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LETTER ARTICLE

The Predictive Role of IQ, Mood, Emotional Reactivity, and Effortful Control on Working Memory among Hafidz Qur'an

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Abstract:

Memorizing the Qur'an is one of the working memory activities as several factors influence the activity of memorizing the Qur'an. However, some argue that memorizing the Qur'an would rather be influenced by the efforts made to maintain perseverance, attention, and mood than the level of individual intelligence. The purpose of this study was to examine the predictive role of the variables in working memory among the Qur'an memorizer, who is called hafidz. This study involved 169 participants from two different universities that hold Tahfidz Qur'an between the age of 17 and 25 were selected from. The participants were asked to fill out four questionnaires (Mood, Emotional Reactivity, Effortful Control, and Working Memory) and paper-and-pencil based IQ test. Based on multiple regression analysis performed, this study found that effortful control was the most significant predictor to working memory, attention and executive within working memory. Effortful attention likewise predicted working memory, attention and execution within working memory. In addition, this study showed that, except emotional reactivity, the other independent variables were the predictors of working memory or its dimensions.

Keywords: Effortful control, IQ, Mood, Emotional reactivity, Working memory, Level of intelligence.

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1. INTRODUCTION

Memory is a human ability to remember past events and bring facts and ideas back to mind [1]. Memory is quite important for experiences, is related to the limbic system, and is the repetition of information over time in order to influence future behaviors [2]. Meanwhile, working memory is some information that can be stored in mind and is used to execute cognitive tasks [3, 4]. Thus, working memory is multi component including storage, attention and executive control. Working memory is one of the most widely used psychological terms. This concept is related to intelligence, information processing, executive function, understanding, problem solving, and learning starting from infancy to old age [4].

One activity that involves working memory is memorizing the Holy Qur'an (in the rest of the manuscript will be written Qur'an). Based on an interview with the Coordinator of the school (which is called Tahfidz Program), the Qur'an memorizer (who is called hafidz), is a Moslem who has the ability to recite the Qur'an fluently with the correct articulation and correct pronunciations, and memorize all of the 30 chapters of the Qur'an (called Juz). Regarding this understanding, not all of the Moslems are hafidz. Becoming a hafidz is particularly important for Moslems as they could include the Qur'anic verses in the regular compulsory daily prayers (5 times a day). Besides, reading the Qur'an itself for a Moslem is one of the religious activities that is believed to bring blessings in life now and after death, as it gives pleasure for Allah SWT, God of Moslem. In order to become a hafidz, a Moslem has to participate in the Tahfidz Program. Every tahfidz program has its own techniques to teach the participants to become a hafidz. The Qur'an consists of 30 Parts (called Juz) involving 114 Chapters of varying length. The total number of verses in the Qur'an is 6666.

The ability to memorize the Qur'an has a greater influence on both cognitive and emotional dimensions, also self-control. The ability to memorize and preserve the Qur'an verses requires memory control processes, as the coordinator reported. Memory control processes are active processes that can be controlled by individuals and can differ from one task to another [5]. Rehearsal, coding, and imaging are important control processes for mastering the entry of information into the human memory system. One of the memory control processes is rehearsal, which refers to the process of repeating information either clearly or vaguely. This activity can delay

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missing information from the memory system or increase memory strength. According to Baddeley's working memory model [3], the phonological loop consists of two sub-systems, including the phonological store and the articulatory rehearsal process. Phonological store plays a role in storing information for a few seconds, and articulatory rehearsal process refreshes the memory. However, based on a survey of 169 Hafidz and interview of the coordinator, there are several factors that influence working memory activities such as memorizing the Qur'an, namely mood, fatigue, loud voices, and intelligence.

Emotional state or mood can distract the mind. Effects of negative moods might appear to be similar to effects of positive moods. However, the results will be different depending on the causes, and disturbing thought is one of the possibly causes [6 - 8]. A study has shown that disturbing thoughts that are irrelevant to ongoing cognitive activity will take up most of the resources available in working memory [9]. Activation caused by negative moods will make working memory and emotions correlate with and influence each other. Working memory capacity and cognitive ability correlate with and contribute to emotional control and function [10 - 12]. Emotions can be a valence of positive emotions (*e.g.*, happy) or negative emotions (*e.g.*, sad), and a response which is manifested through a system of emotions, experiences (feeling sad), physiological (increased rate of heart), and behavior (attack due to anger). The individual's response to emotional experiences depends on his emotional reactivity [13, 14].

Emotional reactivity is defined as the speed and power of an individual's negative emotional response [15]. Three aspects of the functional reactivity of emotion are sensitivity, length of time of recovery from disturbance of emotions, and disruptions or level of function that is impaired associated with the disturbance of emotions. Emotional reactivity is conceptualized as a component of temperament that influences the reason (why) and the way (how) an individual responds to his emotional experiences. The emotional reactivity includes sensitivity, intensity, and persistence of emotional experiences [16].

College student is a representation of adulthood, whose physical, cognitive, and emotional development has reached optimal growth and development. Students memorizing the Qur'an are students who not only carry out their duties academically but also participate in the Tahfidz Program for memorizing the Qur'an. Emotions or moods of students who memorize the Qur'an can, in this way, influence their academic activities and the way they memorize the Qur'an. In addition to mood and emotional reactivity, intelligence (that is known as Intelligent Quotient (IQ)) also influences working memory. IQ is an overall cognitive or intellectual ability required to obtain knowledge, and to use the knowledge in a good way in order to solve problems that have well-defined goals and structures [17]. The relationship between working memory and IQ has implications in learning. Several researchers have suggested that IQ is the key factor underlying the relationship between working memory and learning [18, 19]. An evidence suggested that working memory has a unique relationship with learning [20, 21]. However, the interviews with 3 tahfidz teachers revealed that IQ was not the only thing that determined someone's perseverance to memorize the Qur'an. According to them, the perseverance itself would influence how well a person memorized the Qur'an and how far that person could memorize the Qur'an without being distracted by things. Therefore, in addition to IQ and mood, the authors hypothesized that there were individual differences that played a role in determining working memory, namely effortful control. Effortful control is a part of temperament related to self-regulation.

Several studies have shown that children's temperament can influence how well they perform on working memory tasks [22]. This is because temperament can be related to effortful control [23], therefore working memory and effortful control can be related as well. Three dimensions of functional effortful control are Activation Control, Effortful Attention and Inhibitory control. Individuals' level of effortful control includes a great number of control capacities, including direction of attention and inhibition [24]. Individuals with normal level of effortful control may have thoughts or reactions to certain stimuli but do not immediately act on them. This is because they pay attention to the environment and logically think about the consequences of their actions. Individuals with a normal level of effortful control inhibit their emotional response to stimuli. The opposite condition occurs in individuals with a lower level of effortful control.

Research examining several variables in influencing the working memory of Qur'an memorizers (hafidz) has not been widely studied. Therefore, the authors were interested in examining the influence of intelligence, mood, emotional reactivity, effortful control, on working memory among hafidz. This study aimed to examine if those variables predict working memory and the three dimensions of working memory among hafidz. Furthermore, it was the purpose of this study to find out the most predictive variable for working memory and three dimensions of working memory. In order to answer this research question, the following hypotheses were proposed:

H1: IQ, mood, emotional reactivity (positive and negative), effortful control significantly predict working memory

H2: IQ, mood, emotional reactivity (positive and negative), effortful control, three dimensions of effortful control significantly predict working memory, and its dimensions

2. MATERIALS AND METHODS

2.1. Participants

The participants of the study were 169 students aged 17-25 years old, currently studying and taking the Qur'an memorization program, male and female students, and had memorized at least two Juz of Qur'an. Participants came from different universities in Indonesia that held a tahfidzul Qur'an program (Bogor Agricultural University, Bandung Institute of Technology, Ibnu Khaldun University and Tazkia Istitute).

2.2. Measurement

Data was obtained through four self-report digital form questionnaires (google form), *i.e.*, the questionnaires for measuring effortful control, mood, emotional reactivity and

working memory. The intellectual intelligence was measured by an off-line intelligent test. In addition, there were several questions related to participants' demographic data such as gender, age, semester, student activities, number of juz of the Qur'an that had been memorized, motivation, factors influences in memorizing the Qur'an, and the time schedule. Additionally, we also conducted interviews with the Tahfidz Program coordinators and several Hafidz Students.

Level of intelligence (IQ) was measured by the 3B Scale Culture Fair Intelligent (CFIT) instrument [25]. IQ category ranged from borderline (<80), average (90-109), high average (110-119), superior (120-129), and very superior (≥130).

Mood was measured by the FMDS (Four Mood Dimension) Scale, which consisted of 4 dimensions including Positive Affect, Tired, Negative Affect, and Relaxed [26]. Each dimension had 7 items, and the total items were 28 items. The Cronbach's alpha reliability of the instrument in this study was 0.882.

Emotional reactivity was measured by the PERS consisting of 30 items [27, 28]. PERS-S consisted of 18 items to measure 3 aspects of emotional reactivity (activation, intensity, duration) in the context of positive and negative emotional reactivity. Six separate subscale scores were obtained by summing the three items corresponding to the subscale. Therefore, the minimum and maximum scores for each subscale were 3 and 9. The three subscales of each valence could be combined into a general positive reactivity scale or a general negative reactivity scale score. The general scale scores ranged from 9 to 45. Higher scores represented a higher level of reactivity. The authors adapted a scale with all valid items and the Cronbach's alpha reliability was 0.874.

Effortful control was measured by the short version of ATQ for Adult [29]. The ATQ for Adult consisted of 19 items, and had three subscales *i.e*., inhibitory control (7 items), attentional control (5 items), and activation control (7 items). It had 7-point Likert scale (1 = really does not suit you; 7 = really suits you). The Cronbach's alpha reliability in this study was 0.774.

Working Memory Questionnaire-WMQ [30] was used to measure working memory. The Working Memory Questionnaire (WMQ) is a self-administered scale, addressing three domains or dimensions of working memory: short-term storage, attention, and executive control WMQ consisted of thirty items. The first dimension was short-term Storage, corresponding to the ability to maintain information in short-term memory for a short period of time (*e.g*., "Do you have problems with remembering sequences of numbers, for example, when you have to note down a telephone number?"). The second dimension was Attention, including questions on distractibility, mental slowness, mental fatigue, or dual-task processing (*e.g*., "Do you need to make an effort to concentrate in order to follow a conversation in which you are participating with many other people?"). The third dimension was related to Executive aspects of working memory, such as decision making, planning ahead, or shifting (*e.g*., "When you are carrying out an activity, if you realize that you are making a mistake, do you find it difficult to change strategy?"). Response scale for the instrument ranged from 1 to 5. Cronbach's alpha reliability of WMQ was 0.874.

2.3. Procedure

This study received approval from the Human Ethics Committee of the Research Ethics Committee Universitas Padjadjaran Bandung, Indonesia, No. 2903.30/D3/PG/2017.

The participants were recruited by visiting universities that held tahfidz program, followed by meeting with the tahfidz program coordinator and asking for the permission to conduct research. The tahfidz program coordinator provided the list of the participants to the authors. The WhatsApp invitation was sent to the participants to come to the examination day bringing their mobile phones. On the day of examination, the participants filled out first the paper-pencil informed consent to state their willingness to participate in this research, then took the written IQ test and filled out the digital questionnaires using the platform Google Form on their mobile phone.

The participants were asked to answer each question in the questionnaires according to the conditions they were experiencing. The IQ test and the administration of the questionnaires were carried out in each of the selected universities and conducted and evaluated by a professional psychologist. The test and questionnaires' administration were conducted classically for 20 participants and in general, took approximately 120 minutes.

2.4. Data Analysis

Descriptive statistical analysis was used to describe the data using mean and standard deviation. Multiple regression was applied to test the research hypothesis. There were 8 regression models analyzed. Model 1 referred to hypothesis 1 and 7 other models were developed based on hypothesis 2. The significant independent variables in each model from the first step of analysis were included in the second step of the analysis.

Before testing the hypothesis, we checked the assumptions of multiple regression as follows: 1) the normal distribution of the residual score using Q-Q plot, if the Residual Quantiles are following a straight line, meaning the distribution is normal, 2) multicollinearity between the independent variables was checked using variance inflation factor (VIF) it should be less than 10.3) heteroscedasticity was evaluated using the plot of regression standardized predicted value and regression standardized residual value, if the plot shows a funnel shape pattern, then we say that Heteroskedasticity is present, and 4) no autocorrelation in residuals was evaluated using Durbin-Watson (DW) test, if DW ≈ 2 then we say no autocorrelation in residuals. The data analysis was carried out with the statistical software SPSS v25.

3. RESULTS

3.1. Demographic Data

Participants of the present study were 169 students, comprised of male (40.42%) and female (58.58%) with ages ranging from 17 to 25 years old (M=19.07 SD=1.74). They

were undergraduate students of semester 1 (63.31%), semester 2 (2.96%), semester 3 (14.20%), semester 4 (0.60%), semester 5 (7.69%), semester 6 (2.37%), semester 7 (1.18%), semester 8 (2.37%), semester 9 (2.96%), and postgraduate students of semester 2 (2.73%). Besides, they were also the students of the tahfidz program. The students were active in the students' organizations (41.42%), or were not active in the students' organizations (58.58%).

The number of Juz of the Qur'an memorized was 10.16% (21-30 Juz), of a total 17.75%. The number of Juz memorized was not included in the data analysis due to the very high variance. For example, students who had memorized 3 Juz starting from Juz 30 were different from students who had the same number of Juz memorized starting from Juz 28.

Participants reported the following reasons to participate at the tahfidz program, *i.e.*, they wanted to provide crown to their parents in Heaven (88.76%), they wanted to memorize to use it in their prayer (1.78%), as the way of life (1.18%), and they wanted to seek the pleasure of Allah SWT and the intercession of the Apostle (11.83%).

Concerning the time to memorize the Qur'an, the participants mostly did it before and after the compulsory prayers (60%), during the evening prayer or qiyamul lail (25%), after the prayers of Fajr and Maghrib (10%), and during their leisure time (5%). The participants reported that the factors that interfered the process of memorizing were negative emotions (20%), physical fatigue (45%), noise (5%), drowsiness (5%), and the level of task difficulty (25%). Factors that could improve the process of memorizing were concentration and the meaning that had (50%), the positive emotions (40%), and the negative emotions (10%).

3.2. Descriptive Statistics

The descriptive statistic data of the study included:

Mean, standard deviation, maximum and minimum scores of every variable in this study, *i.e.*, working memory and its three dimensions, IQ, mood, emotional reaction positive and negative, effortful control and its three dimensions, presented in Table **1**.

Results of the analysis showed that the highest IQ score was 145 (very superior) and the lowest was 57 (borderline) (M=109.18, SD=16.28). Frequency percentage of the participants based on IQ level category was Very Superior (9.5%), Superior (11.8%), High Average (33.2%), Average (41.4%), Low Average (2.3%%), and Borderline (1.8%).

The average reactivity of positive emotions (M=34.30, SD=6.71) was greater than the reactivity of negative emotions (M=26.62, SD=8.62).

The average of the three dimensions of WM was relatively similar (WM Storage, M= 32.46, SD=6.61, WM Attention M=30.40, SD=6.62, WM Executive, M32.42,SD=6.35).

A correlation analysis showed that several independent variables correlated with** dependents variables (Table **2**).

Table 1. Descriptive statistic analysis (N=169).

Variables	Mean	Std. Deviation	Max	Min
IQ	109.18	16.28	145	57
Mood	85.66	11.83	122	55
ER positive	34.30	6.71	45	16
ER negative	26.62	8.62	44	9
Effortful control (EC)	85.06	12.45	117	47
EC_activation	31.89	6.48	39	17
EC_attention	19.69	4.86	29	11
EC_inhibitory	33.01	6.79	47	16
Working memory (WM)	95.27	17.56	137	44
WM Storage	32.46	6.61	49	11
WM Attention	30.40	6.62	48	15
WM Executive	32.42	6.35	47	16

Table 2. Correlation coefficients between working memory and IQ, mood, emotional reaction, effortful control (N=169).

Independent Variable	Dependent Variable			
	Working Memory	Storage	Attention	Executive
IQ	0.05	-0.18*	0.27*	0.23*
Mood	0.15*	0.07	0.18*	0.12*
ER positive	0.07	0.05	0.06	0.06
ER negative	0.03	0.04	0.01	0.00
Effortful control (EC)	0.40**	0.02	0.57**	0.56**
EC-Activation	0.20*	0.01	0.23*	0.32**
EC-Attention	0.43**	0.12	0.56**	0.47**

(Table 2) contd.....

Independent Variable	Dependent Variable			
	Working Memory	Storage	Attention	Executive
EC-Inhibitory	0.22*	0.34**	0.31**	0.34**

*p < .05, **p < .01

Table **2** demonstrated the correlation coefficients between WM, and IQ, mood, ER and EC. The result showed that WM has significant correlation with mood (0.15), EC (0.40), EC activation (0.20), EC attention (0.43), EC inhibitory (0.22). WM storage has significant correlation with IQ (-0.18), and EC inhibitory (0.34). WM attention has significant correlation with IQ (0.27), mood (0.16), EC (0.53), EC activation (0.23), EC attention (0.56), and EC inhibitory (0.31). WM executive has significant correlation with IQ (0.23), mood (0.12), EC (0.56), EC activation (0.32), EC attention (0.47) and EC inhibitory (0.34).

3.3. Multiple Regression Analysis

Before doing the regression analysis, we checked the assumptions of the analysis.

The result is described in Table **3**. Almost all models meet the assumptions except model 2 and model 6, and there were two criteria that did not meet the standard.

The result of multiple regression is shown in Tables **4a** and **4b**.

Table 3. The result of checking the regression assumptions.

Checked Assumption	Normal Distribution of the Residual	Multicollinearity	Homoscedasticity	Error Independence
Model 1	√	√	√	1.91
Model 2	X	√	X	1.98
Model 3	√	√	√	1.92
Model 4	√	√	√	1.84
Model 5	√	√	√	1.91
Model 6	X	√	X	1.98
Model 7	√	√	√	1.99
Model 8	√	√	√	1.83

Note: (√)= meet the assumption, (X) = not meet the assumption

Table 4a. The standardized beta coefficient for models 1 – 4 and its revised model.

Predictor Variables	Regression Models							
	Model 1	Model 1 Revised	Model 2	Model 2 Revised	Model 3	Model 3 Revised	Model 4	Model 4 Revised
	Dependent Variables							
	Working Memory		Storage		Attention		Executive	
IQ	-0.02		-0.19*	-0.18*	0.19*	0.19*	0.15*	0.16*
Mood	0.15		0.08		0.17*	0.14*	0.10	
ER positive	0.05		0.03		0.03		0.05	
ER negative	-0.06		0.00		-0.10		-0.08	
EC	0.40*	0.40*	0.04		0.50*	0.50*	0.56*	0.56*
R^2	18%	16%	4%	3%	35%	34%	37%	36%
Regression line fit test (F)	S (7.22)	S (31.21)	Ns (1.40)	S (5.29)	S (17.19)	S (27.84)	S (19.23)	S (46.30)

Note: ER=Emotional Reactivity, EC=Effortful Control, S=significant at 5%, ns=non-significant at 5%.

Table 4b. The standardized beta coefficient for models 5 – 8 and its revised model.

Predictor Variables	Regression Models							
	Model 5	Model 5 Revised	Model 6	Model 6 Revised	Model 7	Model 7 Revised	Model 8	Model 8 Revised
	Dependent variables							
	Working Memory		Storage		Attention		Executive	
IQ	-0.05		-0.21*	-0.18*	0.15*	0.17*	0.12*	0.14*

(Table 4b) contd.....

Predictor Variables	Regression Models							
	Model 5	Model 5 Revised	Model 6	Model 6 Revised	Model 7	Model 7 Revised	Model 8	Model 8 Revised
	Dependent variables							
	Working Memory		Storage		Attention		Executive	
Mood	0.16*	0.13	0.08		0.19*	0.12	0.12	
ER pos	0.03		0.02		0.00		0.03	
ER neg	-0.08		-0.002		-0.12		-0.10	
EC act	0.08		-0.02		0.10		0.18*	0.19*
EC att	0.38*	0.42*	0.12		0.49*	0.53*	0.37*	0.37*
EC inh	0.12		-0.01		0.14		0.23*	0.21*
R^2	23%	20%	5%	3%	42%	37%	36%	35%
Regression line fit test (F)	S (6.87)	S (20.38)	Ns (1.30)	S (5.29)	S (16.34)	S (31.70)	S (13.19)	S (22.06)

Note: ER=Emotional Reactivity, EC act=Effortful Control activation, EC att= Effortful Control attention, EC inh=Effortful Control inhibitory, S=significant at 5%, ns=non-significant at 5%.

A multiple regression was carried out to investigate whether IQ, mood, emotional reactivity (positive and negative), effortful control could significantly predict working memory. Table **4a** showed that the result of the regression indicated that model 1 explained 18% of variance and its revised model explained 16% of variance. The model 1 and its revised model were significant predictors of working memory, F= 7.22, p<.05, F= 31.21, p<.05, respectively. Only effortful control contributed significantly to model 1 and its revised model (β=.40, p<.05).

Multiple regression also was carried out to investigate whether IQ, mood, emotional reactivity (positive and negative), effortful control and its dimensions (activation, attention and inhibitory) could significantly predict working memory and its dimensions (storage, attention, executive). Table **4a** showed that model 2 explained 4% of the variance and its revised model explained 3% of variance. Model 2 did not significantly predict storage, F=1.40, p>.05, but its revised model significantly predicted storage, F=5.29, p<.05. Only IQ contributed significantly to model 2 and its revised model (β= -.19, p<.05; β= -.18, p<.05), respectively.

The result of the regression indicated that model 3 explained 35% of the variance and its revised model explained 34% of variance. Model 3 and its revised model were significant predictors of attention, F= 17.19, p<.05, F= 27.84, p<.05, respectively. IQ, mood and effortful control contributed significantly to model 3 (β=.19, p<.05; β=.17, p<.05; β=.50, p<.05), respectively, while its revised model (β=.19, p<.05; β=.14, p<.05; β=.50, p<.05) respectively. Effortful control was significant predictor of attention within working memory.

The result of the regression indicated that model 4 explained 37% of variance and its revised model explained 36% of variance. Model 4 and its revised model were significant predictors of executive, F= 19.23, p<.05, F= 46.30 p<.05, respectively. IQ and effortful control contributed significantly to the model (β=.15, p<.05; β=.56, p<.05) while its revised model (β=.16, p<.05; β=.56, p<.05) respectively.

Table **4b** shows that Model 5 explained 23% of variance and its revised model explained 20% of variance. Model 5 and its revised model were significant predictor to working memory, F=6.87, p>.05; F=20.38, p<.05 respectively. Mood and EC attention contributed significantly to model 5 (β= -.16, p<.05; β= .38, p<.05), respectively. While its revised model showed that mood did not contribute significantly to the model (β= .13, p>.05), but EC attention significantly contributed to the model (β= .42, p>.05).

Table **4b** showed that Model 6 explained 5% of variance and its revised model explained 3% of variance. Model 6 did not significantly predict storage, F=1.30, p>.05, but its revised model significantly predicted storage, F=5.29, p<.05. IQ contributed significantly to model 6 and its revised model (β= -.21, p<.05; β= -.18, p<.05), respectively.

The result of the regression indicated that model 7 explained 42% of variance and its revised model explained 37% of variance. Model 7 and its revised model were significant predictor of attention, F= 16.34, p<.05, F= 31.70, p<.05, respectively. IQ, mood and EC attention contributed significantly to model 7 (β=.15, p<.05; β=.23, p<.05; β=.49, p<.05) respectively, while its revised model (β=.17, p<.05; β=.12, p>.05; β=.53, p<.05) respectively.

The result of the regression indicated that model 8 explained 36% of variance and its revised model explained 35% of variance. Model 8 and its revised model were a significant predictor of executive, F= 13.19, p<.05, F=22.06, p<.05, respectively. IQ, EC activation, EC attention and EC inhibitory contributed significantly to the model (β=.12, p<.05; β=.18, p<.05; β=.37, p<.05; β=.23, p<.05), respectively while its revised model (β=.14, p<.05; β=.19, p<.05 β=.37, p<.05; β=.21, p<.05), respectively.

Based on Tables **4a** and **4b**, it can be seen that all revised data showed the result almost similar with before revising model. Tables **4a** and **4b** showed that IQ consistently predicted attention and executive within working memory significantly. While mood consistently predicted attention within working memory. Table **4a** showed only effortful control that predicted working memory. Additionally, effortful control predicted attention and executive significantly, except for storage.

Table **4b** shows that both activation and inhibitory predicted executive significantly. While attention consistently predicted working memory, attention and executive within working memory, except for storage. Therefore, the current

study stated that the final predictive models were:

[1] Working memory = 0.40 Effortful control (Model 1)
[2] The model 2 was omitted, because it was not significant
[3] Attention=0.19 IQ + 0.17 Mood + 0.50 Effortful control (Model 3)
[4] Executive = 0.15 IQ + 0.56 Effortful control (Model 4)
[5] Working memory = 0.15 Mood + 0.36 effortful Attention (Model 5)
[6] The model 6 was omitted, because it was not significant
[7] Attention = 0.15 IQ + 0.19 Mood + 0.49 effortful Attention (Model 7)
[8] Executive = 0.12 IQ + 0.18 Activation + 0.37 effortful Attention + 0.23 Inhibitory (Model 8)

4. DISCUSSION

This study was aimed to identify the predictors of working memory and the three dimensions of working memory in the Qur'an memorizers (Hafidz Qur'an). Particularly this study aimed to find out the most predictor of working memory among the Hafidz Qur'an. The research findings are discussed as follows:

4.1. IQ

The current study conducted among the Hafidz Qur'an showed that IQ significantly correlated negatively, specifically with the dimension of storage (-.18, $p<.05$), and correlated significantly positively with the dimension of attention (.27, $p<.05$), and the dimension of executive control (.23, $p<.05$). Thus this study offered new findings of the role of IQ on the dimensions of working memory. The dimension of storage (short-term Storage) corresponds with the ability to maintain information in short-term memory for a short period of time (*e.g.*, "Do you have problems with remembering sequences of numbers, for example, when you have to note down a telephone number?") [30]. Thus, in the context of memorizing the Qur'an in this study, the higher IQ of the participants, the less problem they have with remembering something, which was in this study with remembering the Qur'an. The finding was in line with previous studies that were consistent with the view that simple short term-storage accounts for the relationship between working memory and IQ [31]. However, the current study showed that IQ did not predict working memory (total scores). This result is in line with the previous findings conducted among student' population, saying that working memory is a distinct skill from IQ (total scores) [21].

4.2. Mood

Regarding mood, the results of this study showed that mood predicted Working Memory (Model 5) and the dimension of attention (Model 3 & Model 7). These findings are in line with the previous findings revealing that mood-related and affected working memory [32]. Mood is a conscious state of mind or predominant emotion, including the dimension of Positive Affect, Tired, Negative Affect, and Relaxed [27]. In the context of memorizing the Qur'an in this study, the participants experienced all of the dimensions of mood, *i.e.*, the positive affect (such as receiving a call from parents), tired (*e.g.*, because of studying in the universities and doing the assignments during the day), the negative affect (for examples having conflicts with friends, having bad notes), and relaxed (*e.g.*, having enough sleep) (interview data).

Negative moods will make working memory and emotions correlate with and influence each other. According to Damasio (2004), stated that emotion is a collection of bodily alterations related to homeostasis or balance, which involves changes in brain activation [33]. The emotional state sometimes affects how individuals process information. Emotions can interfere with an individual's ability to monitor and understand the information that must be processed [34]. Factors that interfered with memorizing were negative emotions (20%) and physical fatigue (45%). The studies in line with participants reported that factors that interfered with memorizing Qur'an were negative emotions and physical fatigue. Mood is also related to attention in working memory, which is related to distractibility, mental slowness, mental fatigue, or dual-task processing. [30]

4.3. Emotional Reactivity

This study showed that only Emotional Reactivity (positive and negative) was not related to working memory and three dimensions of working memory.

4.4. Effortful Control and Dimensions of Effortful Control

Previous studies among the student population showed that working memory (total scores) was related to effortful control (total scores) [35]. The results of this study among the Hafidz Qur'an gave similar results (0.40, $p< .05$). This means that the hafidz Qur'an who have high effortful control, was predicted to have the ability to memorize the Qur'an well. This study examined further the correlation between the dimensions of working memory (*i.e.*, attention, storage and executive control) with dimensions of effortful control, (*i.e.*, activation control, attention, and inhibitory control). The results showed that in general the effortful control (total scores) and all of the dimensions (the activation control, the attention, and the inhibitory control) predicted the dimension of executive control. The effortful control (total scores) and the dimension of attention predicted working memory total in general (total scores) and the dimension of attention.

This study showed that dimension of activation control predicted the dimension of executive control. The dimension of activation control is defined as the capacity to perform an action when there is a strong tendency to avoid it [25]. With reference to this result, the participants said that in the context of memorizing the Qur'an they tended to force themselves to memorize the Qur'an at night, even though they felt tired because of doing the assignments during the day (from the demographic and the interview data). This study also demonstrated that the dimension of attention of effortful control predicted the working memory (total scores), the dimension of attention of working memory, the dimension of executive control. These results were in line with the previous finding among the student population [36 - 38].

The dimension of inhibitory control in this study predicted

the dimension of executive control. Inhibitory is necessary to inhibit irrelevant stimuli and unwanted responses [39]. Inhibitory control strengthens and improves working memory performance when irrelevant information is simply ignored. Self-control conflict arises when individuals have options between long-term goals that make them have to delay pleasure and short-term goals (desire or temptation) that offer pleasure [40]. Concerning this result, the participant said that in the context of memorizing the Qur'an, they tried hard to delay pleasure and short-term goals, to suppress the momentary temptation (mostly playing digital games) in order to achieve long-term goals (for example, glorified by God by giving a crown to parents) (the demographic data).

In general, this study contributed to the study of working memory in the context of memorizing the Qur'an. The results revealed the dimension of attention of the working memory was the most predicted dimension in the activities of memorizing the Qur'an. Thus this dimension should be the focus of the Hafidz Qur'an. This dimension was predicted by IQ, mood, effortful control, the dimension of attention of the effortful control. However, executive dimension of working memory was likewise a widely predicted dimension in the activities of memorizing the Qur'an. This dimension was predicted by IQ, effortful control and its dimensions (*i.e*., activation, attention, inhibitory). Therefore, these variables, such as IQ, mood, effortful control and its dimensions should be considered by the Hafidz Qur'an as well as by the institution to enhance the Hafidz' performance.

5. LIMITATIONS

This study did not consider the holy meaning of the Qur'an for the participants as a Moslem actually related to their faith in God. This holy meaning, that was not controlled in this study, according to the coordinator, played a role in the strategy of memorizing the Holy Qur'an. Further studies, therefore should consider this variable for further analysis.

This study did not include the analysis of the two sub-systems of the phonological loop of Baddeley's working memory model [3], including the phonological store and the articulatory rehearsal process. It is therefore recommended in further study to include those analyses in the study.

Concerning the methodology, the participants of the studies were recruited only from the universities that held Tahfidz program and not every university in Indonesia had this program. Being Moslem as the main criteria to participate the program limited the participants of the Tahfidz program significantly. Furthermore, the participants were only recruited with permission from the Tahfidz program coordinator. It is difficult, therefore to estimate the number of the population target and to make the sampling frame. With this limitation, random sampling could not be done in this study. Additionally, the COVID-19 outbreak also made it difficult to access more participants. It made the number of participants even more limited to the small number. This study did not control the number of chapters (Juz) of the Qur'an and the chapters (Juz) of the Qur'an memorized. It is difficult then to control them as it is dependent on the system of rehearsal (that is called murojaah) applied by the institution, which was different from one institution to another.

This study has a number of implications, one of which is to provide an overview of the factors that can affect Qur'an memorization activity to Tahfidz or Qur'an memorization institution. Thus, it will provide input to the institutions about what intervention is required to implement for the Qur'an memorizers. In addition, this study implies that Hafidz Qur'an needs to improve their mood and effortful control (activation, Attention, Inhibitory) to increase their ability to memorize the Qur'an.

CONCLUSION

This study on working memory among the Hafidz Qur'an concluded that effortful control was significant the most predictor for working memory among Hafidz Qur'an in the context of memorizing Qur'an. Additionally, effortful control predicted attention and executive within working memory significantly.

The findings revealed that dimension attention of effortful control significantly predicted working memory, attention and executive within working memory as well. Therefore, among the three dimensions of effortful control, effortful attention was the most significant predictor for working memory and its dimensions of working memory (attention and executive) significantly.

This study also concluded that IQ predicted the three dimensions of working memory, including Short-term Storage, Attention, and Executive Control, but did not predict working memory. However, mood predicted working memory and attention dimension of working memory.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received approval from the Human Ethics Committee of the Research Ethics Committee Universitas Padjadjaran Bandung, Indonesia, No. 2903.30/D3/PG/2017.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are the basis of this research. All human research procedures were followed in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all individual participants included in the study.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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