

## “Watch Your Language”: A Literature Review on the Use of Dirty words in Improving Memory for Adult Learners

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### ABSTRACT

Treatments for neurological disorders have employed the use of dirty language as a method of overcoming language deficits, especially for those who have experienced strokes. Because of the linkage of the cursing language pathway and the memory, there has been some discussion on how the use of dirty language could improve recall in neurologically intact individuals. Twenty-six [1-26] studies were included within this literature review. Inclusion criteria included use of swears words as defined by Jay [10] and attention to memory. This literature review looks at the neurobiological basis of the limbic pathway, explores previous research, and proposes a study to see the effects of the use of dirty language within the adult learner space to increase the overall retention of information for the students.

**KEYWORDS:** Limbic lobe, Cursing, Dirty Mnemonics, Swearing, Memory, Adult Learners

“Oh, Oh, Oh, To, Touch and, Feel, Virgin, Girls’, Vaginas, A, H!” This dirty mnemonic is a major memory key for first year medical students in the anatomy courses around the world to remember the names of the twelve cranial nerves; the nerves that leave the skull and head to their targets instead of traveling first with the spinal cord. These nerves while tricky to learn are necessary for the student to master before spending time within the clinical space. The students are often heard repeating this dirty mnemonic and other such foul phrases to their classmates and whispering it under their breath during exams.

Many, if not all, students swear by the dirty mnemonics and will often pay for services that offer more of these vulgar mnemonic or memory catches. Many schools, private companies, and private tutors have worked to create materials to help these students who often describe the amount of material they have to learn as “Drinking out of a firehose”. While students also often swear (pun intended) by weird/silly rituals to improve grades, this poses the question: does the use of dirty words in learning material actually improve the memory and recall abilities of the learners? This paper will look at the neurobiological basis of the limbic pathway (formerly known as the limbic lobe) and explore previous research to see the effects of the use of dirty language within the adult learner space as a way to increase the overall retention of information for the students.

### NEUROBIOLOGICAL BASIS

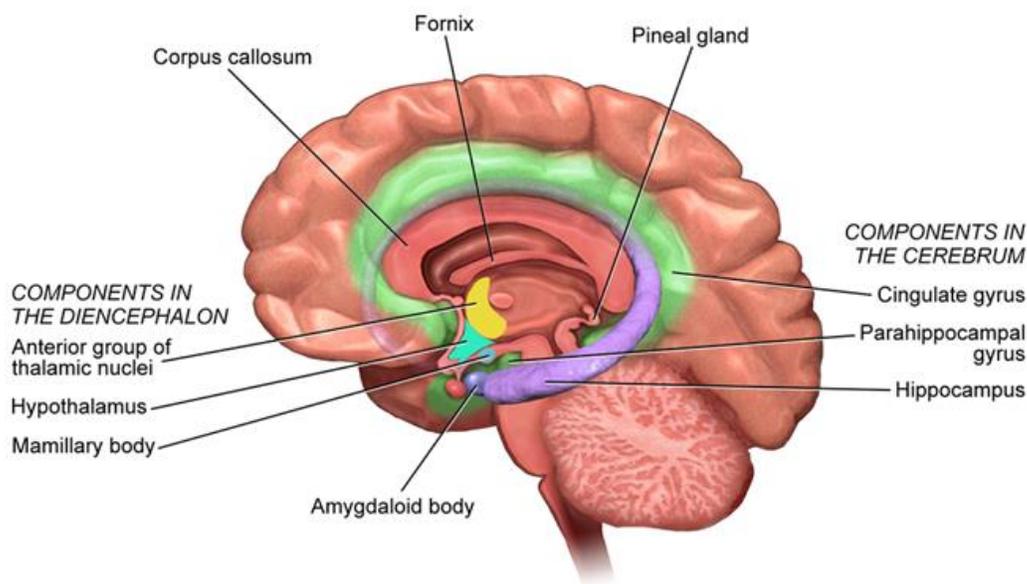
The brain is divided into multiple sections often referred to as lobes or cortexes of the brain. The major lobes that are taught in school are the frontal, the temporal, the parietal, and the occipital lobes. These provide executive function, smell

and hearing, mathematical skills, and vision, respectively. The lobes of the brain are made up of networks of nuclei (cell bodies that appear gray in large groups) that communicate within the lobe and to other parts of the brain. While it is absurd to say that these lobes only perform the function that is classically taught, it is a simplification that needs to be made in order to discuss the overall function of the different groups of nuclei. Nevertheless, it is essential to acknowledge that, the brain itself is a highly integrated network and relies on the integration for the functionality of all the systems involved, a principle also known as emergence [12].

## THE LIMBIC LOBE

One lobe that is often not discussed in the classroom for high school students and even in some college classrooms is the focus of this paper. This lobe, the limbic lobe or mesolimbic pathway, works both in emotion and memory, and is composed of the amygdala, the hippocampus, the mamillary body, the cingulate gyrus, the parahippocampalgyrus, the anterior group of thalamic nuclei, the ventral tegmental area, and ventral striatum (Figure 1). The mesolimbic pathway or limbic lobe consists of set of dopaminergic neurons which utilize dopamine to communicate messages from neuron to neuron at the synapse. This is the same neuronal pathways that are involved in addiction and in the classic conditioning pathways of Pavlovian fame [17] which explain the linkage between a “good cry” or other emotional states and a person’s memory of those events and likelihood to try and relive them.

## The Limbic System



**Figure 1:** The mesolimbic pathway consists of several groups of neurons whose primary neurotransmitter is dopamine. This pathway is a deeper brain structure and is seen best on sagittal cuts like that shown above.

[1] Through Stroke and Multiple Sclerosis research [6], both processes that kill areas of the brain which leads to loss of function in the living person, the limbic pathway has been shown to be the seat for the formation of long term memory, short term memory, and recall [6]. Other activating processes such as epilepsy and tic disorders have also demonstrated this linkage between the limbic pathways and swearing [16,21]. As a result, those activities which increase the dopaminergic release (use of the neurotransmitter dopamine) within the brain, including cursing and the use of foul phrases, can be predicted to increase the retention and recall of facts and statements for the students that use this method of learning [22]. There are several compounds that have demonstrated this type of mechanism of action by increasing dopamine within this circuitry to increase memory, recall, and focus including methamphetamines, methylphenidate, and other amphetamine salts which are often prescribed for conditions such as ADHD [22].

## MECHANISM FOR THE CREATION OF MEMORY

The mechanism of increasing memory is based off the increase in the release of neurotransmitters which recruit astrocytes to wrap around the neural synapse, known as the astrocyte glomeruli, which leads to an increase in the strength of the connection [18]. The current theory of memory is that it is a result of the creation of a new circuit within the brain, a principle called emergence, the stronger the initial stimuli and the more often it is used, the stronger the memory.

## THE AMYGDALA

The amygdala, a walnut shaped nuclei, is the major point of connection for the autonomic nervous system, the fight or flight system of the body, and is one of the several nuclei within the limbic lobe [8]. This is the area of the brain where curse words and other taboo phrases are both interpreted and the nuclei that “lights up” on fMRI when cursing or using phrases that are emotionally charged [24]. The amygdala also fires when positive emotional language is used, albeit less than when negative words are used [7]. The amygdala and the hippocampus, a group of deep brain nuclei and the home of memory formation within the brain are interconnected and like with any group of nuclei the connections become stronger with continued use over time. This is the reason that for deeply emotionally charged events, such as the passing of loved ones, the memories of people can become warped and are easier to “relive” and recall. One of the most interesting recent findings is that euphemisms while more socially acceptable than the actual curse words have a relatively similar effect on the autonomic nervous system using dermal temperature sensors. The dermal temperature sensors measure the effects of the autonomic nervous system as micro-spikes in heat are accompanied by the release of epinephrine and norepinephrine which cause an increase in the burning of glucose to prepare for fight or flight response [2]. While the circuitry of the amygdala and the hippocampus has been studied, there is still much more work that needs to be done to elucidate, both the strength of the circuit and how much of a role it plays in memory [2,5, 25].

## BASAL GANGLIA

One of the final areas of the neurobiological mechanism is the interconnection between the amygdala and the basal ganglia of the brain. The basal ganglia are a group of deep brain nuclei that are the modulators of motion. These structures are necessary for the planning and interconnection between the motor cortex and the cerebellum which modulates that movement over every muscle group within the body. During cursing different pathways from the amygdala are used in connection with the putamen of the basal ganglia. This is different than the simpler Broca’s area pathway from the frontal lobe which is the normal pathway for speech. With the addition of the amygdala, there is an increased number of neurons that is recruited to participate in the use of speech (and mirror neurons in the hearing of that speech) as compared to the use of non-emotionally charged language [26]. The reason that this separate pathway is important is that memory instead of being located in a singular location as was once thought is instead the emergence of the pathway that is created. This means that the more areas of the brain that are involved within the creation of the memory (i.e., hearing, speaking, doing, etc.), the stronger the actual memory will be and the longer lasting this memory will be. Thus, through the involvement of the emotions, the motor action of the mouth and basal ganglia in a non-normal action, the hippocampus memory center, and the remainder of the limbic pathways, there is an increase in the likelihood that the event, fact, or learning experience will be retained for later use.

As a result of all of these factors from the basal ganglia, the limbic lobe, the amygdala, and the dopaminergic surge that accompanies the use of emotionally charged language [24], the reader should, at least in part, be able to understand the effects of using curse words and dirty mnemonics on the neurobiology of the individual. This along with the use of repetition, which reuses the same pathway increasing the likelihood that the wrapping of the synapse (areas in between neurons) with astrocytes (the way that a pathway can become either semi or completely permanent) will occur.

## UNDERSTANDING OF THE CURRENT LITERATURE

To ensure that curse language was properly defined, one researcher in 2009 observed and studied the nature and different types of curse words [10]. Jay found that the majority of curse words fall into the categories of religious, sexual, and excremental [10]. These topics when spoke of in a light manner are considered offensive and as a result have been given the label – profane or taboo. In 2003, a study found that the taboo words and emotionally charged language are more easily recalled as compared with words that had no emotional charge or were considered to be “normal” [11]. This was supported by a 2004 study [15] which found that when taboo words are used in memory association there is increased difficulty in making the memory, but this memory is longer lasting than when a color is paired with a non-taboo word. The researchers for the Mackay et.al [15] study used what were considered to be at baseline normal individuals to test the hypothesis.

## DIRTY WORDS

According to Broderick, Pilotti, and Sena-Jaramillo [3], emotionally charged language was found to have an increased recall when paired with non-emotionally paired words as compared with non-dirty words. This relationship, in neurologically intact individuals lasted for greater than two weeks and while the memory for the dirty words remained relatively stable, those with benign words continued to degrade in recall ability. As stated earlier, the subjects were a randomized group of normal individuals with normal variance of neurological functionality. According to Lang, Newhagen, & Reeves [14], the capacity for memory coding is a result of both emotional arousal and valence, how bad or

good a person viewed the message. They found that this was true for both upsetting and uplifting messages with the hilarious being remembered better. This was further supported by work from Schomaker [20], who showed that novel words and word pairings were recalled at a higher rate than those words which were not novel combinations. Novel word pairing, in this study referred to words that are not normally paired together. This is where the use of dirty or emotionally charged language gets much of its power; the profane is removed from “Proper” language and from most people’s professional environments. As a result, the student will not have paired these words together before. Many dirty mnemonics are made to be funny as a result –it will increase the likelihood that the student will be able to remember the concepts or material from the class.

One of the other aspects of the literature was the idea of expectations and how things that deviate from expectations are offered greater memory. According to Porubanova, Shaw, McKay & Xygalatas [19], language utilization that breaks cultural norms or current understanding of a topic are given a higher place in memory. This was performed through using almost non-sensical statements (i.e., Illiterate-teacher) and seeing how well the subject was able to remember the word pairing as compared to those that were paired in a culturally normative fashion (glass-bottle). One final study was on a patient who has suffered from severe strokes that had taken out their Basal Ganglia (the area of the brain that helps with the coordination of movement). In the article, the patients often lost automatic speech and were very disjointed, however, because swearing was still intact, they were able to help the patients link the swearing and normal language and re-teach them how to speak. This showed that even with neurological loss the linkage between learning and swearing has high impact and might be of great use within the adult learned space [4,23]. The references mentioned in this review of the literature can be seen in Appendix 1.

Article	Year of Publication	Findings	Relevance
Schomaker, J. Unexplored territory: Beneficial effects of novelty on memory.	2019	Showed that the more novel a combination of words was to the person involved, the higher the rate of recall was in normal subjects.	This demonstrates that novel combinations of phrases will improve memory. This is a useful framework for the use of dirty mnemonics.
Sulpizio, Toti, Maschio, Costa, Fedeli, Job & Abutalebi, Are you really cursing? Neural processing of taboo words in native and foreign language.	2019	This article contains a full integration of different areas of the brain that are visualized on fMRI, that increase glucose utilization during cursing.	Further evidence of the areas of the brain that are activated during cursing – potential connectivity for memory.
Viñas-Guasch& Wu, The role of the putamen in language: a meta-analytic connectivity modeling study.	2017	This study looked at the role of the putamen, a deep brain structure within the scope of development and use of language skills.	Further evidence about how language is used within the brain and its connection to memory.
Stanek. Expectation Modulates Episodic Memory Formation via Dopaminergic Circuitry.	2016	This dissertation talks about the effects of expectations on the dopaminergic circuitry of the mesolimbic pathway and the results of that on memory consolidation and recall.	This gives specific areas that are affected by surprising and non-regular approaches to education and memory consolidation. This is useful as it provides the overall mechanism of action and theoretical framework for a potential study.
Porubanova, Shaw, McKay & Xygalatas Memory for Expectation-Violating Concepts: The Effects of Agents and Cultural Familiarity.	2014	The study showed that phrases and ideas that break the normalized thought process are given more importance in memory.	This demonstrates the theoretical requirements for the increased memory retention, when using words and language that break cultural norms.
Broderick, Pilotti, & Sena-Jaramillo. Is the	2014	Found that memory of taboo words or words with emotional charge	Demonstrated that taboo words have an increase in

Emotional Memory Effect Sensitive to Encoding Instructions and the Passage of Time?		were not affected by the passage of time as compared to neutral words.	memory recall and encoding as compared to neutral words.
Bowers & Pleydell-Pearce. Swearing, Euphemisms, and Linguistic Relativity.	2011	The study found that even the use of euphemisms also increased the amount of autonomic activation within the person that was using the language. This was measured through dermal temperature sensors.	Shows that euphemisms when known has an activating effect on the limbic system of the brain that impacts the autonomic nervous system, the hippocampus (Memory center), and the amygdala (Flight or fight response).
Fazio & Marsh Surprising feedback improves later memory.	2009	Found that feedback that did not match the student/learners desired effect increased the overall memory of both the subject and of the specifics of that subject.	This shows that activation of the emotional centers of the brain (amygdala) with responses that provoke either emotional or non-expected responses increase memory functionality.
Jay. The Utility and Ubiquity of Taboo Words.	2009	This article discussed the words that are usually considered taboo and make up the majority of the language of cursing. Found that 80% of public cursing comes from only 10 words.	This provides a list of the most common words and gives insight into what is considered to be dirty or profane.
MacKay, Shafto, Taylor, Marian, Abrams, & Dyer Relations between emotion, memory, and attention: Evidence from taboo Stroop, lexical decision, and immediate memory tasks.	2004	Found that the memory recall of a linkage between taboo words and a color took longer to make than neutral words and that this pairing was easier to recall for the taboo words than it was for the neutral word.	Useful information about taboo word pairing and its effects on memory. Can be used as an argument for dirty or taboo mnemonics and increased recall.
Harris, Ayciçeđi, & Gleason, Taboo words and reprimands elicit greater autonomic reactivity in a first language than in a second language.	2003	Found that the use of taboo words in a non-native tongue had a lesser autonomic response than in the native tongue.	Demonstrated that there is an autonomic response with the use of taboo words. This indicates that the memory centers of the brain linked with amygdala are activated with the use of taboo language, even when the language is non-native.
Kensinger & Corkin. Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words?	2003	The study found that emotionally charged language is more vividly remembered than words that are not emotionally charged. This was found with both quantitative and qualitative measures.	This is beneficial as curse words and dirty mnemonics are emotionally charged and as a result of these findings more likely to be easily recalled.
Hamann, & Mao. Positive and negative emotional verbal stimuli elicit activity in the left amygdala.	2002	Demonstrated that the Amygdala was activated in emotionally charged language, both positive and negative and that the reward centers of the brain were affected with positive language.	Important information as increased activity of the reward centers and the amygdala.
Van Lancker & Cummings, Expletives: Neuro-linguistic and	1999	This paper looked at the different structures involved in swearing and other taboo language. It discussed	Useful information about brain structures and pathways that are used in

neurobehavioral perspectives on swearing.		aphasia, adult left hemispherectomy, Gilles de la Tourette syndrome (GTS), and other neurological disorders which all demonstrate increased cursing.	cursing and the effects of these on other structures in the brain.
LaBar & Phelps Arousal-mediated memory consolidation: Role of the medial temporal lobe in humans.	1998	Showed that there was a connection between the amygdala and the hippocampus that is activated followed by emotional arousal in humans which increases memory consolidation.	More important background information about the roles of different brain structures and evidence that emotional arousal increased memory.
Lang, Newhagen, & Reeves The effects of emotional arousal and valence on television viewers' cognitive capacity and memory.	1995	Found that the capacity for memory coding is a result of both emotional arousal and valence, how bad or good a person viewed the message.	This paper demonstrates that emotionally charged pieces of information affect the ways that participants engage memory.
Morris. The neurobiology of the obscene: Henry Miller and Tourette syndrome.	1993	This article discussed different areas of the brain involved in both Henry Miller and Tourette syndrome and the structures that are often injured or malformed in those affected by the disorder.	This helps with localizing the areas that are affected in those with Tourette's syndrome and their corollaries with those neurotypical and the effects that cursing has on activation of those regions.

## GAPS IN THE LITERATURE

One of the biggest areas that is lacking currently in the literature is studies on the effectiveness on the use of dirty words and dirty mnemonics within the classroom. These words have been demonstrated to have an effect on increasing the level of retention in adults who were passively acting or in a non-learner environment but have not been tested in a learning environment outside of anecdotal accounts – including the use of the mnemonic from the introduction. The use of dirty mnemonics is not common until the doctoral level and studies on the effectiveness of the use of this type of language in the learning environment has not been explored. There are many reasons including how it is considered to be improper to use this type of language around those younger than eighteen years of age and this restriction in the use of such language is then extended passed eighteen. Other questions are whether the retention has a large enough effect size that any changes within curriculum would be worth the change. This leaves room for important and potentially vital research into the effectiveness of using this pathway to increase the overall benefit to the students in adult learner programs.

## CONCLUSION

This paper looked at the neurobiological basis of the limbic pathway (formerly known as the limbic lobe) and explored previous research to see the effects of the use of dirty language within the adult learner space as a way to increase the overall retention of information for the students. The scientific understanding of the brain continues to increase over the last several years and with it the ability to use pathways to increase the skills and knowledge of the learner. The current major limitation of the knowledge acquired thus far has been the limited utilization of the increased memory recall within the classroom. Nevertheless, through simply using what knowledge has been discovered, soon, perhaps, the student will marry the profane and the profound.

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