RACE, GENDER AND AGE VARIABILITY ON HUMAN VISION SENSITIVITY: A STUDY FOR LIMITED MALAYSIAN POPULATION

Adi Saptari, Zuhriah Ebrahim, Mohd. Rizal Saleh

Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya , 76100, Durian Tunggal, Melaka

E-mail: adi@utem.edu.my

ABSTRACT

Human vision sensitivity in this study referring to Critical Flicker-Fusion (CFF) threshold and Fusion-Flicker threshold for limited Malaysian population. The study investigates variability of race, gender and age for CFF threshold. There are three main ethnic groups or races in Malaysia namely Melayu, Chinese and Indian. 233 respondents female and male, young and adult are participated ranging from age 8 to 60+ years. The study found out that the CFF for limited Malaysian population is 36.01 Hertz, and for young age is 32.31 Hertz and adult is 37.57 Hertz. There is not any evidence the CFF is significantly different between adult female and male. However, there is a significant different between young people and adult. No significant differences in CFF with regards to races.

Keywords*: critical flicker fusion, age, race, gender.*

1.0 INTRODUCTION

Many electronic equipment people used nowadays are actually flickering, such as lamp, TV, CRT, video, film etc. Human can detect flickering light for certain frequency, as the frequency get higher reach the threshold, human can no longer see the light is flickering, the light seem as continues. This process of detection is known flicker fusion. Identifying human capability in detection of the threshold where human cannot differentiate flicker and fusion is important, particularly in designing electronic devices where light is used. For example all technologies for presenting moving images are flickering; if the frame rate falls below the flicker fusion threshold, flicker will be visible the movements of the objects will appear jerky. The concept of flicker is also important for designing domestic lighting, existence of flickering will very disturbing to the customers.

Critical Flicker-Fusion (CFF) or Flicker fusion threshold defines as the frequency at which flickering starts to appear continuous to an observer. Normal adult CFF reportedly is around 36-39 Hertz, and it reduces as people have retinal/ neural disease [1]. CFF threshold is affected by several factors including target luminance, target color, and target size [11]. Further study found out CFF obtained is strongly dependent on the measurement method used. CFF is typically determined either by direct electro-physiological measurements from the retina or psycho-physical test [6].

CFF also influence with other factors, among others CFF increase with an intensity of the light stimulus whether viewing is monocular or binocular [8]. In relation to grow old CFF may vary with age (Brundrett, 74) and may decrease by physiological factors (Smith et al. 1992).

The primary purpose of this study is to verify whether there exist variability among races or ethnic group, gender, and age in Critical Flicker-Fusion (CFF) threshold and Fusion-Flicker threshold for limited Malaysian population. The study also wants to find the average of CFF for limited Malaysian population and compare to previous study. The population comprises three ethnic groups (races) namely Melayu, Chinese, and Indian. The Malay is representing the highest percentage of the population around 50%, Chinese 40% and Indian 10%.

2.0 METHODOLOGY

Number of respondents participated for this research 233 persons. For age evaluation, there are two groups employed in this survey i.e. Young group age between 8- 19, and Adult group age 20 and above. Each group also represented by gender female (F) and male (M) participants. Moreover, each group is classified into three races in Malaysia i.e. Melayu, Indian and Chinese.

Among those participants, female respondents are 83, and male 150. Young respondents are 69 or 30% of the sample, age between 8-19 years old, Adult respondents are 164, age between 20 to 60+. The respondents are coming from students of elementary school and middle high school for young group. Adult group is coming from university students, academic staffs and supporting staffs and workers.

Hypotheses are set to test whether there is a difference among various groups. The study wants to verify (1) whether female and male have different CFF; (2) whether between Young and Adult respondents are

significantly different in CFF. And lastly study wants to verify whether among the races in Malaysia have significantly different in CFF.

Firstly, every participant was being checked visually for their eyes condition to make sure they are eligible for the test. Six test are conducted, and each test the respondent was taken three time measurements, i.e. (1) test for CFF from flicker to fusion for left eyes: (2) CFF for left eyes for fusion to flicker; (3) CFF for right eyes from flicker to fusion; (4) CFF for right eyes from fusion to flicker; (5) CFF for both eyes from flicker to fusion; and (6) CFF for both eyes from fusion to flicker.

2.1 Experimental Design

The equipment used to carry out the experiment was Flicker Fusion series 12021. It consists of an opaque length of tube. Mounted at the far end of the tube is a pair of LEDs, controlled by a host computer, which are used to measure the CFF (critical flicker fusion) threshold. The subject views these LEDs by looking through a pinhole aperture at the other end of the tube. The perception of flicker is, at least in part, determined by the brightness of the light source so this is an important factor to control as far as possible. The luminance of source lighting is 58cd/m2, and the stimulus color is white. Light/Dark ratio is 1:1, and viewing angle is 1.9 degrees.

3.0 RESULTS

To verify the results some procedures were set. Firstly, the Normality test was conducted to verify distribution of the data. Secondly, the compared groups will be tested for F statistics to check for their variance, whether they are equal or unequal. Then, the T statistic for Mean hypothesis is performed based on equal for unequal variance.

Checking to the figure of the data on Normal probability Plot performed for normality test, this is carried out in Excel. Figure 3.1 shows Normal Probability Plot for survey results for adult male respondents. The plot shows the points are close to the straight line which reasonably assumes the data are normally distributed. Figure 3.2 illustrate the Mean CFF for different experiments. Left 1 means a test CFF for left eye only, Left 2 means a test CFF for fusion to flicker for left eye. With the same procedures Right 1, Right 2, is for CFF right eye and critical fusion to flicker respectively. Both 1 and Both 2 means CFF for flicker to fusion and Critical fusion to flicker for both eyes respectively.

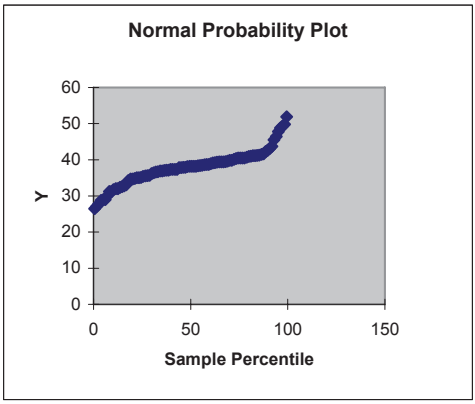

Figure 3.1: Normal Probability Plot for CFF Adult Male

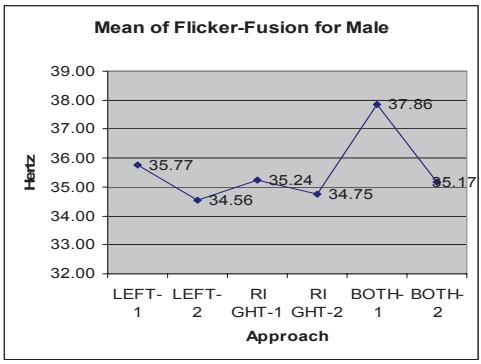

Figure 3.2: Male CFF

Figure 3.2 shows that CFF for Both 1 is much different from Both 2, the rest of data shows value of CFF closer to each other.

Figure 3.3 shows for adult Female respondents, it has relatively quite similar curve compare to the Male, however they provide different rate. It shows that Female has relatively lower CFF than Male.

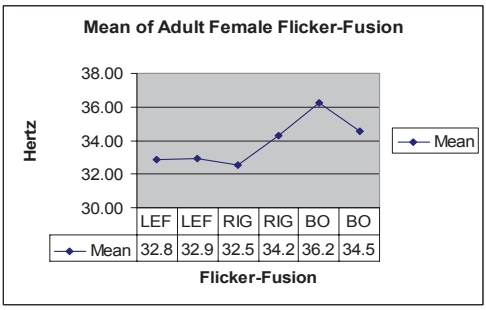

Figure 3.3: Female CFF

Statistics of CFF for Young group, Adult group and all respondents is shown in Table 3.1. Young group has CFF average for only flicker to fusion of both eyes is 32.31 Hertz, for Adult has 37.57 Hertz, and overall mean of respondents is 36.01 Hertz. Compare to previous study done by Shankar et al. (2007), she found out that normal CFF is around 36.4 Hertz to 38.5 Hertz. This study shows similar results.

Table 3.1: Statistic for All Respondents

	Young	*Adult*	*All*
Mean	32.312	37.574	36.015
Standard Error	0.862	0.591	0.512
Median	34.100	37.850	36.800
Mode	36.300	39.600	36.300
Std Deviation	7.159	7.571	7.816
Sample Variance	51.256	57.319	61.092
Range	34.500	71.500	71.500
Minimum	16.100	14.800	14.800
Maximum	50.600	86.300	86.300
Count	69	164	233
C. Level(95.0%)	1.720	1.167	1.009

To compare CFF among the races in Malaysia for both eyes data is use for analysis. Table 3.2 shows the mean of all three races i.e. Melayu, Indian and Chinese.

Table 3.2: Statistics for Different Races

	Malayu	*Indian*	*Chinese*
Mean	34.032	32.875	30.105
Standard Error	1.178	1.169	1.770
Standard Deviation	5.889	5.725	7.916
Sample Variance	34.678	32.780	62.668
Range	21.700	21.900	25.700
Minimum	25.100	19.900	16.600
Maximum	46.800	41.800	42.300
Count	25	24	20
C. Level(95.0%)	2.431	2.418	3.705

It shows a relatively different CFF, the variance also shows a quite significant different especially for Chinese and Melayu and Chinese and Indian. However, T test will be verified to state whether there is significant different.

4.0 DISCUSSION

F test statistics is conducted to verify whether the samples taken have unequal or equal variance. This result will lead to do T test statistics with using equal or unequal variance.

T test is used to verify the mean difference, and 5% confidence level for two tails and one tail.

4.1 Gender Variability

Female and Male CFF for both eyes (Both-1) were tested to see the difference. The hypothesis assumes that there is no significant difference between the two. Table 4.1 shows that there is NOT any significant different between Female and Male CFF. This is verified by the t statistic value (-1.358) and compare to t critical two tails (1.974), and P value for two-tail 0.176.

Table 4.1: Male and Female Test for CFF

t-Test: Two-Sample Assuming Equal Variances		
	Female	*Male*
Mean	36.27358	37.85636
Variance	49.5416	48.05239
Observations	53	110
Pooled Variance	48.53338	
Hypothesized Mean Difference	0	
Df	161	
t Stat	-1.35875	
P(T<=t) one-tail	0.088063	
t Critical one-tail	1.654373	
P(T<=t) two-tail	0.176126	
t Critical two-tail	1.974808	

4. 2 Race Variability

With similar procedures, to verify whether there is a significant different in CFF among different races in limited Malaysian population, t test is employed. However, F test is always performed to check the variance difference first. If the hypothesis assumes that every race has similar value of CFF, then the hypothesis mean difference between two races is zero, then t statistics for two tails is used to check. The hypothesis is written as $\mu 1 = \mu 2$. The t calculated for race Melayu vs. Indian is (0.696) < t critical two tails 2.032, and the P value is 0.489, it means statistically no significant different between CFF for the Malayu and Indian.

Table 4.2 shows results for comparing the mean of each other races. It shows that there is not any significant different for CFF among the races. Note however, for Melayu and Chinese the t test statistics is 1.847 if compare to t critical one tail is larger, but is smaller compare to t critical two tails. Since the study is assume that the two has similar CFF value, then the t critical two tails is used, which concludes that there is not any significant different also between the races.

Table 4.2: Race Variability and Test Hypothesis for CFF

Race	Mean Melayu	Mean Chinese	Mean Indian	t-start	t-critical one tail	t-crit. two -tail	P(T<t) Two-tail
Malay vs Indian	34.032	-	32.875	0.696	1.678	2.032	0.489
Malay vs Chinese	34.032	30.105	-	1.847	1.690	2.032	0.0734
Indian vs Chinese	-	30.105	32.875	1.305901	1.690	2.032	0.200

4.3 Age Variability

Lastly, the study wants to check the CFF between the Young and the Adult. If the hypothesis assumes Young has smaller CFF than Adult or Young has equal CFF as Adult, there will be two scenarios that are: $\mu 1 < \mu 2$ or $\mu 1 = \mu 2$. Table 4.3 shows t calculated is (-4.921) < t critical two-tail (1.64E-06), and probability P(T<=t) is 1.64E-06 which is very small, it means that there is a significant different between CFF Young and Adult. CFF young people in average has lower CFF than average of adult respondents.

Table 4.3: Young and Adult Test Hypothesis for CFF

t-Test: Two-Sample Assuming Equal Variances		
	Young	*Adult*
Mean	32.31159	37.57378
Variance	51.25575	57.31949
Observations	69	164
Pooled Variance	55.53449	
Hypothesized Mean Difference	0	
Df	231	
t Stat	-4.921	
P(T<=t) one-tail	8.19E-07	
t Critical one-tail	1.651477	
P(T<=t) two-tail	1.64E-06	
t Critical two-tail	1.970287	

5.0 CONCLUSION

The primary contribution of this study is to gain more information regarding critical flicker fusion (CFF) for limited Malaysian population. Some findings from this study are as follows:

1. Gender variability: there is not any significant different for Critical threshold for flicker to fusion (CFF) for adult female and male.
2. Age variability: Young and Adult have significantly different frequency CFF threshold. Young has mean CFF 32.3 lower than Adult CFF: 37.57 Hertz;
3. Study found for Adult normal, the mean CFF is 37.57 Hertz with range 36.4 to 38.6 Hertz. This result validates Shankar work, the normal adult CFF is in a range of 36.5 to 38.5 Hertz with mean around 37 Hertz.
4. Race variability: There are some differences of CFF threshold among the races, however there is not enough evidence to state that there is a significant different among the races with considering 5% level of confidence.
5. The mean CFF threshold for limited Malaysian is 36 Hertz.

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