become available to the public.

By dampening the formation of traumatic memories, there is the risk of falsifying one's perceptions of the world and depriving one the opportunity to fully experience and live through a particular event. One study has found that the use of propranolol to block the recall of traumatic emotional memories significantly affected individuals' normal physiological encoding of autobiographical memories (Strange, Hurlemann, & Dolan, 2003). Moreover, it is not yet known what effect the artificial dampening of traumatic memories will have on other closely related memory systems. It is likely that the use of these agents will also result in the impairment of other memory systems, such as semantic memories.

McAdams's (1993) theory of identity stresses the importance of one's "life story" for the formation and continuity of one's identity over time. Although one's life story consists of selective and edited memories, previous research has found that memories that tend to be well remembered are formed during times of change and/or crises (Bernsten, 2001). As a result, if an individual's

access to traumatic autobiographical memories becomes artificially dampened, it is questionable whether the individual will be able to form a coherent and comprehensive self-narrative over his or her lifetime. By altering the formation of certain autobiographical memories, an individual may unwillingly and unconsciously circumvent the formation of important landmarks in his or her life and create a psychological gap in his or her autobiographical life story.

Furthermore, if the formation of important autobiographical memories is manipulated with these agents, the psychological connection between one's present awareness and one's future projections and goals could be disrupted. Raz (1998) claimed that for autonomous individuals to be authors of their own lives, they must have acquired the mental abilities to form intentions with the means to realize future goals. Therefore, in addition to tampering with the formation of one's identity, the use of these memory-dampening agents may also prevent one from becoming autonomous and making important decisions in the future.

The widespread use of these agents will also have significant ramifications on society. In the realm of the military and the police force, these drugs could be given to individuals going into dangerous situations as a form of preventive medicine, with propranolol perhaps used to artificially manipulate their fear responses. For example, propranolol could be administered to soldiers before going into battle or to police officers before responding to horrific crime scenes. Ideally, the use of these agents would allow soldiers and police officers to respond appropriately to threatening events but at the same time would not result in the formation of traumatic emotional memories. One possible consequence of using these agents, however, would be the blunting of the natural fear response, without which soldiers and police officers may be wounded or killed because they will lose their normal adrenaline response and become unaware of actual threats.

The use of these agents may initially seem attractive for the treatment of individuals with PTSD and for the preemptive dampening of unformed memories. The analysis set out above, however, strongly suggests that the costs to individuals and to society in using these memory-dampening agents would significantly outweigh their potential benefits.

Emotional Memories as a Catalyst for Change

An unfortunate but necessary aspect of life is that it inevitably includes sad and unpleasant events. Emotional memories, which stem from these unpleasant events, can serve an important purpose: They can function as catalysts in helping us to evolve and change.

For example, the perpetrator of a crime may experience feelings of remorse or guilt after committing an offense, such as assault or causing death by drinking and driving. Because the perpetrator is able to recall the event and remember the emotional memories associated with the event, he or she may continue to reexperience and relive the guilt. Similar to the concept underlying taste aversion (Parker, 2003), in which an individual is conditioned to avoid particular types of food that result in nausea, the negative emotions associated with the recall of the traumatic event may condition the perpetrator to avoid similar behaviors that lead to feelings of guilt and remorse. Memory-dampening agents may result in blunting these feelings of guilt, and the emotional barometer that ensures that one learns from painful experiences will be shut off. As a result, the potential change that could have resulted from feeling guilty may not be achieved.

From the perspective of victims, a similar argument can be made. If individuals in abusive relationships take memory-dampening drugs, they may be prevented from leaving the relationships, because they would not experience the emotional pain associated with the ongoing abuse. On the other hand, if these individuals vividly recall and remember the emotional pain associated with each abusive episode, these memories may serve as an emotional catalyst to seek help and leave the relationships.

In some cases, a person's painful emotional memories can act as a catalyst for change, not only for that individual but also for society as a whole. Some important examples include the publicized life experiences of Jane Doe and Roméo Dallaire. Doe, a woman living in Toronto, was raped at knifepoint in her own home by a serial rapist in 1986. Doe brought a suit against the Metropolitan Toronto Police Force claiming that the police had conducted a negligent investigation and failed to warn women whom they knew would be potential targets and were at risk (*Jane Doe v. Metropolitan Toronto [Municipality] Commissioners of Police*, 1998). The court ruled in favor of Doe in 1998, almost 12 years after the rape. She subsequently wrote a book about her experiences of the rape and her subsequent legal suit against the police (Doe, 2003). If Doe had taken a memory-dampening agent and blunted the recall of her traumatic experiences, she may not have been as passionate and determined to bring justice against the Toronto police and share her life story with the world.

Dallaire was a lieutenant-general with the Canadian Forces and was the commander of the United Nations peacekeeping mission in Rwanda. During his time in Rwanda, he witnessed the genocide of 800,000 Rwandans in 1993. He was medically released from the Canadian Forces because of PTSD in 2004. Despite his painful traumatic memories about the events in Rwanda, Dallaire began writing and lecturing about his experiences. These writings eventually resulted in a published book, which allowed him to share his experiences with the rest of society (Dallaire, 2003).

Both of these inspirational and influential individuals experienced traumatic events. The painful and traumatic memories associated with these events became integrated into their lives and became crucial landmarks in constructing their identities. Moreover, they were given the opportunity to educate the rest of society by creating narratives of their experiences and suffering. Because they shared their autobiographies with the world, others were able to learn from their traumatic experiences and were perhaps able to evolve and change. Had they taken memory-dampening agents, they may not have been able to achieve the same level of influence on society.

In summary, by dampening the recall of traumatic memories, an individual not only disrupts the internal narrative that is necessary to shape one's personal identity but also prevents the sharing of these narratives, which could potentially help others in society change and evolve.

Conclusions

Currently, memory-dampening agents are not yet available to the public. The quickly advancing field of neuroscience, however, may be able to provide new, more specific, and safer agents to help dampen painful memories associated with traumatic events. In the near future, some of these newer technologies could be potent enough to allow memory deletion to take place. In fact, memory deletion has already been conducted in rats: Researchers used the drug U0126 (not yet available in humans) to delete a specific memory associated with fear (Doyere, Debiec, Monfils, Schafe, & LeDoux, 2007). Therefore, it is likely only a matter of time before memory deletion can take place in humans.

Pharmaceutical companies will likely market these drugs to make them accessible and attractive to consumers. For example, similar to the concept behind a daily dose of aspirin to prevent heart attacks, pharmaceutical companies may develop site-specific memory-dampening agents that could be taken on a daily basis to prevent certain memories from being formed during difficult periods of one's life. Another example would be the development of a memory-deleting agent similar to the morning-after pill, levonorgestrel (Plan B; Duramed Pharmaceuticals, Inc., Pomona, NY), which is currently available over the counter for emergency contraception. In the case of memory deletion, individuals who want to forget bad memories may be able to simply go to the drug store and purchase "emergency forgetting pills."

It is still unclear how the development of these memory-dampening agents will affect society, and we must consider the temptation of people to "pop a pill" to artificially dampen or even forget unpleasant memories. It will therefore be necessary for courts and governments to be informed of these new pharmacological developments so that they will be in a position to weigh both the legal and ethical implications of using these agents in the future. If we start taking these memory-dampening drugs, however, it is questionable whether we can continue to be truthful to ourselves, because it is our identities that allow us to maintain psychological continuity over time, it is our identities that allow us to form our future goals, and finally it is our identities that allow us to psychologically and emotionally evolve over time. By allowing memory-dampening agents to alter our identities, we may ultimately lose our autonomous "selves" in an array of manipulated memories that can no longer be accurately integrated into our coherent autobiographical life stories.

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