



**THEORETICAL CORRELATION OF AGEING,  
MENTAL ACTIVITY AND MEMORY RECALL:  
IMPLICATION FOR SECURITY PERSONNEL**

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**Abstract:**

This study explored theoretical correlation of ageing, mental activity and memory recall and its implication for security personnel. Ebbinghaus' experiment with the list of nonsense syllables in 1885 has created the awareness that a lot factors can influence brain behaviour; critically ageing and mental activity. Despite the abundance of empirical literature on varying experiments to expose the correlation of brain behaviour and other human behavioural outcomes, the need to establish theoretical basis for understanding these relationships becomes important. Using Two-Stage Process theory of memory recall by Watkins and Gardiner (1979) which emphasized search and retrieval process; and Encoding Specificity theory by Tulving and Donald (1973) which emphasized encoding conditions and conditions at the time of retrieval, memory recall process was reviewed as brain behaviour in the light of how ageing and mental activity (cognitive exercise) may influence it. Given the found theoretical linkage, it is recommended that positive valences which improve mental wellbeing and varying brain behavior be encouraged in the workplace to improve the quality of human output in the organization.

**Keywords:** brain behaviour, memory recall, ageing, mental ability, security personnel.

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## 1. Introduction

Since Ebbinghaus' list of nonsense syllables in 1885 to test his own memory, it has become apparent that brain behaviour influences memory process, forgetting, memory recall etc (Ebbinghaus, 1885; 1962). What the brain does has been argued to influence a variety of human behaviour (Meusel, Grady, Ebert & Anderson, 2017). Psychologically, there is a school of thought who also believes that many other behavioural antecedents and life circumstances influence brain behaviour such as; injury, mental activity and ageing (Brown, Roediger & McDaniel, 2014; Bermingham, Hill, Woltz & Gardner, 2013; Stoddard & Wright, 2006). Considering how topical brain behaviour has become especially in explaining cognitive behavioural patterns, there is need to understand if there are theoretical assumptions to it.

Several strings of studies have been patterned to explain cognitive underpinnings which occur in the art of processing information in the human brain in the face of varying circumstances in context with different individual physical, physiological, and psychological makeup or otherwise (Cansino, Trejo-Morales, Estrada-Manilla, Pasaye-Alcaraz, Aguilar-Castañeda, Salgado-Lujambio, & Sosa-Ortiz, 2015; Salthouse, 2006). For instance, Salthouse (2006) used the "use it or lose it" hypothesis to validate the effects of mental exercise and mental aging as brain behavioural response to physical and psychological changes in the human person. Salthouse's (2006) hypothesis was also validated by Brown, Roediger & McDaniel's (2014) and Stoddard & Wright's (2006) study which affirmed that there are long term cognitive effects of training on everyday functional outcomes of brain behaviour in older adults. The assumptions of the above studies and similar other studies have given the need to establish theoretical foundation for accepting if the varying brain performance are theoretically circumstantial and what relationships can theoretically be accounted for considering the current focus of this study on the theoretical correlation of age, mental activity and memory recall among security personnel.

In the Nigerian work setting, very little is emphasized of the importance of mental health and its relationship to effectiveness (Oyewunmi, Oyewunmi, Iyiola & Ojo, 2015), it is even more critical for those in the Nigerian Federal Ministry of Interior whose prerogative is internal and external security of our nation. For security personnel, ageing and mental activity may become critical factors of performance with expected correlation with on how they may influence memory recall among officers being the reason why Westbrook (2011) called for mental health legislation and involuntary commitment in Nigeria. Considering its role in human brain behaviour, memory recall synonymous with information retrieval may be a critical success factor in policing and security process as it aids correlation of events and circumstances for quicker reaction upon varying security challenges.

## 2. Literature

### 2.1 Memory Recall

Memory recall is mental process of retrieval of information from the past; it is also acquainting oneself with past events (Bermingham, Hill, Woltz & Gardner, 2013). Along with encoding and storage, it is one of the three core processes of memory: free recall, cued recall and serial recall. Psychologists test these forms of recall as ways to study the memory processes of humans and animals (Meusel, Grady, Ebert & Anderson, 2017; Bermingham, Hill, Woltz & Gardner, 2013; Brédart & Barsics, 2012; Botvinick, Wang, Cowan, Roy, Bastianen, Mayo, & Houk, 2009). Two main theories of the process of recall which are the two-stage theory and the theory of encoding specificity try to explain the underlying assumption and mechanisms in the process of memory recall.

### 2.2 Two-Stage Process Theory of Memory Recall (Watkins & Gardiner, 1979)

The two-stage theory states that the process of recall begins with a search and retrieval process, and then a decision or recognition process where the correct information is chosen from what has been retrieved (Watkins & Gardiner, 1979). In this theory, recognition only involves the latter of these two stages, or processes, and this is thought to account for the superiority of the recognition process over recall. However, Watkins and Gardiner (1979) emphasized that recognition only involves one process in which error or failure may occur, while recall involves the two; and recall has been found to be superior to recognition in some cases, such as a failure to recognize words that can later be recalled (Tulving & Donald, 1973).

Recall works by a two-stage process:

1. A search through memory for something that might satisfy the search criteria.
2. A comparison of recalled memory with the detail of which is being sought.

Recognition works only by a single process, where the stimulus leads to a memory already being found. Recognition, thus only needs the second step from the two-stage recall process which makes recognition more likely to be successful as compared with recall. Although, it was criticized by Bernbach (1975) as lacking in merit to explain cognitive patterns, Tarnow, (2016) provided first direct evidence of two stages in free recall and three corresponding estimates of working memory capacity.

Tarnow, (2016) found two stages can be seen directly in sequential free recall distributions. These distributions show that the first three recalls come from the emptying of working memory, recalls 6 and above come from a second stage and the 4th and 5th recalls are mixtures of the two. He also found a discontinuity, a rounded step function, shown to exist in the fitted linear slope of the recall distributions as the recall shifts from the emptying of working memory (positive slope) to the second stage (negative slope). The discontinuity leads to a first estimate of the capacity of working memory at 4-4.5 items. Working memory accounts for the recency effect. The primacy effect comes from the second stage with a contribution also from working memory for

short lists (the first item). His findings were validation of the assumptions of two process theory.

### **2.3 Encoding Specificity Theory (Tulving & Donald, 1973)**

Encoding specificity theory provides a framework for understanding how the conditions present while encoding information relate to memory and recall of that information. Memory researchers, Thomson and Tulving (1973) contended that when the conditions at the time of encoding match the conditions at the time of retrieval, recall is most effective. The physical location or surroundings, as well as the mental or physical state of the individual at the time of encoding are examples of matching conditions of encoding and recall. This principle plays a significant role in both the concept of context-dependent memory and the concept of state-dependent memory. Performing an activity in the place of practice and with familiar faces increases the chances of higher performance than in strange environment with unfamiliar faces. This is a good argument for encoding specific theory.

Another example could correspond to the state an individual is in at the time of encoding; studies show that a person who is intoxicated at the time of encoding has better time retrieving information if later the person is also intoxicated at the time of retrieval (Thomson & Tulving, 1973). State can also refer to the emotional state the individual is in at the time of encoding and at the time of retrieval; if these states match, the individual is more likely to recall the encoded information.

### **2.4 Ageing and Memory**

Brain changes occur throughout life, although new neurons are formed each time the capacity of the human brain is not static. It peaks in young adulthood (20-30yrs) and gradually wanes through middle life to old age in size and capacity develop throughout our lives. For instance, experts have discovered that blood flow to the brain also decreases over time as age increases. However, the good news is that many studies have shown that the brain remains capable of re-growth and of learning and retaining new facts and skills throughout life, especially for people who get regular exercise and frequent intellectual stimulation (Gotoh, 2012; Brédart & Barsics, 2012). Salthouse's (2006) study which explored mental exercise and mental aging also validated the claim for brain re-growth and improvement of learning and memory behaviour. Particularly, the author emphasized "use it or lose it" hypothesis as mental solution for improving learning and memory behaviour. Similarly, Stoddard & Wright (2006) explored the long-term effects of cognitive training on everyday functional outcomes in older adults and found that it is helpful in learning and memory retention and recall.

Meusel, Grady, Ebert and Anderson's (2017) study on brain-behavior relationships in source memory and effects of age and memory ability found specifically that there is considerable evidence for age-related decrements in source memory retrieval, but the literature on the neural correlates of these impairments is mixed. Their study used functional magnetic resonance imaging to examine source

memory retrieval-related brain activity, and the monotonic relationship between retrieval-related brain activity and source memory accuracy, as a function of both healthy aging (younger *vs* older) and memory ability within the older adult group (Hi-Old *vs* Lo-Old). Participants studied lists of word pairs, half visually, half aurally; these were re-presented visually in a scanned test phase and participants indicated if the pair was 'seen' or 'heard' in the study phase. The Lo-Old, but not the Hi-Old, showed source memory performance decrements compared to the Young. During retrieval of source memories, younger and older adults engaged lateral and medial prefrontal cortex (PFC) and medial posterior parietal (and occipital) cortices. From their findings, it was revealed that older adults recruit additional brain regions to compensate for age-related decline in source memory, but the specific regions involved differ depending on their episodic memory ability.

Other evidential studies on correlation of age and memory ability can be found in the study by Liederbach and Stelle (2010) on policing a graying population: A study of police contacts with older adults. Their report showed a sharp decrease in recall ability when dealing with older suspect by the police. Also, Brown, Ahalt, Steinman, Kruger and Williams (2014) revealed that older officers on the front line of community geriatric care face age related challenges in memory behaviour.

Despite the tremendous differences among individuals, some cognitive abilities continue to improve well into older age, some are constant, and some decline. Semantic memory continues to improve for many older adults. Semantic memory is the ability to recall concepts and general facts that are not related to specific experiences (McRae & Jones, 2013). For example, understanding the concept that clocks are used to tell time is a simple example of semantic memory. This type of memory also includes vocabulary and knowledge of language. In addition, procedural memory, your memory of how to do things, such as how to tell time by reading the numbers on a clock typically stays the same as some types of memory decline such as episodic memory (Conway, 2009; Tulving, 1984), which captures the "what," "where," and "when" of our daily lives; both episodic and longer term memory decline somewhat over time.

## 2.5 Mental Activity

Brain behaviour is generally accepted to decline with age as posited above, however, it has also been proven that certain mental activities also improve the capacity of the brain across all ages (Meusel, Grady, Ebert & Anderson, 2017). Also, Salthouse (2006) and; Stoddard & Wright (2006) contended that mental exercise is helpful in improving memory recall. They stressed the long-term effects of cognitive training on everyday functional outcomes especially in older adults.

Meusel, Grady, Ebert and Anderson's (2017) study showed that the control and experimental groups differed in how brain activity related to source memory accuracy in dorsal anterior cingulate cortex, precuneus/cuneus, and the inferior parietal cortex; in each of these areas, greater activity was associated with poorer accuracy in the Young, but with higher accuracy in the Hi-Old (anterior cingulate and precuneus/cuneus) and

Lo-Old (inferior parietal lobe). Follow-up pair-wise group interaction analyses revealed that greater activity in right para-hippocampal gyrus was associated with better source memory in the Hi-Old, but not in the Lo-Old. The finding is a confirmation that mental activity may equally improve the brain capacity especially as regards recognition and recall.

## **2.6 Implications of the Study**

Healthy cognitive ability is critical success factor in the workplace. Most cognitive process stem from brain behaviour which may influence other behavioural outcomes directly and indirectly. Brain behaviour (such as memory recall) may also be influenced by other human related factors such as age and mental activity. Without cognitive harmony of what the brains does, effectiveness in the workplace will remain elusive.

Unlike the human mind, the human brain is dependent upon psychological and physiological changes which may influence its behavioural functioning. These psychological and physiological changes varies from individual to individual and is the major reason for individual subjective outcomes depending upon environmental and other circumstantial factors which prelude the particular situation.

For the security personnel, to be up in their game, higher levels of episodic memory capacity is important to enable them capture the what," "where," and "when" of events in the field of work. However, this important type of memory decreases with age implying that personnel policy should see younger officers in departments critical for analyzing spontaneous security tasks to keep a pace with wave of crime whereas older officers with likely higher levels of semantic and procedural memory may be required to be deployed to think-tank departments where their understanding of interwoven concepts may be utilized.

There is also need to enhance the brain capacity of officers through cognitive activities and other mental exercises. Through training and re-training of officers and daily practice of cognitive activities and mental exercises which improve the mental alertness and memory ability of officers, government should ensure that officers understand the relationship among these concepts and how they may improve workplace performance. This should also reflect in the recruitment policies which need to be based on higher intelligence quotient (IQ) and integrity. The security personnel reform should also understand that officers with head injuries which hamper memory recall need not to continue on the job as it retards effectiveness.

## **2.7 Limitations**

Individual differences make it difficult to ascertain the actual relationship among the concepts and subjective factors may likely be a determining factor within observed course of difference. Another important factor which also limits these theoretical assumptions is environmental factors. Although, it was described by encoding specificity theory, it is difficult to totally control its influence in moderating brain behaviour at a given circumstances.

The current study is based on theoretical assumptions that decrease in mental ability or brain behaviour such as observed difference in memory recall between the old adult and the young adult may be as a result of physiological changes in the brain which comes with age. Also, the theoretical relationship between cognitive exercises (mental activity) is based on the assumption that ageing or dormant brain cells may be stimulated by neural impulse which comes with cognitive activity and thus may help to improve on the brain capacity such as increased memory recall capacity.

### **3. Recommendations**

Considering the importance of mental process in human activities, it is recommended that positive valences which improve mental wellbeing and brain behavior be applied in the workplace to improve the quality of human output. There is need to consider both neural changes during encoding and retrieval process across the young and old to observe if there are evidential changes. Such experiments may also be replicated among a sample taking cognitive exercise aimed at improving memory recall. There is need also, to consider if there are racial and cultural differences pertaining to the possible changes.

### **4. Conclusion**

Memory recall is a critical aspect of brain behaviour which is important for daily living and executing job tasks in the workplace. What the brains does is related to human behaviour because the brain gives sense to other behavioural outcomes. Responsive memory recalling is critical for personnel in the Nigerian Federal Ministry of Interior which are charged with the responsibility of maintaining internal security. However, without taking cognizance of the effects which ageing factor and mental exercise may have in memory recall, challenges of lower levels of memory recalling may prevail. The importance of this has spurred the search for theoretical correlation among age, mental activity and memory. Literature reviewed theoretically and empirically, showed that there may be factors which influence brain behaviour such as memory recall. Some of those factors are age and mental activity. Literature confirmed that decreasing age implicates lower levels of episodic memory with higher levels of semantic memory; although, procedural memory may remain fairly stable. These differences may account for critical performance indices in effectiveness across most security outfits in Nigeria as there is no current effort which has emphasized its importance in the work setting.

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