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Memorization Activity and use of Reinforcement in Learning: Content Analysis from Neuroscience and Islamic Perspectives

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Abstract: The field of neuroscience focuses on the nervous system. Activities of neurons, primary cells of the system, are responsible for all human behavior, e.g., physical activities (such as movements) and complex mental activities (such as planning). These brain functions that neuroscience researches of different approaches have totally entrusted to the neurons are considered from the Islamic perspective as activities traversing across diverse issues, including matters pertaining to religious responsibilities of a Muslim. The current constraints due to compartmentalization of knowledge could lead to confusion and/or conflicts among students, educators and the Muslim community from the various conventional science streams. In addition, individuals with Islamic studies background have different understanding and usage of terms which are commonly difficult to explain to those educated in the conventional science stream. Non-comprehensive understanding of the two parties on specific issues could result in a clash of views, thus, leading to any arising problematic issues being unsuccessfully addressed. This study focused on the learning process, a general acquisition process for new information, behavior and/or capabilities and consequent processing by the nervous system. Through content analysis approach, systematically collected information of memorization activities and the use of reinforcements; two activities associated to the process of formal learning, was looked at from the perspectives of neuroscience and Islam. Memorization of al-Quran, a practice commonly implemented in Islamic studies education, was also focused on. Findings show that although from both neuroscience and Islamic perspectives memorization and the use of rewards have similar features, significant differences were also noted.

Key words: Neuroscience, islamic perspective, learning, memorization, reinforcement

INTRODUCTION

Neuroscience is a multidisciplinary field of research focusing on the nervous system; related to central nervous system (brain and spinal cord) and/or peripheral nervous system (cranial and spinal nerves) (Kandel *et al.*, 2005). Further specialization of the field, includes behavioral science, developmental neurobiology, neurophysiology and others. The term 'neuro' is derived from the term 'neurons', referring to the main cells of the nervous system which process and interpret impulses received and, consequently, produce an appropriate response. Integration of neuronal activities enables the brain to interpret sensory stimuli (e.g., auditory, visual, smell, touch sensation and taste) and respond accordingly. The integration of specific information with others received simultaneously or previous ones already kept as memories and also influenced by emotion will consequently generate individualized responses.

Functions of brain that are generated by neurons traverse different issues when viewed from Islamic perspective (Hasan Adli *et al.*, 2003). Constraints due to separation/ segregation of academic specialization result in confusion and/or conflicts among Muslim individuals in various fields of conventional sciences, including those in the education field. Individuals with Islamic studies background commonly understanding and have use of terms which are difficult to explain to those who are educated in conventional science stream, such as neuroscience. Non-comprehensive understanding of related issues could potentially cause misunderstandings and clashes in public opinions. One of such issues is learning; a process of acquiring new information, behavior, capability and is directly related to formation and accessibility of memories. Researches on learning often deal with the study of human behavior, including behavior modification through the use of rewards. Two activities, which could be associated with formal learning

processes, are memorization activities and the use of rewards to reinforce learning process. The concept of learning or seeking knowledge is also important in the Islamic tradition, e.g., “hafazan” (memorization) of al-Quran.

However, without establishment of systematic organized relevant information from both neuroscience and Islam perspectives, a comprehensive understanding of the matters involved will not be achieved.

MATERIALS AND METHODS

Through content analysis approach, systematically gathered information on memorization and use of reinforcements from the perspectives of conventional science and Islam were looked at. Various sources of existing established outputs of neuroscience researches, including behavioral science and educational psychology, were studied. As for the views from the Islamic perspective, information was gathered from various sources of Islamic tradition, e.g., al-Quran, Hadith and the writings of Islamic scholars. Based on the information gathered, analysis was done by looking at the differences and/or similarities of memorization activities and use of reinforcements from both perspectives. Focus was also given to memorization of al-Quran, a practice commonly implemented in Islamic studies education.

RESULTS AND DISCUSSION

Learning from neuroscience perspective: Human go through the process of formal and informal learning to form simple behaviors (e.g., making movements) and complex behaviors (e.g., planning) (Kandel *et al.*, 2005). In a formal setting, learning is said to have occurred when there is a change in behavior resulting from the involvement of students through an educational experience. Successful learning process leads to changes in the brain and reflected as appropriate behavior produced based on relevant memories being accessed. A change in the behavior of individuals is also generated by the events of the environment; conscious and unconscious acceptance of environmental stimuli. Thus, both individual's emotional status and environment during the learning process are important factors to induce behavioral changes (Nicholls, 2002) with the hormones of the endocrine system influencing the behavior, including those related to learning (Kandel *et al.*, 2005). Hence, a more comprehensive understanding of the learning process will assist educators in adjusting environment to maximize learning by students. Learning-based experiences (experiential

learning) suggested a variety of approaches, e.g., learning modules in the form of practical learning through laboratory work, practice, training in industry and various types of small groups teaching (Ayob, 2005).

Various research types contributed important information on how learning process occurs; from cellular level (e.g., electrochemical process of neuronal synapses) to behavioral level (e.g., influence of emotions). Whole brain is known to be involved in learning activities, processing information in various ways, e.g., analyzing, comparing, differentiating, synthesizing and evaluating, but having unique strategy, which distinguishes it from other individuals.

Various theories explaining the learning process take into account the involvement of both structure and function of the brain. Three theories of learning often referred to are Behaviorism, Constructivism and Cognitivism.

Memorization: From behavioral perspective memorization process involves the learning process, itself, and the ability to produce behavior that reflects the imitation of the learned information. Thus, being able to access the memory of whatever has been learned reflects the success of a memorization process. Therefore, memorization involves a learning process, the process of memory formation, memory storage, accessing the memory and producing behavior reflecting the memory. The three stages of memory are registering, storage and recall (Schunk, 2007). The registering level is when the sensory input is changed into a form, which can be processed by the nervous system, and the experience is changed to codes that can be registered by the memory system. Thus, if the brain does not register experiences received through the senses, the experience will be lost. The information must then be stored properly to enable recollection when needed. The left brain has been associated to the process of language learning, mathematics, logical thinking, analytical, linear and memorization, while the right brain with reconstruction, control of creative activities, rhythm, music, visuals, colors, pictures and thoughts that can describe metaphorical analogy and pattern (De Porter and Hernacki, 2002). During recollection stage the stored memory is recalled to help individuals resolve the situation encountered.

In terms of memory retention duration, there are Short-Term Memory (STM) and Long-Term Memory (LTM) (Schunk, 2007). STM has limited capacity, few seconds retention duration, existing at a semi-conscious level and can be transformed into LTM through memorization process. As for LTM, it has an unlimited capacity and is a permanent memory storage

facility, which could be accessed later. Four types of LTM are episodic, semantic, visual and procedural (Kandel *et al.*, 2005). Episodic memory is stored as meaningful event to a person (e.g., the first time when an incident occurred); semantic memory is stored as words, concepts and meaning while information of visual memory is coded in the form of photos, images and scenery. Storage of procedural memory is in the form of sequences of events.

Reward: Behaviorist approach: The use of rewards to facilitate the learning process is one of the most debated and researched on topics by psychologists and educationists, especially its association to emotion (Schunk, 2007). Psychologists such as Watson, Pavlov, Thorndike and Skinner are proponents of the Behaviorist Approach (Schunk, 2007). Watson established the original principle of this approach, which explicitly rejected involvement of internal elements in behavior changes, but believed that manipulating external elements could influence behavior. Subsequently, his ideas were further developed by the others: Pavlov’s infamous experiment of Classic Conditioning that an organism can be taught to respond to a given stimulus followed by Thorndike’s Operant Conditioning Theory that proposed learning could be shaped by rewards and fines. Finally, Skinner introduced measurements on the influence of rewards and penalty on responses of the learning process. According to him, Operant Conditioning consists of reinforcement and punishment penalty concepts which influence the learning process; the former being classified into positive and negative reinforcements (Table 1). All these theories are characterized under the radical behaviorism paradigm.

Kandel *et al.* (2005) introduced the concept of limbic system being responsible for the affective/emotional

aspects of behavior, especially responses to fear and anger. The execution of its influence is carried out by the hypothalamus of the endocrine system. The limbic system comprises structures located in the middle of the two cerebral hemispheres, including hippocampus and amygdala which are adjacent to each other. Both structures are involved in memory formation. Damage to either of them will result in the inability to form new memories, thus, consequently blocking LTM formation.

Learning from Islamic Perspective: In the Arabic language, learning is referred to as “dirasah” (from the word “darasa”) or “ta’allum” (from the word “allama”) (Al-Ayyid and Abduh, 1989). The learning process had been very much part of the prophethood of Muhammad (peace be upon him). The first wahyu (divine revelation) received by Prophet Muhammad is an important milestone in the history of Islam because it signaled that Allah has enthroned Prophet Muhammad as His Messenger (Abdullah *et al.*, 2005). Wahyu is a form of highest level source of knowledge revealed by Allah in several ways, e.g., through the angel Gabriel, dreams, inspiration and direct communication (Abdullah *et al.*, 2005).

After the death of Prophet Muhammad, the Caliph Rashidun and other Companions of the Prophet developed education environment based on al-Quran and Hadith, encouraging academic pursuits in various fields of knowledge. The group lead by Caliph Rashidun travelled to all corners of the world. Later, during the reign of King Mamalik (655H-923H), various disciplines were established, e.g., Tafsir, Hadith, Fiqh, Biography, Medical Knowledge, Astronomy, Mathematics, al-Jabr (algebra), Chemistry and Science.

Many Islamic educational institutions (madrasahs) were established, e.g., Nizamiah Madrasah of East Baghdad, one of the not less than 32 madrasah at the time. Books authored by prominent Muslims were sources of reference to Western academia, e.g., Muqaddimah, a book by Abdul Rahman Ibn Khaldun.

Importance of knowledge is emphasized through Allah’s first revelation to Prophet Muhammad, a 40 years old ummi (an illiterate) who was taught by the angel Gabriel. Knowledge and teaching and learning activities made up the theme of the first revealed *surah* (chapter) of al-Quran: Surah al-‘Alaq (Al-Quran al-Karim, verse 1-5): "Proclaim! (or read!) in the name of thy Lord and Cherisher, Who created (1). Created man, out of a (mere) clot of congealed blood (2). Proclaim! (or read!) And thy Lord is Most Bountiful (3). He Who taught (the use of) the pen (4). Taught man that which he knew not (5)" (Yusuf Ali, 2007a). Other than being mentioned in al-Quran, there are also Hadith with the same theme as the one narrated by Ibn Majah (Al-Qazwini, 2000a):

Table 1: The behaviorist approach

Reinforcement		
Positive	Negative	Punishment
Stimulus that increases the probability of a behavior to occur	Stimulus that creates hurtful condition or discomfort, but it can be avoided if a specific behavior is to occur; increases probability of behavior to be repeated to prevent or reduce the negative situation.	Stimulus that causes the probability of a behavior to be decreased or stopped
Students who answer questions (behavior) and are praised by the teacher (positive reinforcement) will repeat behavior with hope of getting more praises	Students will hand in assignment on time (behavior) to avoid scaling by the teacher (negative reinforcement).	Students who disturb others (behavior) are made to sit alone at a corner (Penalty)

Anas bin Malik reported that the Messenger said, "Seeking knowledge is obligation of every Muslim". In Islam those seeking knowledge and those passing on knowledge ('teachers') are praised and regarded with honor.

Hafazan (Memorization of al-Quran): The Arabic term of "hafaza" refers to the process of maintaining the control of 'knowledge' from being lost, thus establishing it as memory, e.g., a person can recite verses of al-Quran based on memory alone, without seeing the text (Al-Ayyid and Abduh, 1989). "Hafiz" of al-Quran is one who commits the verses of the whole al-Quran to his memory. Thus, "hafazan" means preserve, remember, care, control that what has been learned will not be damaged and lost and is commonly used when referring specifically to the memorization of al-Quran.

Activity of memorization of al-Quran began when the first revelation was taught to Prophet Muhammad (Abdullah *et al.*, 2005). From then onwards Prophet Muhammad, the first hafiz (memorizer) of al-Quran, received more verses of al-Quran in stages mostly through the angel Gabriel. It was a tradition that Prophet Muhammad would recite al-Quran aloud with the angel Gabriel listening and correcting his mistakes every night in the fasting month of Ramadhan (Al-Bukhari, 2000a). This face-to-face Islamic tradition learning activity is referred to as "talaqi". Worried that he might lose the verses, Prophet Muhammad at times did his recitation hurriedly. However, he conducted his memorization at a more reasonable pace after the revelation of Surah al-Qiyamah (verses 16-19) (Al-Quran al-Karim): "Move not your tongue in haste, (repeating the words of the revelation (16). For, behold, it is for Us to gather it (in you) and to cause it to be read (as it ought to be read]) (17). Thus, when We recite it, follow thou its wording (with all thy mind): When We have finished reading it, then follow that reading (18). And then, behold, it will be for Us to make its meaning clear (19)" (Yusuf Ali, 2007b). These verses also referred to relationship of learning and memory.

During the life of Prophet Muhammad, his companions 'received' al-Quran directly from him. They heard verses repeatedly from Prophet Muhammad during 'learning sessions' held, prayers, his sermons and even during daily activities when he recited certain verses in relation to specific situations (Al-Qattan, 1987). Individuals who learned the verses directly from Prophet Muhammad are known as "al-Aqra" or "those who have more" (Yusoff *et al.*, 2006). Among them are Uthman Affan, Ali Abi Talib, Ubay Ka'ab, Abu Darda, Abu Musa al-Asy'aari, Abdullah Mas'ud, Zayd Thabit

(Al-Zarqani, 1988). To improve their memorization of al-Quran, Prophet Muhammad often ordered them to recite al-Quran in front of him so as to correct them if necessary. Uthman Affan was the first companion to recite in front of him (Al-Dhahabi, 1988). After Prophet Muhammad's death, his companions play the roles as teachers to the generation of "Tabi'in" or "those who learned from the Prophet Muhammad's companions".

From the time of the Tabi'in and onwards, the establishment of study centers such as *madrasahs* (Islamic schools/ colleges) paralleled the expansion of Islam throughout the world. The system of learning al-Quran as practiced by Prophet Muhammad was established in many places. Famous learned Tabi'in in Medina included Sa'id Al-Musayyib, Urwah, Salim, Umar ibn Abd al Aziz and Muaz al-Harith; while Ata' Mujahid, Tawus, Ikrimah, Mulaykah and Ibn Abi Ubaid Umair were in Mecca (Al-Zarqani, 1988).

Systematic organized activities of memorization of al-Quran in non-middle eastern countries, e.g., in Malaysia, developed with the establishment of maahad tahfiz (institutions dedicated to memorization of al-Quran). In Malaysia, the earliest was established in 1966 on the recommendations of the first Prime Minister of Malaysia, Tunku Abdul Rahman Putra Al-Haj (Abdullah *et al.*, 2005). At present many maahad tahfiz have been established to provide opportunities to learn hafazan. In fact, hafazan of al-Quran as a subject in the academic program have been implemented in some conventional schools. This effort is to preserve memorization of al-Quran among the Muslim community.

Reward: Prophet Muhammad had employed the concept of "rewards" (positive reinforcements) and "threats" (punishment or negative reinforcements) in his teachings so as to strengthen the belief of Muslims in the various principles of Islam and to deter them from the forbidden (Najat, 2008). In a hadith narrated by Syaikh, Tirmidzi and Nashif (Al-Bukhari, 2000b) heaven is promised as positive rewards if one wants to believe in Allah/ become Muslim, even though he had committed sins or bad acts: Abu Dzarr R.A. reported that the Messenger said, "Gabriel came to me, then he informed me of the happy news that anyone who leaves the world without associating anything with Allah, then that person will enter heaven. I asked, "Even if the person has committed adultery or stealing?" Gabriel replied, "Even if the person has committed adultery or stealing." I asked again, "Even if the person has committed adultery or stealing?" Gabriel replied, "Even if the person has committed adultery or stealing." Then on the fourth time Rasulullah said, "Solowly is Abu Dzarr (since he repeatedly denied my

words)." Prophet Muhammad relayed such promises at the beginning of Islam as a means to persuade those in the community to become Muslims. Similarly in another hadith which was narrated by Imam Muslim (Al-Qushairi, 2000): Jabir reported that a man met Prophet Muhammad and he asked, "Messenger of Allah, what two things are considered as requirements?" Prophet Muhammad answered, "Whoever dies without associating Allah with anything else, he will enter the heaven. Whoever associates anything with Allah, then he will enter hell".

Prophet Muhammad's persuasion to Islam was not only focused on matters relating to the hereafter, but also practical daily matters, e.g., emphasizing the importance of gift or payment as a motivation for good works as in a hadith narrated by Ibn Majah (Al-Qazwini, 2000b): "Give payment to an employee before his sweats dried up." Provision of reward to a person who has completed his duties can motivate enthusiasm and being earnest in improving the quality of one's work (Najat, 2008).

A study on the application of rewards module from al-Quran in the formation of personality of youths committed to a school for juvenile delinquency had been reported (Yusoff *et al.*, 2006). It appeared that the module of "Tabsyir and Indhar" was mostly mentioned in al-Quran. In al-Quran, the concept tabsyir a derivative from the word "bashsyara" which means delivery of good news, refers to notification of Allah about rewards due to obedience to Him. Thus, tabsyir could also be interpreted as all positive rewards, including gifts or praises given by teachers in the learning process that can provide motivation to students to succeed. As for indhar, it is a derivative from "andhara" and it means informing with intimidation. The concept of indhar in al-Quran involves all notifications from Allah on punishments due to disobedience to Him (Yusoff *et al.*, 2006). Hence, indhar could also be interpreted as all negative rewards or punishments meted out by a teacher in the learning process, e.g., in the form of fines, for the purpose of intimidating and to provide awareness or reasons for the students to change for the better. In addition, Islamic scholars such as Imam al-Ghazali, Ibn Khaldun and Ibn Jama'ah supported the concept of tabsyir and indhar on educating the children. Others have described guidelines for educating children, e.g., giving fines and penalties (Ulwan, 2006). Other aspects related to the reinforcement of learning in Islamic education include relevance of correct intention (niat) and sincerity, the right etiquette prior-during-after each learning session, and supportive practices (e.g., prayers (doa) practiced before the start of learning sessions).

Similarities and differences from neuroscience and islamic perspectives:

There are some similarities from both perspectives in relation to memorization and the use of reinforcement (Table 2). Both neuroscience and Islam put special emphasis on learning and its related activities. Learning is accepted as an important behavior associated to human mind and related to other cognitive functions, e.g., planning, which is executed based on learned information stored as memories.

Neurobiological researches elucidate mechanisms of memorization, an activity very important to the learning of al-Quran. Similar related activities of memorization are being encouraged, e.g., the basic act of repeating information of interest. This is known as "takrir" in the memorization of al-Quran and the neural basis of this act is to strengthen the interneuron synapses. The act of

Table 2: Similarities and differences from neuroscience and Islamic perspectives

Comperison	Neuroscience	Islam
Similarities		
Memorization	Repeats of information of interest. Involve visual, vocal sound/motor, auditory and feedback	Takrir (repeating many times) is basic activity of memorization of al-Quran. Talaqi and tasmi of al-Quran involve visual, vocal sound/ motor, auditory and feedback.
Rewards	Use of rewards (behavior operant conditioning) as reinforcement in the learning process. Rewards involve sensory and/or emotional stimuli.	Use of rewards is based on targhib and tarhib approach. Use of sensory and/or emotional stimuli as rewards, as long as it is not forbidden in Islam.
Differences		
Memorization	No emphasis on etiquette. No mention of specific time during the day being considered as suitable for memorization activities. encouraged for memorization of al-Quran activities, e.g., before Subah prayer. Practices of dob, zikr, special prayers (e.g., solat hifzi), selected chapters from al-Quran to improve Memorization.	Emphasis on specific etiquette prior to-during -after session of memorization of al-Quran. Specific time
Rewards	Limbic structures of the brain are involved in emotion and also memory formation. Rewards include gifts, praises, scolding, criticisms and punishments. promise of ajr and sins with relevance to heaven and hell in the hereafter.	No organ system is directly referred to in this context. In addition to gifts, praises, scolding, criticisms, punishment as rewards, there are also

verbal repetition facilitates the formation of memory, due to the activation of motor pathways and the integration of additional information processed by the auditory system. Thus, the tradition of Prophet Muhammad reciting out verses of al-Quran to his companions or to the angel Gabriel could also produce the same effect. Getting feedback from others especially those who have the capability to suggest corrections has been established as good strategy of converting STM to LTM. Understanding the meaning of information of interest is also emphasized in memorizing al-Quran. Mastering the Arabic language, thus, understanding the chronology and 'story line' of the verses making up the chapters in al-Quran would assist in memorization. From the perspective of neuroscience, committing information this way involved both the semantic memory and the procedural memory.

Long before the proposed Behaviorist Approach based on experiments on animals, Islam has acknowledged that animals, e.g., dogs and eagles, could be taught to hunt and these learned behavior could be kept as memories by these non-human species as mentioned in Surah al-Ma'idah (verse 4) (Al-Quran al-Karim): "They ask thee what is lawful to them (as food). Say: lawful unto you are (all) things good and pure: and what you have taught your trained hunting animals (to catch) in the manner directed to you by Allah. Eat what they catch for you, but pronounce the name of Allah over it: and fear Allah. For Allah is swift in taking account" (Yusuf Ali, 2007c). It is worth noting that Islamic scholars such as Ibn Sina and al-Ghazali warned the Muslim community not to totally accept the Behaviorist Approach fearing it could be 'dakyah' (propagation of ideas against Islamic teachings) by the proponents of this concept who were mostly atheists. Muslim educators are urged to also give consideration to internal elements besides Behaviorist Approach.

From the aspect of using reward in the learning process, current education systems all around the world adopted established conventional ideas with some modifications. Teachers normally handled the management of class by applying these theories of behavioral science, a branch of neuroscience. The use of rewards in learning cannot be dissociated from its impact on students. From the Islamic perspective, more emphasis is given to internal nature of a human and Islamic etiquettes/ traditions, e.g. *doa*/ personal prayer, ablution before starting hafazan of al-Quran session, facing towards Qiblah (al-Haram Mosque) and respectful of the teachers. There are also the concepts of Jannah (heaven)

and Nar (hell) which are associated with positive rewards and punishments, respectively.

Each has features which enhanced its positive or negative values. Human instinct to seek pleasure and to avoid unpleasantness will be a motivating factor inducing a Muslim to behave accordingly, although both heaven and hell are part of the hereafter. Belief that forgiveness will be given if it is asked sincerely and earnestly can also function as a negative reinforcement, since it can reduce guilt and depression. Conventional psychology supports that punishment has less impact than reinforcement (Ormrod, 2007). This is not a foreign concept in Islam as similar principle can be found in a Hadith Qudsi (sayings of Prophet Muhammad on non-Quranic words of God) (Al-Bukhari, 2000c), "When Allah decided on Creation, God promised to record in His book that he has set: My blessings winning over My wrath." Along this same concept, a Muslim is promised ten ajr (positive rewards) by doing a good deed but will only get one sin (negative reward) for committing a bad deed and a Muslim who has the intention to do good deeds will already be positively rewarded with a record of the intention, but only when a Muslim commits a bad deed that he is considered as having been sinned. The concept of emphasizing al-Tarhib (inducing good feelings) before al-Tarhib (intimidating) especially when teaching something new, is consistent with conventional concepts.

Although there are similarities of features related to memorization and the use of rewards from the perspectives of conventional science and Islam, there are also differences as illustrated in Table 2, e.g., the Islamic etiquette of getting oneself ready, especially, prior to, during and after each session of memorization of al-Quran has no specific behavioral analogy.

Probably, in performing these acts one could be preparing the brain to be in a more focus state to receive the learned knowledge and then forming it into memories. As for the aspect of the use of rewards, in Islam some of the rewards are not tangible, e.g., in the form of sins (negative rewards) and ajr (positive rewards) which are promised and to be expressed its relevancy in the hereafter. Also rewards must always be within the realms of what is permissible in Islam.

CONCLUSION

Memorization activities and use of rewards in learning processes have similar features in both neuroscience and Islamic perspectives, but some differences also exist. Future studies should detail out issues pointed out in this study.

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