HEAT MAPS AND SCAN PATHS: QUALITATIVE EYE-TRACKING EVIDENCE ON HOW THE QUR’AN IS MEMORIZED THROUGH READING

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ABSTRACT

The process of memorizing the Qur’an typically takes place through reading its printed version (mus’haf). The Qur’an is read word by word so that the process of recalling the memorized verses or chapters is done accurately and fluently. Memorizing the Qur’an may be a great challenge to non-Arabic speakers because of their lack of knowledge in the Arabic vocabulary and grammar; yet more and more non-Arabic speakers continue to memorize the Qur’an for various reasons. In order to scientifically investigate how non-Arabic speakers memorize the Qur’an, a reading experiment was conducted to achieve this aim. Sixty-four (21 Male, 43 Female) native speakers of Malay who have memorized a portion of the Qur’an (10 juzu’ and below) participated in this experiment. Using the Tobii TX300 eye-tracking machine,
participants’ eye movements, as they read to memorize four verses of the Qur’an (two with and two without Malay translations), were tracked, and their gaze plots were analysed qualitatively (via heat maps and scan paths). Results show evidence that Malay non-Arabic speakers’ act of reading the Qur’an to memorize it went beyond what is usually known as “cramming”; instead, the process involved finding the meaning of unknown words, so that the process of recalling the memorized verses can be done accurately and fluently.

**Keywords:** Cognitive processes, eye movements, memorization, psycholinguistics, Qur’an


**1.0 INTRODUCTION**

The Qur’an is guarded from any forms of modification, distortion, or loss since the day of the first revelation some 1,400 years ago through the preservation of the Qur’an in the hearts of men and women. Hence, the name *huffaz* (literally, “the guardians”) is given to those who have memorized all the 6,236 verses (around 80,000 words) verbatim, in the right sequence. The process of memorizing the Qur’an typically takes place through reading its printed version (*mus’haf*). During the process of memorizing the Qur’an, the Qur’an is usually read word by word so that the process of recalling the memorized verses, or chapters, is done accurately and fluently.

All Muslims are encouraged to memorize the words of The Creator; hence Qur’anic memorization is not exclusively for Arabic speakers. Since the act of memorizing the Qur’an is also inclusive of non-Arabic speakers, not being an Arabic speaker should not be an excuse for not memorizing the words of the All-Mighty. Although memorizing the Qur’an may be a great challenge to non-Arabic speakers due to their lack of knowledge in Arabic vocabulary and grammar, the number of non-Arabic speakers who memorize the Qur’an worldwide increases day by day. One of the motivating factors that encourages non-Arabic speakers to memorize the Qur’an can be found in a hadith. A’a-ibah (r.a.) reported that the Prophet Muhammad (s.a.w.) said:
The likeness of the one who reads the Qur’an and memorizes it is that he is with the righteous honourable scribes. The likeness of the one who reads it and tries hard to memorize it even though it is difficult for him, he will have (at least) a double reward (Al-Asqalani, 1988).

The common practice for non-Arabic speakers in Malaysia to become a hafiz (for singular male) and hafiza (for singular female) is through the tahfiz schools. School-going age children are sent to these schools, in which Arabic is taught formally as a subject, and in some cases, is used as the medium of instruction for religious subjects. Hence, those who memorize the Qur’an at tahfiz schools are typically those who have some knowledge of the Arabic language.

The strategies of teaching students how to memorize the Qur’an that have been identified in Malaysian tahfiz schools are mentioned in Ariffin et al. (2013) and Hashim, Tamuri, and Jemali (2013). Ariffin et al. (2013) for example, found four methods (i.e., Sabak, Para Sabak, Ammokhtar, and Halaqah Dauri) that are being used in the process of getting the students to memorize the Qur’an. Hashim et al. (2013) on the other hand, found that in some Malaysian tahfiz schools, the tahfiz teaching and learning framework proposed by al-Qabisi in the year 1955 has been adopted. The framework involves talqin (teach), tikrar (drill), al-mail (love for the Qur’an), and al-fahm (understand). These techniques are perhaps suitable for learning how to memorize the Qur’an in the context of a classroom. How then should those who are not tahfiz school-goers but have the aspiration to memorize the Qur’an on their own initiatives, at their own pace, and do not have the luxury of being guided by an instructor face-to-face in their process of memorizing the Qur’an, memorize the Qur’an?

2.0 QURANIC MEMORIZATION IS PSYCHOLINGUISTIC IN NATURE

Memorizing is a psychological activity. It is a process of committing something to memory. Linguistically, the word “memorize” derives from the root word “memory” to refer to “the psychological function of preserving information, involving the processes of encoding, storing, and retrieval” (Colman, 2009, p. 451). The suffix “-ize” that is added to the root “memory” suggests the idea of making “the process of retaining and recalling past experience possible” (Salehuddin, 2018, p. 126). This word comes from the Latin word memoria, from memor, which means mindful. Hence, the fact that the verses of the Qur’an are linguistic in nature makes the act of memorizing the Qur’an a psycholinguistic process.

The first scientific study on memory was carried out by Hermann Ebbinghaus in 1850 on memorizing nonsense syllables (Lieberman, 2012). In this experiment, participants were
asked to memorize words that carry no meaning to them (semantically not significant), and his findings show that forgetting (i.e., deterioration of learned items) takes place with the passage of time. Ever since the study conducted by Ebbinghaus, there have been many more studies conducted on memory, including those on memorizing items that are linguistically (usually semantically) meaningful to the participants (e.g., memorizing numbers, objects, and spelling).

The success of memorizing is dependent on an individual’s ability to recall. According to Colman (2009, p. 641), recalling refers to the act or process of “retrieving information from memory spontaneously” either with or without cues. The process of recalling “involves reproduction of the remembered” (Colman 2009, p. 641). When an individual is not able to recall, he or she is said to have “forgotten”.

In memorizing the Qur’an, it can be hypothesized that quite a number of theories of psychology and linguistics can be looked into. They include the following:

1. Chunking for Working Memory (Miller, 1956);
2. Rehearsal / Repetition – Behaviourist Learning Theory (Skinner, 1957);
3. Spatial Contiguity Principle (Mayer, 2001);
4. Temporal Contiguity Principle (Mayer, 2001);
5. Segmenting Principle (Mayer, 2001); and

All these theories can be related to the act of memorizing the Qur’an and this claim can be made based on the strategies used in tafhid schools in Malaysia (Hashim et al., 2013). For example, “repetition” can be related to tikrar (drill), whereas “memorizing with understanding” (Au, 1998), can be related to al-fahm, two of the strategies proposed by al-Qabisi in 1955 (Hashim et al., 2013).

Drilling (or tikrar), is closely related to the Behaviourists’ notion of rehearsing. Rehearsal is the act of repeating or going “over something, usually in order to commit it to memory or to retain it in memory” (Colman, 2009, pp. 647-648). When rehearsal takes place, the individual who is in the process of memorizing usually recalls or enumerates “items repeatedly in order to retain them in short-term memory” (Colman, 2009, p. 438).

Chunking is a psychological process where individual pieces of information are bound together into a meaningful whole (Neath & Surprenant, 2003). A chunk is “a familiar collection of more elementary units that have been inter-associated and stored in memory repeatedly and act as a coherent, integrated group when retrieved” (Tulving & Craik, 2000, p. 33). According
to Colman (2009), chunking helps to overcome the limitation of short-term memory as the grouping of information enables information to be processed cognitively as a single entry. The $7 \pm 2$ items then would mean $7 \pm 2$ chunks. The size of a chunk however, is said to be different based on language and culture; each chunk has a strong association within its member, but weak associations with other chunks (Gobet et al., 2001). From the description of chunking above, it can be said that chunking is closely related to one of Mayer’s (2001) 12 Principles of Multimedia Learning, i.e., Segmenting Principle, where humans learn better in user-paced segments rather than as a continuous unit.

Apart from Segmenting Principle, Mayer’s (2001) two other Principles of Multimedia Learning can also be applied to memorizing the Qur’an. For example, studies have shown that humans learn better when corresponding words and pictures are presented near to each other on the same page (Spatial Contiguity Principle), simultaneously (Temporal Contiguity Principle).

Based on the discussion earlier, this study aims to investigate how individuals, who have experience in memorizing some verses of the Qur’an, successfully memorize verses of the Qur’an that they have never memorized before. This was done by qualitatively analyzing the reading pattern of individuals who successfully memorized four selected verses as they read the verses to memorize them through the use of the eye-tracking machine.

### 3.0 METHODOLOGY

To most learners, the memorization of the Qur’an involves the process of reading the mushaf (the printed version) of the Qur’an. Hence, the eye movement patterns can be the window to understanding the cognitive processing of the individuals, when they read, memorize, and recall the verses of the Qur’an. This is because, in performing reading, the eyes make a lot of complex but rather systematic movements called saccades (very rapid ballistic movements), fixations (pauses) and regressions (moving back to earlier text) (Rayner, Pollatsek, Ashby, & Clifton, 2012). Salehuddin and Ho (2014), for example, in an eye-tracking experiment, found that when reading Malay in the Arabic script, readers rarely look at the vowel diacritics. It is interesting to find out what individuals, who are memorizing the Qur’an, look at when they read the Qur’an to memorize the verses. Therefore, an ethical approval (Ethics Committee/IRB Ref No: UKM PPI/111/8/JEP-2016-642) was obtained from the UKM Ethics Committee to investigate the cognitive processes involved in memorizing verses of the Qur’an through the eye movements of the memorizers.
3.1 Participants

Sixty-four individuals (21 Male, 43 Female) participated in this experiment. Their age range was between 10 and 25 years old and all of them have at least memorized the 30th Juzu’ and some selected chapters (e.g., chapters number 36, 67) of the Qur’an. Although all of them have had the experience of going to religious schools, they were not from tahfiz schools. Nevertheless, all of them have had the experience in memorizing a good portion of the Qur’an (i.e., the 30th Juzu’ and some selected chapters) at different stages of their lives, and have the aspiration to continue memorizing the Qur’an.

3.2 Instrument

This is a qualitative study that investigates the heat maps and the scan paths of participants who participated in a memorizing experiment using the Tobii TX300 Eye-Tracking machine (Tobii Technology AB, Sweden). Heat maps and scan paths are two types of representations of eye tracking data (Holmqvist et al., 2011). A heat map refers to “a visualization that uses different colors to show fixation count or duration” (Bergstrom & Schall, 2014, p. 363). A fixation count refers to the number of times the eyes are fixated on an area of interest, whereas a fixation duration refers to the amount of time (usually in milliseconds) the eyes are fixated on an area of interest. Both fixation count and fixation duration enable data collected from eye-tracking experiments to be analysed quantitatively. A heat map gives researchers a “quick, very intuitive, and in some cases objective visual representation of eye-tracking data” (Holmqvist et al., 2011, p. 231). Typically, areas with many and longer fixations are highlighted with warm colors (e.g., red); those that are hardly looked at get a colder color. In other words, color represents the duration and number of fixations.

A scan path refers to “a trace of a participant’s eye-movements in space and time – and its events and representations” (Holmqvist et al., 2011, p. 363). According to Holmqvist et al. (2011) scan path patterns are useful in reading research as the patterns can be used to correlate with the cognitive processes that are involved in reading.

Both heat maps and scan paths present the spatial distribution of eye movement data (for visual inspection) as they provide visual preliminary qualitative information about the position, the duration, and the frequency the participants of an eye-tracking experiment look at in any given stimulus. Unfortunately, both heat maps and scan paths cannot provide information on why participants look at a certain area of interest and not others. Nevertheless, the recording and replaying function available in Tobii TX300 enable participants to look at their gaze plots after participating in an experiment and explain to researchers what actually
happened when they looked at the stimulus. Although heat maps and scan paths do not provide avenue for systematic and statistical comparisons, they can still be used to exemplify, support and nuance quantitative results (e.g., confirmatory examples). Nevertheless, this paper discusses results from the qualitative analyses of heat maps and scan paths as the first step to visualize how the process of memorizing the Qur’an can be studied using the eye-tracking machine.

Four verses of the Qur’an were used as the visual stimuli for this experiment. The four verses of the Qur’an were as follows: Qur’an, 30:51; Qur’an, 15:14; Qur’an, 17:41; and Qur’an, 22:32. All of them have nine words in each of them and where their presentation in the mushaf is concerned, they occupy a single line. Each of the verses has both high and low frequency words (i.e., words that frequently occur in the Qur’an (as high as 2033 times, such as “min”) and words that rarely occur in the Qur’an (e.g., as low as only once, such as “farouahu”) in them. They were all selected based on common knowledge that they are not verses that are frequently recited among the Muslims in the Malaysian context.

Figure 1: The stimuli with both word-for-word and complete translation

Figure 2: The stimuli without any form of translations
To eliminate the order effects, the stimuli were presented in two sets for two different participant groups. The first set consists of two different slides, with two different verses with a word-for-word translation of the respective verse and a complete translation of the verse, underneath the verses (Figure 1). This is to follow Mayer’s (2001) Spatial Contiguity Principle. Following the two slides, two test pages (similar slides with missing words from the verses) were presented and participants were to recall the memorized verses. After the two test pages, participants were presented with the other two verses on different slides, without any forms of translations present on the slide (Figure 2). Following this, two test pages (similar slides with missing words from the verses) were presented and participants were again required to recall the memorized verses. The second stimuli set presented for a different participant group has a different order, in which slides in Figure 2 were shown first and then followed by slides in Figure 1.

### 3.3 Procedure

A call for participation was sent out to various individuals around Malaysia via the email. Out of these, 80 responded and after some filtering, 64 were finally selected to participate in this experiment. The experiment was conducted individually. Participants first read the Information Document Form and then signed the Consent Form and Permission to Use the Data Form. They then answered a questionnaire on “Learning Styles” and another questionnaire on their Memorization Practices; they later took a Vocabulary Test. Once all these were done, the participants participated in the Eye Tracking Experiment.

During the running of the Eye Tracking experiment, participants were first informed that the four verses of the Qur’an would be displayed on the screen, and their task was to memorize each verse. One verse would be presented to them first and once they have memorized the verse, they could proceed to memorizing the second verse. Once the second verse was memorized, they would have to recall the verses they had earlier memorized. The recalling task involved reciting the entire verse. The same procedure was repeated for the other two verses. They were told to use the click of the mouse to navigate from one stimulus to another and were also informed that the presentation of the stimuli was linear in nature, i.e., they could not go back to an earlier screen display. Once they understood the instruction, the participants’ eye movement was calibrated and the experiment took place. The experiment duration vary from one participant to another as no time limit was set; the pace of the experiment was determined by the participants themselves. They were also reminded not to
move their head too much, and that they could read aloud the verses they were memorizing if that was the usual way they memorize the Qur’an.

After each participant had completed their respective experiments, the participants’ respective gaze plots were replayed and a verbal retrospective interview was conducted on the respective participants to seek answers to why certain areas of interest were looked at while others were not. Each participant was then given RM50 for his/her participation, another RM25 for their travel fee, and a Certificate of Participation.

4.0 RESULTS

Out of the 64 sets of heat maps and scan paths, 20 sets were analysed. These 20 sets were the heat maps and scan paths of participants who scored a 100% in the recalling test. Results of the qualitative analysis of the other 44 sets are not presented here as the aim of this paper is to qualitatively describe the eye movement behaviours of successful memorizers as they read to memorize the verses. Overall, the heat maps of the 20 sets show that:

1) Low-frequency words (e.g., ‘faraau-hu’ (1), ‘musfarran’ (3)) received the warmest color (i.e., red) compared to the high-frequency words (e.g., ‘min’ (2023), and ‘bima’ (282));

2) When word-for-word translations were provided, the participants looked at them, especially the meanings of the low-frequency words; the meanings of the high-frequency words were sometimes skipped. Not many looked at the complete translations; and

3) No two participants have an identical heat map.
Figure 3: The heat map of one of the participants reading a verse from *ar-Rum*. The heat map suggests that this participant spent the longest time on the word “faroauhu” and the shortest on “min”. This participant also read the word-for-word translation of some of the words and read the entire translation. However, not much time was focused on these two types of translation.

Overall, the scan paths of the 20 participants show that:

1) The entire verse was first read as a whole before it was broken down into smaller chunks;
2) The smaller chunks were read and reread before moving on to the next chunk;
3) The size of each chunk varies;
4) Some participants toggled from the Arabic verse to the word-for-word translation; some finished the Arabic verse then looked at the word-for-word translation; some read the Arabic verse, then the complete translation, and only later toggled from the Arabic verse to the word-for-word translation; and
5) No two participants have an identical scan path.
Figure 4: The scan paths of all participants for one of the verses tested in this study. The size of each circle gives an idea about the duration of a particular fixation whereas the number in each circle refers to the sequence of the fixation.

Figure 5: A screen capture of a participant’s scan path. It can be seen that the participant actually looked at some of the word-for-word translations of the Arabic words, and also the complete translation of the verse.

The scan paths of the top 20 scorers show a variety of gaze orders and gaze trails. Despite the participants’ individual unique eye movements, there are certain patterns that can be identified from participants’ overall gaze plots. When reading the Arabic verses, participants tended to read the full verse first before chunking the words into several groups. Based on the pattern of participants’ gaze trails, in a verse that consists of nine words, the participants tended to chunk three words together. This, however, depends on the structure of the verse. If the complex verse consists of two simple phrases, participants tended to chunk the words into two groups; the first simple phrase and the second simple phrase. Participants who were presented with the translation of the verse tended to separate the verses into two groups as they might be relying on the Malay translation of the verses to help them in separating the verses. On the other hand, those who were presented with the verse only, tended to chunk the words into three groups.
There were also participants who used chunking for verses without translation in a similar pattern with those who were presented with verses with translations. This might be due to their familiarity with the Arabic verse structure. In one of the retrospective interviews with the participants, it was mentioned that the verses were separated into two groups as it was easier for the participant to memorize the words in each group. The participant later emphasized that the word ‘fa’ (i.e., an Arabic word that serves as a conjunction) in ‘fainnaha’ has helped her to break the verse into smaller groups. The conjunction ‘fa’ in the word ‘fainnaha’ also helped her to recall her memorization of the rest of the verse during the test.

Nonetheless, the size of chunking changes and is not fixed throughout the reading and memorization process. Analysis of the pattern suggests that after a while, the participants reduced the size of the word groups. Only after a few attempts of reading, the chunking pattern got bigger and went back to the size of the earlier groups (i.e., a three-word chunk). In a retrospective interview, one of the participants mentioned that at times, it was harder for her to memorize a bigger group of words, especially when there were words that she was not familiar with, or had difficulty to pronounce. Such conditions explain the reduction in the size of the chunks for certain verses in memorizing them. All these explain the changes in the size of the word groups throughout the time. The chunking size went back to the original size, and the size of chunking got bigger until no chunking was observed in the verse. This happened when the participants were able to memorize the entire verse in one go.

This information also explains why participants kept on repeating their reading several times. For example, when reading the verses, there were instances when participants’ gaze plot stopped at certain words, particularly low frequency words. They then appeared to restart their reading from the beginning. This pattern might be due to the participants’ attempt in trying to get familiar with the order of the words. Moreover, it could also be seen that whenever the participants paused their reading at a low frequency word, they would restart their reading either from a previous word or from the previous two words. Our retrospective interview with one of the participants revealed that the participants actually read the sentence again from the start if he could not pronounce the words correctly; this was done until the pronunciation of the words became “familiar to his tongue”. This supports Lieberman’s (2012) claim that when memorizing difficult words, memorizers try to link the word (usually low frequency words) with words that come before it. This might be the way for the participants to strengthen the order and the association of the words in terms of its pronunciation to help them in memorizing the words and when recalling the words later.

In conditions where participants were presented with the translation of the verse, their
gaze trails suggest their reliance on the word-by-word translation when memorizing certain words. For instance, when reading the final words of each sentence, participants’ gaze trails were seen to be moving repetitively between the Arabic words and their respective translations. A retrospective interview with one of the participants revealed that participants tended to get confused with the final word in a verse. This is because some of the sentences end with almost a similar syllable like ‘yakfurun’, such as ‘ya’malun’ and ‘yafqohun’. Because of this, the participants claimed that knowing the meaning of the word actually helped them to memorize the final word in the verse.

Interestingly, all of the participants read the translation of the first word of each sentence. Our retrospective interview conducted on one of the participants revealed that knowing the meaning of the first word of each verse is very important in helping them to link the first word with the rest of the verse, both when memorizing and recalling the verses.

Besides that, it was found that some participants read the word-by-word translation whereas there were a few of them who read the full translation of the verse. However, for low frequency words, all of the participants read the words’ respective word-by-word translation.

Our analysis also suggests that the focus of participants’ gaze plot varies according to the frequency of the words. The participants’ gaze plot got bigger on low frequency words compared to high frequency words. Note that the participants of this study had already memorized a portion of the Qur’an; hence there were words that they were familiar with and there were also some words that they were not familiar with in terms of their pronunciation. Since they wanted to make sure that the words were correctly pronounced, they made a conscious effort to fully analyze each syllable of the word. This is so because correct pronunciation is one of the important aspects in reciting the Qur’an. In fact, correct pronunciation will ease the process of memorizing and the process of recalling the words. Participants’ bigger gaze plots on the final and the first words also confirms the claims mentioned before (i.e., to avoid confusion of the syllable, to assist them during the recalling process).

The gaze plot also shows that participants tended to look away after reading a few words. A majority of the participants mentioned that it was easier for them to memorize the words when they looked away from the verse or when they closed their eyes. This is in line with one of the effective techniques in memorizing the Qur’an suggested by Mohamad Salmi et al. (2017) (a family of five professionals who memorize the Qur’an), which is to read aloud the verse for a few times and then try to recite it without looking at the mushaf. Memorizers should only look back at the mushaf only when difficulty arises in recalling the words. This then, according
to Mohamad Salmi et al. (2017), should be continued with repetitive reciting while looking at the *mushaf*, followed by reciting the verse without looking at the *mushaf*. This explains participants’ repetitive regressions with intermittent missing gaze plots from the scan paths. According to the participants, they were actually trying to visualize the order of the words without relying on the *mushaf* when they were closing their eyes or when they were looking away from the monitor.

5.0 DISCUSSION

It was argued earlier in this paper that the process of memorizing the Qur’an is psycholinguistic in nature and using various arguments from previous studies, we have shown that aspects from psychology and linguistics are very much applied in the memorization process.

Qualitative analysis on the scan paths of successful memorizers (i.e., those who successfully recalled all the verses that they had to memorize) shows that while the process of memorizing takes place, the memorizers read the verses in small segments/chunks. The participants may have read the entire verse all at once for the first time, but later, the verses were broken into small segments, and this is shown by the regressive movement to an earlier part of the verse before the completion of the entire verse. The size of the chunks, however, varies, and when the participants were asked about the manner in which the verses were chunked, they indicated that the chunking was done based on what was familiar to them. For example, they grouped several words into one chunk when they faced familiar phrases like ‘*sya-aa iril llahi*’. They also claimed that they break the verses into chunks whenever the word “*wa*” (which is the Arabic word for “and”) appears in the verse.

This study has shown that when the process of memorization took place, each chunk was read and reread multiple times, and this was observed in the scan paths through regression, i.e., when readers return to an earlier part of the verse. At the surface level, the memorization process might seem to be a purely rote learning process i.e., as described by Colman (2009, p. 667), “memorization through repetition, and reproduction without attention to meaning” due to the fact that the memorizers may not understand the meaning of the Arabic words.

Nevertheless, in reality, the memorization of the Qur’an verses was not done like the memorization of the periodic table in chemistry, the multiplication tables in mathematics, anatomy in medicine, the cases of statutes in law, or basic formula in sciences, in the sense that the participants tended to look for the meanings of the Arabic words. This is evident in the scan paths and the heat maps of the successful memorizers.

What we can see is that the scan paths and the heat maps suggest that although this
appears to be a mere memorization task, the participants went beyond what is known as “cramming, parroting, or mugging” (Colman, 2009, p. 667), where meaning is secondary in such processes. The participants’ act of reading the meanings of the words suggests that a deeper rather than a surface processing was applied so as to make the process of memorizing more meaningful (Rossum & Schenk, 1984). Hence, although the meaning of some of the words are not known to the participants, the memorization of the Qur’an is not the same as the memorization of nonsense syllables in Ebbinghaus’ experiments. This is probably because the participants may have read the entire Qur’an more than once.

This study has shown that the scan paths and heat maps in Tobii TX300 can assist researchers in understanding what actually happens when individuals memorize the Qur’an using the playback function that the eye tracker has. Although the findings are qualitative in nature, the visualization actually helps researchers to ask the participants retrospectively, through the visualization of their eye movement patterns, what actually happens in certain eye movement behaviors and why they look at certain areas within the stimulus and not others. Participants were generally happy and excited upon seeing their heat maps and scan paths; and such visualizations actually helped in extracting information from them.

This qualitative study precedes and paves the way for the quantitative analysis of the fixation counts, fixation durations, and visit durations of the same eye tracking experiment presented in this paper. Information obtained from the current study helps to identify the areas of interests for such a quantitative analysis. Hence, although no big claims should be made just from the qualitative findings of a research that uses the eye-tracking machine, the results presented in this paper can still be useful to individuals who aspire to memorize the Qur’an, specifically on how and what they can do to improve their memorization techniques.

6.0 CONCLUSION
This study has shown that the process of memorizing verses of the Holy Qur’an by those who do not understand the Arabic language goes beyond the act of “cramming”. The process involves making use of information that is available around the memorizers, including word-for-word as well as the complete translation of the respective verses. This deeper cognitive process of memorizing makes the processes of chunking and repeating more effective, resulting in efficient recalling of the memorized verses.

Findings from this study can be used to encourage Malay non-Arabic speakers to memorize the Qur’an. It is hoped that with the knowledge obtained through this study, more
individuals, regardless of their age and background, will be motivated to memorize verses of the Holy Qur’an on their own initiatives, at their own pace, as part of their daily routine.

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REFERENCES


