

IMPACT OF PSYCHOLOGICAL STRESS, GENDER AND COLOUR ON VISUAL RESPONSE LATENCY

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Abstract : The measure of visual reaction time has been used to evaluate the processing speed of Central Nervous System and the co-ordination between the sensory and motor systems. As the reaction time is influenced by different factors, the impact of psychological stress, gender effect and the colour of objects in modulating the reaction time have been investigated in this study. 32 male and 38 female medical students in the age group of 18 -21 yrs participated as subjects. It was observed that a) the males had a visual reaction time lesser than their female counterparts b) response latency for green colour was lesser than that for red in both the males and the female subjects and c) psychological stress resulted in a significant decline in the reaction time to green colour in males. The longer reaction time in females could be due to the effect of female sex hormones, which reduced the velocity of nerve impulse and increased the synaptic delay. Green colour evoked a faster response due to its stronger stimulation on the visual receptors.

Key words : reaction time
sex difference

psychological stress
colour perception

INTRODUCTION

The time interval between the delivery of visual stimulus and the motor response thereon is termed as the visual response latency or the reaction time. The reaction time gives an idea about the integrity and the processing ability of the Central Nervous System (1). The earlier studies indicate that the female subjects have a faster processing

ability and hence a shorter reaction time (2). Skandan et al (3) have reported that girls from the age of eight years and above have mental alertness superior to the boys of comparable age. The girls seem to have intellectual abilities, which are at least one to two years ahead of the boys. These observations have been contradicted by earlier workers (4, 5, 6). Further it has been reported that red colour elicits a faster

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response when compared to green (2). The psychological stress is reported to alter the response time in both males and females for a single colour (7). It increases the release of epinephrine due to enhanced sympathetic activity (8). However, the inter-relationship between the psychological stress and the role of different colours viz., red and green in influencing the reaction time in males and females have not been extensively studied.

The present study is undertaken keeping in view the conflicting reports about the reaction time for red and green colours among male and female subjects. A clear understanding of the behavior of males and females under psychological stress with special reference to the reaction time will help in designing the signals and choosing the colour of light for the dashboard panels where the reaction time becomes a critical factor.

METHODS

32 male and 38 female medical students in the age group of 18–21 years participated in the study. None of the subjects had colour blindness. They were explained in detail about the experimental protocol. The subjects were highly motivated and gave their informed consent. The reaction time was measured by using an indigenously designed portable apparatus. The instrument has a master console that is to be used by the examiner and a slave console for the subject. A long flexible insulated cable connects the two consoles. The subjects' console has Light Emitting Diodes of green and red colour mounted

prominently on the front panel. It also has a response key which helps to register the response to visual or auditory signals. The examiners' console has a timer that can measure up to 10 ms. There are three push button switches on the front panel. One of the switches is used to deliver the visual stimulus to the subject. The other two switches are used to control the timer. A toggle switch on the side panel is used to select the colour of light.

This equipment has the additional facility to generate auditory signals, so that the auditory reaction can be estimated. These signals can be delivered with the help of an earphone through the output jack located on the side panel. This instrument operates on 2 type AA cells.

Recording procedure

The master console was held in hand by the investigator, which was kept out of sight of the subject. The subject was seated comfortably in front of the slave console. The visual signals were delivered by pressing the push button switch on the front panel of the master console. When the visual signals were delivered, the timer starts counting on the master console and the selected Light Emitting Diode (LED) red/green glows on the slave console. As soon as the visual signals were perceived, the subject registered the response by using the push button switch on the slave console. This response of the subject stopped the timer. The visual reaction time was directly read out from the digital display in the timer in milliseconds.

The subjects were exposed to red and green coloured lights one after the other. There was a time gap of not less than 30 minutes between two sets of recording. The exposure to the coloured lights were done in two sequence viz., red after green and green after red. The sequences of exposure were randomly assigned to avoid the bias. However each subject had the same order of exposure for stress and stress-free conditions.

The practice sessions were conducted one day prior to the actual trial so that the subjects would be acquainted with the instrument and the procedure of the experiment. The baseline assessments of the reaction time for stress-free period for red and green colours were done 45 to 50 days prior to their practical examinations. Assessments done during the practical examinations were taken as the values for the stressful period. All the recordings under stress and stress-free conditions were done between 11-00 a.m. and 1-00 p.m. During both the situations 10 trials were given for red and green colour and the mean of these sets of readings were used for comparison.

Statistical analysis

The recorded values were expressed as Mean \pm Standard deviation. The different parameters were compared by using Independent 't' and paired students 't' test.

RESULTS

The reaction time of males for green and red colour during stress free situations were 207.38 ± 17.07 ms and 213.16 ± 16.02 ms and that for females during the corresponding periods were 212.63 ± 14.10 ms and 219.24 ± 14.56 ms respectively (Table I).

TABLE I: Comparison of reaction time in different conditions. (Time in milli seconds).

	Male	Female
Green stressfree	207.38 ± 17.07	212.63 ± 14.10
vs	196.56 ± 20.58	208.39 ± 18.00
Green stress	P<0.001	NS
Red stressfree	213.16 ± 16.02	219.24 ± 14.56
vs	211.03 ± 22.13	222.92 ± 19.55
Red stress	NS	NS
Green stressfree	207.38 ± 17.07	212.63 ± 14.10
vs	213.16 ± 16.02	219.24 ± 14.56
Red stressfree	P<0.04	P<0.005
Green stress	196.56 ± 20.58	208.39 ± 18.00
vs	211.03 ± 22.13	222.92 ± 19.55
Red stress	P<0.0001	P<0.0001

The males exhibited a shorter visual response time of 5.25 ms for green (P<0.04) and 6.08 ms for red colour (P<0.005) when compared to females.

The difference in the response time between green and red colour during stress free condition were 5.78 ms in males (P<0.04) and 6.61 ms for females (P<0.005). Further, green colour elicited shorter response latency than red colour in both the sexes (Fig. 1).

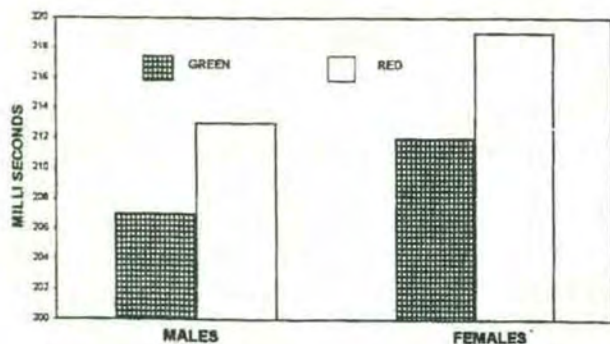


Fig. : 1 Reaction time during stress-free condition.

During stress, males had reaction times of 196.56 ± 20.58 ms and 211.03 ± 22.13 ms for green and red colours. The corresponding values for female were 208.39 ± 18.00 ms and 222.92 ± 19.55 ms. Thus males had a shorter visual reaction time of 11.83 ms for green colour ($P < 0.012$) and 11.89 ms for red colour ($P < 0.02$) in comparison with the female subjects (Fig. 2).

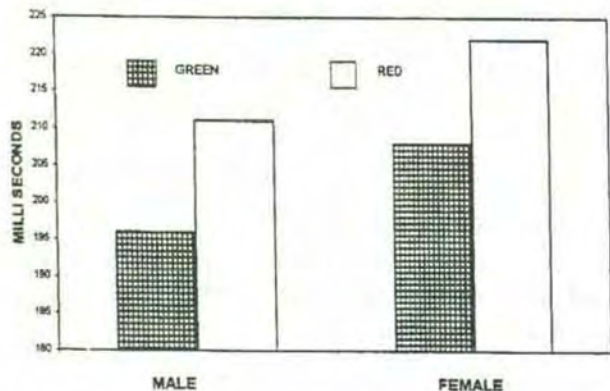


Fig. : 2 Reaction time during the period of stress.

Further, males had a shorter response time of 14.47 ms to green when compared to red colour ($P < 0.0001$). Females also showed a very similar trend. The difference in response time was 14.53 ms ($P < 0.0001$).

There was a significant decrease by 10.82 ms in response time for green colour in males during psychological stress

as compared to stress free condition ($P < 0.0001$).

DISCUSSION

In the present study, it has been observed that females had a longer reaction time when compared to males. Bruce and Russel (9) have indicated that varying level of sex steroids during different phases of menstrual cycle have sodium and water retaining effect. This retention of salt and water could modify the axonal conduction. Further, it is also suggested to alter the availability of the neuro-transmitter at the synaptic level. This modulation of neurotransmitter coupled with altered rate of impulse transmission due to fluctuation in the levels of hormones affect the sensory, motor association and the processing speed at the Central Nervous System. Our observation are contrary to the views expressed by Dhangauri et al (2) and are consistent with the observations of the other workers (4, 5, 6).

Contrary to the conclusions of Dhangauri (2) it was observed that the reaction time for green colour was shorter in males and females in both stress free and stressful conditions. Tomito et al (10) have studied the relative number of cones that are activated in response to a particular colour of light. They have reported that maximum numbers of cones are activated for red followed by blue and the least response is for green colour. Further, the summing effect of the response observed in the cones will determine the appreciation of the intensity of light rather than the speed of perception of the light. Thus the phenomenon of varying number of cones getting activated for different coloured lights fail to influence the visual response time.

The corpuscular theory of light, proposed by Max plank (11) explains the relationship between the wavelength and the energy carried by different coloured lights. It indicates that one quantum of red light has the maximum wavelength and hence carries the least energy. The green light of same quantum has shorter wavelength and carries greater energy than red colour. The greater energy carried by green light could be an important factor in stimulating the visual receptors faster, when compared to red colour, producing a shorter response time.

Malathi et al (7) have documented a significant increase in heart rate (HR) and decrease of Galvanic Skin Resistance (GSR) just before the examinations indicating the existence of anxiety status. The increase in HR is due to increased secretion of epinephrine (8). The examination stress induced an anxiety state resulting in increased level of arousal (7). In the conditions of stress and anxiety there would be an

increase in adrenaline secretion that is closely associated with increased alertness of mind (12). This could result in reticular activation leading to facilitation of the central integrative time, enhancing the processing speed of Central Nervous System.

There was a significant decrease in the reaction time to green colour in males during stress. Female subjects demonstrated a marginal variation in the response time for green and red colour under psychological stress when compared to stress free conditions. These observations bring out the fact that, females are influenced by stress much less than the males and are capable of withstanding the stress better.

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