COLOUR PERCEPTION AND RETENTION OF PRACTICE EFFECTS ON PERFORMANCE

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Abstracts: **Background & objectives:** Time response is supposed to be the best factor for the management of homeostasis which we call as reaction time; this parameter is widely used in selection process of many occupations like pilots, car drivers and in industrial situation to prevent accidents. When subjects are new to a reaction time task, their reaction times are less consistent than when they have had an adequate amount of practice, subsequent reaction times are slower, as if the subject is being more cautious. According to colour expert and strategist Kate Smith (2008), found that the red colour stimulates energy and can increase heartbeat, blood pressure, respiration, and pulse rate more than any other colour and red has the most obvious association as a learned stimulant, especially as a connection to stop signs and traffic lights. So, present study was carried out to compare red and green colour light perception and retention of practice effects on visual reaction time among young healthy males. **Methods:** 35 young healthy male volunteers of age 19 to 25 years were randomly selected for recording visual reaction time displaying red and green colours light, initially without practice and later with practice of three weeks on reaction time instrument, in a adequately illuminated, noise free room between 9am-10am, to avoid discrepancy in the result due to changes in the shades of colours, with an hour after light breakfast to prevent hypoglycaemia. Neuropsychological data were determined with the Folstein Mini-Mental State Examination for cognitive disability and Hamilton Rating Scale for Depression. **Results:** It was observed that young healthy males' response faster to visual stimuli after practice, however red colour light perception was faster as compared to green colour light with or without practice. Statistical analysis was done by using paired student't' test and was found to be statistically significant ($P<0.05$). Data were expressed as mean±SD. **Interpretation & conclusion:** Training on a complex task both shortened the reaction time and improved accuracy. In today's fast-paced world of digital technology, every person works invariably in complex setups, require to react to a variety of situations or changes in the external environment promptly and correctly. Colour vision is of particular importance in drivers of air, sea and road transport vehicles, railway engine drivers, bus and truck drivers, pilots etc. however red colour perception is faster as compared to green colour with or without practice. This can be explained on the basis of relative number of cones activated in response to a particular colour of light that is Thomas Young and Von Helmholtz's Trichromatic Theory of Colour Vision.

Key Words: Colour perception, Practice, Visual reaction time, Young-Helmholtz trichromatic theory of colour vision.

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Introduction:

One measure of information processing is reaction time and is used to judge the ability of the person to concentrate and coordinate. It provides an indirect index of the integrity and processing ability of the central nervous system [1]. Simple reaction time is a simple, non invasive means of determining sensori-motor co-ordination and performance of an individual [2]. Reaction time is defined as an interval of time between the application of stimulus and the initiation of appropriate voluntary response under the condition that the subject has been instructed to respond as rapidly as possible [3]. Thus it indicates the time taken by an individual to react to external stimulus [4]. In everyday life one has to respond almost instantaneously to many diverse situations. Visual reaction time is the speed, with which a person can respond to a visual stimulus. Time response is supposed to be the best factors for the management of homeostasis which we call as reaction time; this parameter is widely used in selection process of many occupations like pilots, car drivers and in industrial situation to prevent accidents[5]. Sanders (1998) cited studies showing that when subjects are new to a reaction time task, their reaction times are less consistent than when they've had an adequate amount of practice. Also, if a subject makes an error (like pressing the spacebar before the stimulus is presented),

subsequent reaction times are slower, as if the subject is being more cautious[6].

Material and Methods:

35 young healthy males in the range of age group 19 to 25 were randomly selected for study. The study was conducted in a quiet room of experimental Laboratory in Physiology Department, with good visibility of conditions. Institutional ethical committee approval was taken before beginning the study. Before selecting them as participants they underwent general physical examination, systemic examination to rule out any systemic and ophthalmological diseases. The examination was done in concerned departments OPD of Hospital. The participants had no hearing disability and no visual defects including colour blindness. Before they were selected, procedure of the study was explained in detail and they had given informed written consent for participation.

The participants thus selected were tested for simple reaction time for visual stimuli. Visual reaction time were recorded of each participant initially without practice and later with practice of three weeks on reaction time instruments, Yantrashilpa System, Pune, displaying reaction time in seconds, in a adequately illuminated, noise free room between 9am -10 am, to avoid discrepancy in the result due to changes in the shades of colours, with an hour after light breakfast to prevent hypoglycaemia. It was ensured that the location and direction of instrument as well as the subject was constant, so also the distance between them. Subject was asked to press the button with thumb of dominant hand as soon as he sees the stimulus. Visual reaction time for each colour was recorded 3 times and the average of 3 recordings for each colour was considered for statistical analysis.

Neuropsychological data were determined with the Folstein Mini-Mental State Examination (MMSE) and Hamilton Rating Scale for Depression (Ham-D). MMSE scores for these normal participants ranged from 26 to 30 (28.0±1.2) indicating no significant cognitive impairment. Ham- D scores ranged from 0 to 8 (4.1±2.2), indicating no significant depressive symptoms [7, 8].

Inclusion criteria: Study group were included all young healthy males with normal colour vision and normal acuity of vision.

Exclusion criteria: Males who were involved in exercise programmes and yoga and having any prior experience in recording procedures of reaction times, playing any sports, musical instruments, alcoholic or drug abuse and who were complaining of medical (hypertension, diabetes, hepatic & endocrine diseases) neurological, and cognitive disorders, any major auditory or visual defect , colour blindness were excluded from the study.

Statistical analysis was performed using paired student 't' test. Difference among males were found to be statistically significant [$P<0.05$]. Data were expressed as mean±SD.

Result:

It was observed that young healthy males' response faster to visual stimuli after practice, however red colour light perception was faster as compared to green colour light with or without practice.

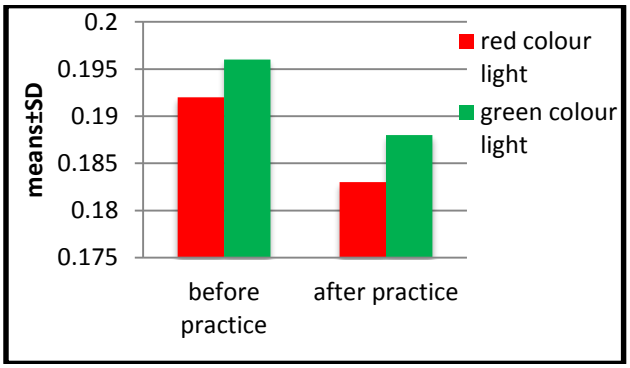
Table1: Showing Demographic, clinical investigations and neuropsychological data.

Parameters	Data (mean±SD/ values)
Minimum educational qualification	Higher secondary school passed
Age in range 19-25 years	21.33±2.34
Body Mass Index by (Quetelet's Index) in Kg/m2	23.19±1.18
Acuity of vision by Snellen's chart for distant	6/6
Acuity of vision by Jaeger's chart for near	N5
MMSE scores	28.0±1.2
Hamilton Depression Scale	4.1±2.2

Table2: Showing mean±SD 0f visual reaction time for red and green colour light, before and after three weeks of practice among same young healthy males.

Visual reaction time (secs) (n=35)	Before practice (mean±SD)	After three weeks of practice (mean±SD)
Red colour light	0.192 ± 0.010	0.183 ± 0.009
Green colour light	0.196 ± 0.010	0.188 ± 0.007
Statistical significance (P value)	P<0.05	P<0.05

Fig 1: Showing mean±SD 0f visual reaction time for red colour light and green colour light, before and after three weeks of practice among same young healthy males.



Discussion:

The perception for red colour light was quick as compared to green colour light, same with the after practice for 3 weeks, although the visual reaction time decreases with practice was found in study. In 1994 Shenvi D and Balasubramanian P found that reaction time to red light stimulus was the least and the difference for the red and green light stimuli was significant [9]. Similarly in 2014 Kalyanshetti S.B observed that response latency for red colour was lesser than that of green colour [10]. This can be explained on the basis of the Thomas Young and Von Helmholtz's Trichromatic Theory of Colour Vision that depends on 3 types of cones, each with a specific photopigment that is maximally sensitive to one colour at the retinal level of eye and the ganglion cells contribute to colour vision by adding or subtracting inputs from one or the other area. When Tomita and co-workers illuminated the retina with microelectrode penetration of single cones, they found that 16% of the units peaked in blue spectrum, 10% in the green and 74% in the red. Thus maximum number of cones is activated for red colour followed by blue and least response is for green colour. The human eye is sensitive to all wavelengths of light from 350 to 700 nm, which constitute the visible part of the electromagnetic spectrum. The colour sense is perceived by 3 types of cones in the retina, each cone containing a specific photopigment that is maximally sensitive to one of the three primary colours- red, green, and blue, with varying degree of stimulation of red-sensitive or long-wave pigments (723-647 nm), green-sensitive or middle-wave pigment (575-452 nm) and blue-sensitive or short-wave pigment (492-417 nm) [11].

According to color expert and strategist Kate Smith (2008) found that the red colour stimulates energy and can increase your heartbeat, blood pressure, respiration, and pulse rate more than any other color and red has the most obvious association as a learned stimulant, especially as a connection to stop signs and traffic lights[12]. In non-human primates, the largest neuronal population in the Lateral Geniculate Nucleus is the Parvocellular cells; these are thought to form the basis of red-green colour vision because they have Long/Middle-cone opponency, high sensitivity to Red-Green colour contrast and lesions of the Parvocellular cell layers produce a dramatic reduction in colour sensitivity[13].

Ando et al (2002 and 2004) found that reaction time to a visual stimulus decreased with three weeks of practice, reported that the effects of practice last for at least three weeks [14, 15]. Koehn et al (2008) also found that "accusing" subjects of making an error slowed their processing of the next stimulus more than indicating that they had made a correct choice[16]. Visser et al. (2007) found that training on a complex task both shortened reaction time and improved accuracy [17]. With repetition of motion, person's conscious effort is decreased and the motion becomes more and more automatic[18]. Motor circuits of basal ganglia play a key role in the automatic execution of motor tasks[19]. Mental practice can effectively cause motor improvement and

performance[20]. Practice for three weeks on visual reaction time results in improvement in the perception of stimuli both for red and green colour light, that male's response faster to visual stimuli after practice, however red colour perception was faster as compared to green colour light with or without practice. This can be explained on the basis of relative number of cones activated in response to a particular colour of light that is Thomas Young and Von Helmholtz's Trichromatic Theory of Colour Vision.

Conclusion: Reaction time study is an important method used for central information processing speed and fast coordinated peripheral movement response. It is an external indicator of the ability of the nervous system to receive process and initiate a response to incoming stimuli. In today's fast-paced world of digital technology, every person works invariably in complex setups, required to react to a variety of situations or changes in the external environment promptly and correctly. When subjects are new to a visual reaction time task, their reaction times are less consistent than when they've had an adequate amount of practice, subsequent reaction times are slower, as if the subject is being more cautious. Colour vision is of particular importance in drivers of air, sea and road transport vehicles, eg ., railway engine drivers, bus, and truck drivers, pilots etc.

Acknowledgment: Author wish to thank to all participants for their participation and co-operation to make this study successful.

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Disclosure: No conflicts of interest, financial or otherwise are declared by the authors.