The Normativity of Memory Modification

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I. Introduction

Memory is being understood in increasing detail. Although we are far from scenarios in movies such as *Eternal Sunshine of the Spotless Mind*, in which a couple undertakes a procedure to erase each other from their memories when their relationship falters; or *Total Recall*, in which a man purchases virtual vacation memories of the planet Mars, there have been significant advances in the development of memory modifying technologies (MMTs) in recent years, and it may soon be possible to intervene in the memory systems in very specific ways to affect their function and contents.

In this paper, we are interested in examining ethical issues that may arise from the development and use of MMTs, if and when they become available. We shall set aside questions about safety and justice, and research ethics issues such as risk, informed consent, conflicts of interest, definitions of efficacy, and so on, which are important questions that pertain to the development and use of all new technologies.[1] We shall also set aside issues concerning what might be called relational uses of MMTs, that is, issues regarding whether one group might coerce another, whether many individuals' using MMTs might make everyone worse off, and so on. Our focus here will be on personal uses.

To begin, we shall give an overview of the memory systems and present some distinctions that have been made regarding them that are useful for our purpose. We shall also detail current research on how memories can be modified.

II. Memory Systems and Memory Modifications

Memory in the biological sense is best understood as the systems underlying our capacity for retaining, storing and recalling experiences. According to earlier theories of memory, memory is a unitary system performing learning and recall of information and associating related pieces of information with each other.[2] Later psychological and biological studies divide this unitary view of memory into a number of functional systems with more specialised functions that can be dissociated from each other through experiments or lesions. These systems were originally discovered on the psychological level,[3] but neurological evidence has since helped identify particular brain systems necessary for particular memory systems.[4] Squire and Zola-Morgan[5] have, for example, combined this evidence into a memory taxonomy similar to Figure 1, and Schachter and Tulving[6] have also offered a complex system with five major systems and eleven subsystems.

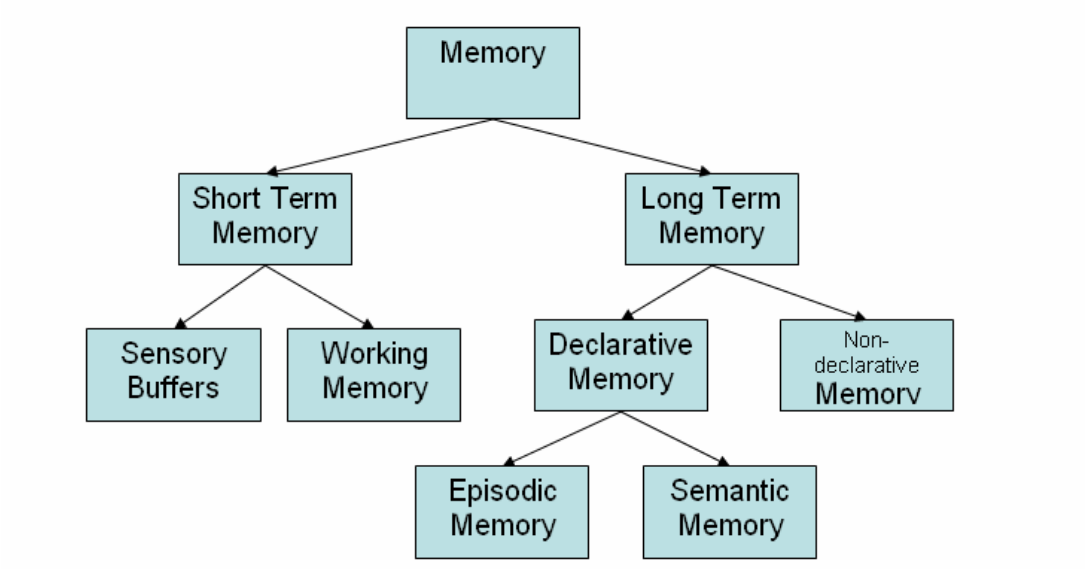

Figure 1: A simple taxonomy of memory systems. As we shall note later, emotional content is a component of most, if not all, subsystems.

As one can see from Figure 1, a major division is between short-term[7] and long-term memory. Long-term memory can maintain information for decades, has a practically unlimited capacity, a slow rate of acquisition and a tendency to encode items according to meaning. In contrast, short-term memory is easily disrupted by distractions, has a rapid rate of acquisition and limited capacity, and is sensitive to surface characteristics of the information.[8] Short-term memory has been described as consisting of a number of "sensory buffers" corresponding to the different senses, retaining recently experienced information for less than a second,[9] and a central working memory acting as the "mental workplace" where currently attended information is manipulated. There have been several different models of its structure and relationship to other forms of short-term memory.[10] In the following, we will mainly focus on modifications of information in long-term memory, since modifications of short-term memory is more akin to interventions in the perceptual, or thought, processes (which pose their own normative problems).

Long-term memory has further been found to have separable subsystems. Declarative (explicit) memory is defined by conscious recollection of memory contents such as facts and events that can be recalled to consciousness.[11] Non-declarative (implicit) memory is detectable through behavioural changes such as the acquisition of skills, habituation or priming, but the actual memory content remains inaccessible to consciousness. Acts of declarative memory retrieval produce a product that can be held in mind, while acts of non-declarative memory retrieval do not.[12] Declarative long-term memory appears to be dependent on the medial temporal lobe (MTL). This is evidenced

by the deficits in patients with MTL lesions, who are impaired in learning new declarative material but not impaired in learning procedural skills. They also retain declarative memory of events long before the lesion and yet have amnesia for events close to the time of the lesion.[13] A common interpretation of the data is in terms of a gradual consolidation process where memories of experiences first exist as a fragile MTL-dependent representation and are then consolidated into a non-MTL-dependent representation, likely distributed across the neocortex.[14] In the following, we will be concerned with modifications of declarative rather than non-declarative memory, although it should be noted that habits and compulsions are strongly tied to the non-declarative memory system.

Another division within declarative memory is between episodic memory and semantic memory.[15] Episodic memories are memories of past experienced (or imagined) events. They are particular, covering a specific instance or single learning experience (often with a strong autobiographical aspect) even if the exact point in time to which they refer cannot be recalled. Semantic memories represent world-knowledge such as the meaning of and the relationship between objects, people, places and concepts, and lack autobiographical content and ties to a particular point in time or context. The distinction between episodic and semantic memory has been debated,[16] and it has been hypothesised that semantic memories emerge from the merging of many episodic memories based on their commonalities.[17]

An important aspect of memory not directly included in the above taxonomy is the emotional content of memories. Emotional states at the time of learning affect the likelihood of later recall;[18] and retrieved memories often reactivate associated emotional

states. There is some evidence that the emotional component of memory can be dissociated from other memory contents,[19] at least when the memory information does not itself strongly initiate an emotional response. Anatomically, the most studied structure is the amygdala, which plays a key role in creating many emotional (in particular fear) associations[20] and in modulating memory consolidation in other brain regions.[21] The emotional modulation system can be both upregulated and downregulated, changing the likelihood of retrieval and the emotional valence of memories.[22]

Our best present account of how long-term memory works on the biological level says that experiences cause patterns of neural activity among neurons in the brain. Neurons activated at the same time and connected to each other through synaptic connections then become more strongly connected through a process called long-term potentiation (LTP). LTP in turn makes the overall network of neurons that were activated by the original experience more likely to become activated as a whole when given stimulation similar to the original stimuli, enabling recreation of past active states and associations.[23] While it is common to speak of memory's being 'stored,' memories are not spatially localized. They are spread across different structures, likely as distributed networks of potentiated synapses.

This accumulated knowledge of how memory works enables some targeted interventions that affect memories on the biological level. The LTP process itself has several stages involving different chemical messengers, moving from an initial labile form to stable structural changes in the synapse. This local consolidation process can be affected by chemical interventions, abolishing or promoting the formation of memories. Recall of memories may independently return involved synapses and the memory to a

labile form followed by reconsolidation.[24] This allows the selective disruption of memories by pharmacological interventions or by providing interfering information.

There is a wide range of memory enhancer drugs that can improve memory performance by improving memory encoding, including nutrients, hormones, stimulants, neuromodulators and drugs that directly interact with memory storage processes.[25] At the same time, genetic modifications of receptors, messengers and growth factors[26] have also had demonstrated effect in improving memory function in animals, and there are similar genetic targets for memory function in humans.[27] Such drugs enhance memory encoding shortly after the drugs are taken, thereby enhancing subsequent recall of any episode experienced during this time. Other drugs enhance the consolidation of recent events. These drug-effects are not specific to a particular memory but rather to a time period. There are also consolidation blocking drugs such as scopolamine,[28] benzodiazepines[29] and kinase inhibitors[30] that are known to interfere with memory consolidation so that the affected period does not become fixed in long-term memory.

While mainly studied in animals, reconsolidation has been demonstrated in human motor learning[31] and a word list task.[32] Reconsolidation processes can be targeted with selective misinformation, which impair recall of selected memories.[33] Reconsolidation can also be made specific to a particular memory. Indeed, disrupting a specific fear memory in an animal model did not affect associated memories.[34] Whether reconsolidation-based editing of episodic memory is possible remains to be seen. But given the evidence for reconsolidation in a variety of brain systems and memory paradigms, it appears likely.[35]

Moreover, there is currently considerable research in the area of reducing the emotional strength of memories, intended for example as a treatment for Post-Traumatic Stress Disorder (PTSD) where a traumatic memory easily resurfaces, causing distress and a positive feedback loop of anxiety. It has been shown that taking the beta-blocker propranolol shortly after a traumatic event reduces the intensity of the memory and the risk of PTSD.[36] There is great interest in applying this form of memory modification to soldiers in wars.[37] Conversely, there is evidence that the salience of emotional memories can be enhanced so that past lessons would stand out more vividly.[38]

There is also much research that shows that false memories can be induced.[39] The memory retrieval process is to a large degree reconstructive rather than a faithful representation of the original experience, and can be affected by information available at the time of recall. This means that each time we recall a particular event, it may be somewhat different.[40] While this reduces the factual reliability of human memory, it makes it easier to insert false memories. If false information is used as the seed for the reconstruction it will easily fill in nonexistent details in a maximally plausible way.[41]

Also, much misremembering is caused by confusing perceived and imagined events.[42] For example, the "lost in the mall" paradigm involves giving subjects a list of childhood events supposedly described by family members, and asking them to recall details of the events. Mixed in with real events is a false event such as being lost in the mall. The recall process causes the subject to elaborate false details that are incorporated into a false memory. This can be strengthened by allowing subjects to look through family albums for 'evidence,'[43] even to the extent of introducing exceptional-and-yet-false memories such as balloon rides.[44] It is also possible experimentally to introduce

implausible or personally salient experiences such as falsely remembering the first days of infancy,[45] witnessing demonic possession[46] or believing that one cheated on a test in school.[47] These experiments only use non-pharmacological interventions to guide imagination, but given that drugs can modulate the strength of encoding processes, it seems likely that hybrid MMTs that can insert false memories more efficiently could be developed.

This said, it should be emphasized that we are still a long way off from being able selectively to modify people's memories at will. Although cognitive-behavioural treatments are being developed to minimize the trauma induced by negative memories (e.g., soldiers with PTSD), the effects of these treatments on memory are still poorly understood. We still do not know in general to what extent 'weakening' memory traces are due to an actual change in the synaptic network underlying the memory, a loss of retrieval ability or the development of an inhibiting secondary memory. In order to target a memory it has to be cued by some form of stimulus, which may also cue other memories. This might pose a limit on the exactness of memory editing. Also, drugs administered post-encoding can certainly impair subsequent retention, but these drugs are not selective, and the long-term consequences for personally significant memories in humans also are poorly understood.

Still, this does not mean that it is premature to discuss the normativity of MMTs. In order to pose normative problems, MMTs do not have to be perfect. Even if particular memories cannot be exactly targeted for modification, it is sufficient for our purpose that memories can be deliberately modified in a non-random way.

III. Issues Concerning the Development of MMTs

There are at least two sets of development issues to keep in mind when developing MMTs. The first, what might be called Technical Limitations, is concerned with questions such as whether it is possible to read and retrieve specific memories, copy them, delete them, and so on. Memories are not discrete objects, but overlap and interconnect. When deleting or editing memories, other memories will therefore be affected. The extent to which this will happen remains to be determined. Strongly interconnected memories (e.g. with strong personal meaning) may turn out to be very hard to affect, owing to the reinforcing effects of overlapping memories. However, the selective extinction of fear conditioning in rats using reconsolidation-linked lability suggests that even emotional memories can be affected.[48] It might also take time before the precision and unwanted side effects of MMT become visible. Still, it is likely that in the short term, the biggest challenges to the development of MMTs will come from these limitations, as much of what has been done at present to alter memory works nonselectively, and it is the untargeted nature of these approaches that currently raises the most problems.

Supposing that Technical Limitations can be met, there is a second set of issues that should be considered, what might be called User Limitations, which arise from the fact that our organism is built in a certain way, at least at present.

For example, there are what might be called Abstraction Concerns. MMTs that enable an individual to remember everything in great detail could undermine our ability to make abstractions, because when every instance of something is remembered individually, the shared link between the instances making them examples of a category

may become weak.[49] Without being able to abstract, however, it may become impossible to recognize larger patterns and make high-level plans. The mnemonicist described by Russian psychologist Alexander Luria was able to recall individual experiences with great clarity but had trouble drawing meaning from them.[50]

Or, when confronted with a problem, we have a tendency first to look to our past experiences for relevant analogies, after which we would then think about the problem. If MMTs give us perfect memories, we may try to examine all our past memories first and thereby becoming overwhelmed and limited in our creativity. For example, a student might recall all examples previously given of a certain kind of calculation, and hence become bogged down in their details rather than try to find a new solution.

Another problem is Attention Control. A woman with extreme autobiographical memory also reported having trouble preventing memories of past events from intruding when reminded.[51] Constant recollections might be disruptive for both problem solving and the ability to focus on the here-and-now.

Here it should be asked, are User Limitations surmountable? Possibly, we can improve our control over memory retrieval (perhaps by use of attention enhancers) such that we would not be impaired by unnecessary recollections, thereby handling Attention Control. In any case, if excessive remembering were an effect of memory enhancement, it would reduce the utility and appeal of enhancement, reducing the extent of use or restricting it to particular situations.

Regarding the Abstraction Concerns, if MMTs would reduce abstraction ability and cause us not to think freshly, again this may simply mean that users would be less inclined to favour this level of memory modification.

In general, Technical and User Limitations are of great practical significance. As we have noted earlier, the untargeted nature of present ways of modifying memories will, in the short term, raise the most problems. User Limitations further highlight the importance of taking into account how the human organism is built. These issues should therefore be kept in mind when developing MMTs. But even when these concerns can be met, using MMTs may raise a number of normative issues. We now consider five such issues that have been raised in the literature or that could be raised. As it will become clear, we do not believe that these issues are intractable or that they are novel. But we do believe that they are not obvious and that they warrant serious consideration and discussions. After analyzing these issues individually, we shall generalize the discussions and develop some guidelines regarding the normativity of using MMTs.

IV. The Issue of Truthfulness

One issue that could be raised is the Issue of Truthfulness, that is, modifying our memories may affect what we believe to be true about the world and about ourselves. In particular, memories serve as epistemic evidence for events that have transpired and for one's roles in these events. Supposing that these epistemic evidence are normatively salient, given that they are connected to what has in fact taken place, it could be said that if you modify your memories in a certain way, you may alter what you believe to be true about these events. This is most obvious in the case of inserting false memories, e.g., by deliberately undergoing therapy that promotes the construction of them. Also, this could be true in, e.g., reducing the emotional strengths of one's memories. For example, in using propranolol, a soldier may come to remember and believe that he did not really

want to kill the enemy, when in fact he lusted after the killing. In a surprisingly direct analogy to the plot of *Total Recall*, a Russian firm has already been providing false "evidence" for exotic holidays.[52] It seems likely that the same motivations (such as social esteem) that drive people to buy these "holidays" in the future might drive people to buy false memories. Call this the Living in Falsehood Problem.

A related problem is that memories enable us to form a certain narrative identity, which is crucial to our having a sense of what we believe to be true about ourselves. From our past experiences and our memory of them, we may believe that we are brave or cowardly; altruistic or selfish; generous or stingy; and we may identify ourselves with certain ideologies: liberal or conservative; egalitarian or elitist; feminist or male-chauvinist, and so on. If we modify our memories in a certain way, this may change what we believe to be true about ourselves. For example, consider Beth, who is a feminist. Beth's memory that her father often made disparaging remarks against women forms a part of her narrative identity as a feminist. Being a feminist may be an integral part of Beth's true self. Suppose she removes these memories of her father because they hurt – for example, by reactivating the memories under the supervision of a therapist, who prevents reconsolidation using pharmacological means, possibly combined with a beta-blocker treatment to reduce the emotional impact. Beth may be modifying an integral part of her narrative identity as a feminist. If so, modifying her narrative identity as a feminist may mean that she no longer has a true self. Motivated by this concern, Leon Kass, the former Chairman of the President Council on Bioethics, says that "to deprive oneself of one's memory – in its truthfulness also of feeling – is to deprive oneself of one's own life and identity."[53] Call this the Losing True Self Problem.

In response to the Living in Falsehood Problem, it is worth noting that not all MMTs require altering your perception of what in fact has happened. If you restore forgotten memories, you need not be altering your perception of what has happened. Also, some memories may just be trivial, even if they are true. If so, removing them would not cause you to live in falsehood. Of course, it should be kept in mind that it is difficult to know which memories are trivial when there has not been enough time to see events play out fully.

At the same time, some memories are fuzzy. In particular, fuzziness can be due to weak encoding during the experience; or to problems in the storage of the information (e.g. other memories' overwriting them or the loss of associative connections); or to problems in retrieval (e.g. faulty retrieval mechanisms or attempting to use wrong kinds of associations to find them).[54] Editing or deleting memories in the first two categories might not alter your perception of what in fact has happened.

In any case, a bit of falsehood might not be so bad. Believing that you had a nice holiday so that you would feel more relaxed, or believing that you are more attractive than you really are, seem permissible as long as these beliefs do not harm others or yourself, as we shall argue later.

Suppose you cannot get over some traumatic experiences, it could even be better for you to remove these memories. For instance, consider Sophie in *Sophie's Choice*.[55] Sophie is tormented by her memory that in the concentration camp, she made the decision to save her son rather than her daughter. In the end (*spoiler alert!)*, partly because her feeling of guilt regarding this decision became unbearable, she commits suicide with her lover, Nathan. In this case, suppose that it was not possible for Sophie

partially to reduce the emotional intensity of her memories so that she would be able to make a rational assessment and come eventually to understand that she did not really have a choice at the concentration camp. Since Sophie is suffering unbearable pain as a result of her memory of these events, were MMTs available such that she could use it to forget about what she has done in the concentration camp, it might be better for her to remove these memories. Later, we shall discuss the issue of whether this might conflict with a duty to remember.

It is worth noting that one's ability to live in falsehood may be dependent on what others remember. If everyone else around you remembers what in fact has happened, you may be constantly told of this even if you removed certain memories. The social nature of remembering can put a limit to how inconsistent or false memories can be.

In response to the Losing True Self Problem, if a memory is crucial to your narrative identity, it is likely that it is nested in many other beliefs and memories that are mutually reinforcing. For example, as a result of being a feminist, Beth will have other memories of her being a feminist such as taking courses in feminism, partaking in protests, and so on. If so, it is hard to imagine that Beth would stop being a feminist just on the account that she no longer remembers how she became a feminist. Also, if a memory is so crucial to your narrative identity, it is unlikely that you would want to modify it. This said, you might have always wanted to be a different person. As long as you are aware of the consequences, this might not be so problematic from a personal point of view. Indeed, our narrative identity is fairly fluid; we constantly reinterpret our identity and act in order to maintain or improve our current model of this identity.[56] Our

true self may be regarded as residing less in the invariant features of the narrative and more in the process of its unfolding.

Furthermore, modifying your narrative identity may in fact enable you to access your true self. Following Harry Frankfurt's distinction between first-order and second-order desires, where one's second-order desires represent one's true self, you may have a second-order desire to be a particular kind of persona, but you are hampered by your memory.[57] Removing that memory may then enable you to access your true self. For example, Beth may have become a feminist of a particular sort because what her mother had said, and not because she has a second-order desire to be a feminist of that sort. Removing that memory may enable Beth to become who she really wants to be.

It should be remembered that the human self is a dynamical entity, far more fluid and less fragile than often assumed. Given the fallibility of memory, it is likely that much information in our memories is inaccurate, biased or even false,[58] and that our memories are constantly reinterpreted in the light of our ongoing project to construct a self.[59] An illustrative example is how twins occasionally dispute the *ownership* of memories (but not their content), demonstrating not only the potential for memory fallibility and the often self-serving ways we interpret them,[60] but also how bizarre states may be acceptable without impairing normal life or a sense of selfhood. In fact, even under conditions of extreme memory confusion, there is an ongoing experience of selfhood. Patients suffering from Korsakoff's syndrome confabulate briefly consistent explanations of what is going on based on their old memories and details in their surroundings but retain a sense of selfhood. During a dissociative fugue individuals lose access to (or repress) their autobiographical memories, but construct a new narrative self. Rather than

worrying that the merest inconsistency would break our self, we might want to be on the lookout for interventions that might impair our ability flexibly to reconstruct ourselves.

V. The Issue of Appropriate Moral Reaction

Another normative issue someone might raise in regards to modifying our memories is the Issue of Appropriate Moral Reaction. When an event occurs, as moral agents, there are more and less appropriate ways of responding to these events. For example, if a friend betrays you, an appropriate moral reaction is to feel indignant to a certain degree. Then, suppose that the friend has apologised, you should then at some point forgive the friend. Call this the Betrayal Case. Or, suppose you are contemplating committing a crime, e.g., killing an old, innocent lady like the protagonist does in *Crime and Punishment*. The appropriate moral reaction is to feel guilt and repugnance. After you have committed the crime, you should feel regret. Then, once you have repented and served your punishment, you should at some point forgive yourself. Call this the Crime Case.

However, modifying one's memories may affect how one responds to these events. For example, suppose you weakened your emotional memory in the Betrayal Case using propranolol, you might feel much less indignation regarding the betrayal. You might not even feel the need to forgive, since you were not that bothered about the betrayal. Appropriate forgiving consists of allowing one's moral values to overcome resentment, something that seems likely to be beneficial both morally and emotionally. Or, suppose you strengthened your memory in the Betrayal Case by using memory

enhancer drugs that promote consolidation, you might not only feel greater indignation, you might also not forgive your friend long after your friend has apologised.

Or, prior to robbing the old lady, suppose you weakened your emotional reaction and memory encoding using e.g. benzodiazepines so that you would not remember so well what you were about to do, you might no longer feel repugnancy and guilt. (Rohypnol might have already been used "strategically" by criminals for this purpose).[61] And, after committing a crime, suppose you removed your memory about your act altogether, you might no longer feel guilt or regret. You would also deprive yourself of the opportunity to forgive yourself once you have truly repented.

The Betrayal Case is a part of a general cluster of cases in which harm has been done to you. In some of these cases, the harm might be so traumatic (e.g. in the case of rape) that you would want to take MMTs to forget these events altogether. Also, supposing that the perpetrator of the crime has been punished, it may not matter to you whether you have had the opportunity to react in an appropriate way.

Concerning the Crime Case, this is a case in which you are about to or have committed harm against others. There does seem to be a duty not to remove these kinds of memories until one has come to realize one's errors. This is particularly so if deliberate forgetting may increase the likelihood of future crimes of this type. On the other hand, deliberate forgetting could decrease the likelihood of future crimes of this type, because remembering may make it easier to commit the crime in the future, since one has already done it before.[62]

VI. The Issue of Self-Knowledge

Modifying our memories may also raise the Issue of Self-Knowledge. Memories are constitutive of learning. Without them, we would repeatedly ask the same questions because we would not be able to recall what we have learned. Certain past memories help us infer how we might act when confronted with similar situations in the future. If you modify these memories, you may deprive yourself of the opportunity to learn about how you might act when confronted with similar situations in the future.

Some people object to the use of SSRIs such as Prozac on similar ground.[63] The use of SSRIs is based on a belief that depression is caused in part by serotonin-deficit and can be treated by increasing the brain's level of serotonin. Critics of SSRIs argue that serotonin levels (also) change in response to external events and features of oneself, and they worry that taking SSRIs can prevent one from having to confront those events and features.[64] For instance, suppose Jane has mild depression. It might be that Jane's experience of depression reflects her awareness on some level that her approach to major life problems was not working. Without pharmacological intervention, she might have tried to deal with her condition by discovering its root causes. By coming to understand those root causes, she would have had a better chance of overcoming her depression. Moreover, this new self-knowledge might have enabled her to prevent more serious depression in the future. However, so the argument goes, if Jane used pharmacological means to alleviate her mild depression, she would lose the opportunity, or at least the incentive, to work through her problem in this way. As a result, she would not acquire valuable self-knowledge. She would be more likely to suffer serious depression in the future, because she had not understood the causes of her mild depression.

In the case of using MMTs, it is useful first to recall the distinction between declarative and non-declarative memory. On this distinction, it is possible that if only your declarative memories are erased, you would still retain your habits and skills so that you would 'know' how to act in a similar manner in the future. For example, causing a traffic accident would normally produce a declarative memory of the event, a conditioned aversive reaction to stimuli associated with the accident, and a tendency to avoid dangerous traffic behaviour. Even if the declarative memory of the accident and the emotional association were removed (e.g. through blocking reconsolidation in the cortex and amygdala), the tendency could remain since it is based on other memory systems.[65]

It is true that removing the declarative memory may remove an important aspect of self-knowledge, since the causes and circumstances of how a habit was formed would no longer be available, and further development of the habit by reflecting on this knowledge would not be possible. But if the declarative memory was painful or otherwise problematic, in certain circumstances, it may be good enough to retain the "know-how" from the event. Also, even without knowing the source of the habit, a MMT user can reflect on his or her present motivations and find reasons in his or her current knowledge to accept, reject or change these habits.

Secondly, even if you erased both declarative and non-declarative memories, sometimes it may be in your interest to do so, especially if the memory, like a serious depression, is quite traumatic. Soldiers who killed in battle may not just want to forget that they killed; they may also want to forget how to kill; and it may be in their interest to do so. Some habits are destructive (such as drug abuse or a cycle of spousal abuse) and

may be hard to break even when desired by the person. Here MMTs could help second-order desires to break the first-order desires.

Returning to the analogy with depression, confronting root causes and learning from them require a certain deal of courage and energy, something that is often lacking in people suffering from serious depression. In this regard, empirical evidence suggests that a combination of antidepressants and therapy may be better than each of them in isolation.[66] Indeed, an individual with severe depression may be better off first taking SSRIs and then undergoing therapy in order to regain rational capacities. SSRIs in such a case would help rather than hinder in the acquisition of self-knowledge.

MMTs may also enable an individual to acquire self-knowledge in certain circumstances. As an example, a person who has acted wrongly and caused major harm may be prevented from learning from the experience owing to massive guilt, making rational reflection and assessment of his act impossible. Reducing the emotional intensity of the memory (possibly only temporarily) may enable rational reflection and assessment of his role in the act.[67] As another more positive example, MMTs could be used to add emotional valence to a past learning experience and memory. This may in turn trigger exploration of the subject and self-motivated development, which may then lead to greater self-knowledge, even if the triggering modification itself was not permanent.

VII. The Issue of Agency

Another issue someone might raise is that modifying our memories may affect our normative status as agents. In particular, retaining the memory of a particular event that has taken place gives you an opportunity to think through this event for yourself and to

address it. Doing so is exercising appropriate agency, and respecting yourself as an agent. When you modify a particular memory, e.g. by removing or changing it, you may be depriving yourself of an opportunity to think through this event for yourself, thereby not respecting yourself as an agent. Consider an analogy. Suppose you are doing some math problems, the answers of which are in the back of the book. You could try to work through the problems or you could just look up the answer in the back of the book. If every time you are stuck you would just look up the answer without thinking through the problem, it seems that you would not be exercising appropriate agency, and you would not be respecting yourself as an agent. Call this the Issue of Agency.

It is true that when confronted with a traumatic event, it may be undesirable immediately to resort to using MMTs. But supposing that you know that you will not be able to handle a traumatic event and retain your agency, then using MMTs may be permissible. You would be putting yourself in a position where you would still be a functioning agent after the event. In such a case, you are still respecting yourself as an agent, because your aim is to preserve your agency. For example, one might regard people with PTSD as essentially handicapped. If they seek to reduce PTSD using MMTs so that they could remain agents, they may be respecting themselves as agents given that their aim is to preserve their agency.

VIII. The Issue of Moral Obligation

Finally, being able to modifying our memories may affect our moral obligations, raising what might be called the Issue of Moral Obligation. Memories serve as evidence not just for oneself but sometimes also for others. For example, Neil Armstrong's

memory of landing on the moon, or a Holocaust victim's memory, may not just be evidence for them but also for humankind. Some of these memories might be so important to others that there is a duty to remember them. If so, there may be a duty not to use certain MMTs that would remove or alter these memories. Call this the Duty to Remember Problem.

Relatedly, even if certain memories are very important such that one should try to remember them, at present, without MMTs, one may not be held responsible for forgetting. However, once MMTs are available, one may be obligated to take MMTs to maintain these memories, and one may be held responsible for forgetting them. Call this the Ought Implies Can Problem.

Concerning the Duty to Remember Problem, it is important to mention the distinction between episodic memory (memory of the experiences), and semantic memory (memory of the facts regarding the events itself). If what is valuable is just the facts regarding the events, it may be sufficient for there to be a duty to retain semantic memory with no or reduced emotional content. Lesion studies show that one can lose one but not the other, e.g., in semantic dementia and transient global amnesia.[68] These findings suggest that semantic and episodic memory are dissociable and have overlapping yet also distinct neural basis. While it remains conjectural that, for example, retrieval-induced lability and reconsolidation could take place in one but not the other, these dissociations at least show the theoretical possibility. The memory may even be stored elsewhere (e.g., in a journal), and not necessarily in the mind of the individual who has been traumatized by the event. Indeed, in the case of Sophie in *Sophie's Choice*, it may

be sufficient to fulfill a duty to remember, if the semantic memory of what had taken place at the concentration camp is preserved.

Some people might think that in addition to preserving semantic memory, there is also value in preserving episodic or emotional memory. For example, some people might think that if possible, preserving Sophie's full memory of her experience at the concentration camp could also be valuable. This may be so, but if Sophie's preserving her episodic memory is too painful for her, it may be too onerous to require that Sophie retains her memory of the event. In any plausible moral theory, moral obligations should typically not be so demanding such that one must make enormous sacrifices in order to fulfill them. As Judith Jarvis Thomson observes, "nobody is morally *required* to make large sacrifices, of health, of all other interests and concerns, of all other duties and commitments . . . in order to keep another person alive."[69] It is difficult to say exactly where the limit of moral demandingness lies. But, arguably, if Sophie will commit suicide if she retained her episodic memories, then maintaining her memories might just be too demanding such that she is not obligated to do so.

Here it is worth considering whether there is a duty to retain *all* semantic memories. Our view is that it does not seem that there is such a duty. If there were such a duty, and suppose there are MMTs that can help you to retain your memories, you would be obligated to use them so that you would retain even trivial memories such as that you had cereal this morning. But it seems that you do not have a duty to retain trivial memories.

Regarding the Ought Implies Can Problem, this is a general problem that applies to all new technologies. It does not mean that someone who has a difficulty remembering

must use MMTs. There may be simpler means such as writing in a diary, telling a friend to remind you, and so on, which may have less normative problems. This said, taking MMTs may sometimes be required if no other means are effective. For example, a doctor in the jungle may have a duty to use MMTs to help her remember certain medical facts if there are no other means of recalling these facts.

IX. A General Case for the Permissibility of Using MMTs

We now seek to generalize the discussion above and propose some guidelines regarding the normativity of personal uses of MMTs.

Ultimately, the point of using MMTs for most of us will be to enhance our personal well-being. On the most plausible objectivist account of well-being, it will consist of pursuing valuable activities that one endorses such as deep personal relationships, knowledge, and active and passive pleasures.[70] Or, on the most plausible subjectivist account of well-being, it will consist of pursuing basic activities that one would desire after informed deliberation whatever else one might desire.[71]

One obvious constraint on the pursuit of personal well-being is that we should not harm others in the course of doing so.[72] There are different conceptions of what constitutes harm to others, but it seems that on any conception, intentionally using MMTs to make it easier to rob an old lady and not feel guilty about it – as for example in the Crime Case – would count as harm to others.

Another obvious constraint on the pursuit of well-being is harm to self. For example, in most if not all cases, using MMTs to wipe out all of one's memories or to cause one not to be able to remember anything would be a serious harm to self. Even

removing only autobiographical memories could be a serious harm to self, since autobiographical memories help establish a continuous self through time, and also help direct our actions through past experience and maintain a social identity.[73]

Moreover, as we have mentioned, there might be prima facie duties to preserve certain memories that are important not just to one but also to others, e.g., Neil Armstrong's memory of landing on the moon, or a Holocaust victim's semantic memory of what had taken place in the concentration camp.

Aside from these more obvious constraints, how should we regard the normativity of using MMTs? Earlier we noted that using MMTs could affect certain normative values such as truthfulness, appropriate moral reaction, self-knowledge, or agency. One might be tempted to give these values certain priority over other values of well-being such as pleasure or the avoidance of pain. For example, one might be tempted to hold the view that any amount of truth is always more important than any amount of the avoidance of pain. However, we shall argue that none of these values have priority over other values such as pleasure and the avoidance of pain.

This is most obvious in cases in which the pain is unbearable. For example, consider again Sophie's traumatic episodic memories. It seems that in her case, it would be permissible for her to use MMTs to alleviate the unbearable pain she is suffering as a result of these memories. This is the case, even if doing so may cause her to live in falsehood, lose part of her narrative identity, and not give her a chance to come to terms with the tragic event. Indeed, the event may be so traumatic for her that her not having these memories may be the only way she would be able to function as an agent.

But even in less extreme cases, these other values may not have priority over values such as pleasure and the avoidance of pain. For example, if the pleasure to be gained is significant, and if it is not very important that the other values obtain in the circumstances, then it may be permissible to choose pleasure over the other values. Indeed, as we have mentioned, believing that one had a holiday so that one would feel more relaxed or believing that one is more attractive than one really is may be permissible, even if they involve a bit of living in falsehood. Or, it may be permissible to overlook some trivial one-off offences to one altogether (e.g. removing the memory of a somewhat insensitive, bad joke about one) even if this deprives one of reacting to the event in an appropriate way.

In general, as long as individuals do not harm others and themselves in the ways we have defined and as long as there is no prima facie duty to preserve particular memories, we propose that it is up to individuals to determine the relative weightings of these different values of well-being and how much they would allow MMTs to affect these values.

Here it is worth mentioning that this approach, which we take to be pluralistic, should be compatible with those who view normativity from the perspective of virtues rather than from what is forbidden and what is permissible. It seems that a virtuous person would also strive for a proper balance of the virtues of these different values and not try to give any particular value priority over all the others. In other words, while upholding truth and fulfilling one's duties are virtues, there is also virtue in promoting choice and personal well-being.

X. Conclusion

MMTs for personal uses raise interesting developmental and normative concerns**.** We first argued that those developing desirable MMTs should keep in mind certain Technical Limitations as well as User Limitations such as Attention Control and the Abstraction Concerns. We next pointed out that personal uses of MMTs can raise certain normative issues about Truth, Appropriate Moral Reaction, Self-knowledge, Agency, and Moral Obligations. Finally, we proposed that as long as individuals using MMTs do not harm others and themselves in the ways we have specified and as long as there is no prima facie duty to retain particular memories, it is up to individuals to determine the permissibility of particular uses of MMTs.

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[1] For a good discussion of issues relating to safety, distributive justice, and coercion in regards to the development of memory modification technologies, see, e.g., (Farah, Illes et al. 2004). For a good discussion of some of the issues in which we are interested, see also (Levy 2007; Wasserman 2004).

[2] For example, Plato's *Theaetetus*.

[3] (James 1890; Brown 1958; Peterson and Peterson 1959)

[4] (Scoville and Milner 1957; Shallice and Warrington 1970; Zola-Morgan and Squire 1993)

[5] (Squire and Zola-Morgan 1991)

[6] (Schachter and Tulving 1994)

[7] It should be noted that many scholars use the term working memory instead of or including the older concept short-term memory.

[8] (Waugh and Norman 1965; Baddeley 1966; Baddeley 1966)

[9] (Averbach and Sperling 1961)

[10] (Baddeley 1999; Baddeley 2000) It should be noted that there are alternative accounts of working memory in terms of activated long-term memories and focus of attention, e.g. (Cowan 2005).

[11] (Cohen and Squire 1980; Squire, Knowlton et al. 1993)

[12] (Tulving 1999)

[13] (Scoville and Milner 1957; Cohen and Squire 1980; Zola-Morgan and Squire 1993).

[14] (Fuster 1995; Squire and Kandel 2000)

[15] (Tulving 1972)

[16] (Graham, Simons et al. 2000)

[17] (Mcclelland 1994; Baddeley 1999) But see also (Nadel and Moscovitch 1998), which shows that semantic knowledge can be acquired as one-shot learning and during impaired episodic memory.

[18] (Schmidt 1994; McGaugh 2000)

[19] (Bechara, Tranel et al. 1995)

[20] (Fanselow and LeDoux 1999; Medina, Repa et al. 2002; Moita, Rosis et al. 2003)

[21] (Cahill and McGaugh 1998; McGaugh 2000)

[22] (Hurlemann, Hawellek et al. 2005).

[23] (Hebb 1949; Squire and Kandel 2000; Kandel 2001) While long-term memory depends on LTP, short-term memory appears to be independent of it. According to most biological theories of working memory, short-term memory consists of self-sustaining neural activity patterns rather than synaptic change (Fuster 1995).

[24] (Przybyslawski and Sara 1997; Debiec, LeDoux et al. 2002; Lee, Everitt et al. 2004)

[25] (Lynch 2002)

[26] (Tang, Shimizu et al. 1999; Routtenberg, Cantallops et al. 2000) (Wang, Ferguson et al. 2004)

[27] (de Quervain and Papassotiropoulos 2006)

[28] (Caine, Weingartner et al. 1981)

[29] (King 1992)

[30] (Pastalkova, Serrano et al. 2006; Shema, Sacktor et al. 2007)

[31] (Walker, Brakefield et al. 2003)

[32] (Hupbach, Gomez et al. 2007)

[33] (Hupbach, Gomez et al. 2007)

[34] (Debiec, Doyere et al. 2006; Doyère, De ogonbiec et al. 2007)

[35] (Tronson and Taylor 2007)

[36] (Pitman, Sanders et al. 2002; Vaiva, Ducrocq et al. 2003)

[37] (The President's Council on Bioethics 2003; Schogol 2006)

[38] (Wagner, Degirmenci et al. 2005)

[39] (Loftus 1997; Hyman and Loftus 1998; Gonsalves and Paller 2002; Thomas and Loftus 2002; Loftus 2003)

[40] (Schacter 2001)

[41] (Hyman and Loftus 1998)

[42] (Gonsalves and Paller 2002)

[43] (Lindsay, Hagen et al. 2004)

[44] (Gerrie, Garry et al. 2005; Garry and Gerrie 2006)

[45] (Spanos, Burgess et al. 1999)

[46] (Mazzoni, Loftus et al. 2001)

[47] (Holderfield 2006)

[48] (Doyère, De ogonbiec et al. 2007)

[49] A vivid fictional example is found in Borge's short story *Fuentes the Memorious* (Borges 1970).

[50] (Luria 1987)

[51] (Parker, Cahill et al. 2006)

[52] (Murphy 2006, pp. 85-90)

[53] (Kass 2003)

[54] (Schacter 2001)

[55] See also (Wasserman 2004) for a different example.

[56] (Weber 2001)

[57] See, e.g., (Frankfurt 1988)

[58] (Schacter 2001)

[59] (Weber 2001)

[60] (Sheen, Kemp et al. 2001; Sheen, Kemp et al. 2006)

[61] (Dåderman and Lidberg 1999; Dåderman, Fredriksson et al. 2002).

[62] (Levy 2007)

[63] (Manninen 2006)

[64] See also Author A for this point.

[65] See e.g. (Nyberg and Tulving 1996) for the examples of dissociations between the memory systems.

[66] (Fava, Ruini et al. 2003; Fava, Ruini et al. 2004; Furukawa, Watanabe et al. 2007)

[67] Greene et al. have studied the neurocognition of personal vs. impersonal moral judgement, finding higher activation of brain areas correlated with emotion for person-moral judgement and more cognition-related areas for impersonal judgement (Greene, Sommerville et al. 2001; Greene and Haidt 2002). Whether lowering emotional arousal could contribute to more *adaptive* moral cognition beside *changed* moral cognition is an interesting question.

[68] In particular, see Nyberg, L. and E. Tulving (1996). "Classifying human long-term memory: Evidence from converging dissociations." European Journal of Cognitive Psychology 8(2): 163-183; and Kensinger EA and Giovanello KS (2005). "The status of semantic and episodic memory in amnesia." Progress in Neuropsychology Research: Brain Mapping and Language. Hauppauge, NY: Nova Science Publishers, Inc.

[69] (Thomson 1997 p. 77)

[70] See, e.g., (Finnis 1980, pp. 85-90).

[71] See, e.g., (Rawls 1971; Griffin 1986); For an interesting account of welfare, see (Darwall 2002), who argues that someone's good is what one should want for that person insofar as one cares for her.

[72] (Mill 1978)

[73] (Bluck, Alea et al. 2005)

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