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ARE MEN'S AND WOMEN'S VISUAL AND AUDITORY REACTION TIMES DIFFERENT?

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Abstract

Background: Reaction time is required for a muscular reaction to start after an administered stimulus (RT). RT assesses the pace at which the central nervous system analyses sensory information and executes it as a motor response. Our bodies react to various sorts of stimuli at varying rates. It is crucial to have this on hand for everyday and emergencies. Several factors, including gender, age, physical fitness, exhaustion, distraction, and alcohol, have impacted reaction time. This visual and aural reaction time area merits more investigation, specifically the impact of object colour (red), acoustic stimulation (beep tone), and gender. To compare medical students' simple visual and auditory reaction times to red colour and beep tone. To compare female and male medical students' simple visual and auditory reaction times. **Material and Methods:** After gaining ethical approval (IEC/GMC/Cat-C/2021/531 dated 24/05/2021) and signing informed consent, all 250 (125 women and 125 men divided into two groups) first-year medical students from the cohort of 2020-21 aged 17 to 20 were selected. Anand Agencies Pune developed RT equipment to record VRT and ART. The data were analysed with the SPSS 26.0 statistical program and the unpaired t-test. **Results:** Study participants showed a statistically significant difference in their VRT for Red (R) and ART for Tone (T), respectively, with 0.199±0.033 seconds and 0.082±0.009 seconds ($p < 0.001$). As an added benefit, the variance of men's VRT was substantially more significant than that of women's VRT ($p = 0.001$), with a mean of 0.192±0.026 seconds for men and 0.206±0.037 seconds for women. In contrast, ART had no discernible gender difference ($p=0.246$). **Conclusion:** Our analysis revealed that the VRT for red was substantially higher than the ART for tone. This might be because the visual processing time is longer than the audio. Men also respond faster to VRT than women, although their responses to ART are considerably quicker or equivalent to those of women, which explain why these gender disparities occur.

Keywords: Auditory Reaction Time, Female, Male, Visual Reaction Time.

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Introduction

Reaction time (RT) measures how quickly an organism responds to stimuli. Reaction time is the time it takes for a muscular response to occur after a trigger has been administered.[1] RT measures the rate at which the central nervous system analyses sensory data and executes it

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as a motor response. The human body reacts differently and at varying speeds to different sensory modalities. This is useful in both everyday situations and crises. These actions can be both typical and critical. Typical ones include replies to a phone call, a doorbell, game consoles on PCs, and even the whistle of a pressure cooker. Driving, operating a fighter jet, reacting to enemy fire, or simply averting an accident are all examples of critical ones.[2] Doctors, nurses, athletes, pilots, drivers, military personnel, and security guards must be vigilant. Hence their reaction times must be fast. Various factors can affect reaction time, including gender, age, physical fitness, amount of fatigue, distraction, and alcohol.[3] Three alternative response time tests are possible.[4]

1. Experiment with simple reaction times: A uniform stimulus and uniform reaction are necessary. In simple reaction time tests, only one stimulus and one response are required. Calculate simple reaction time (e.g., React when seeing the colour or hearing the sound).
2. Choice reaction time tests include presenting several stimuli and monitoring how long it takes the individuals to react to each one. As a result, in choice reaction time tests, the subject is presented with at least two stimuli and is expected to respond accordingly.
3. Recognition reaction time experiments: Some stimuli should evoke a response while others should not.

The two primary components of reaction time are mental processing time (perception, identification, and analysis of stimuli) and movement time: This is the time it takes to act once you've determined what to do. It's been widely acknowledged for over a century that the average simple reaction time for college-age students to light and sound stimuli is 190 milliseconds and 160 milliseconds, respectively.[5] Given the lack of literature on college students, more study on the effects of object colour (Red), auditory stimuli (Beep Tone), and gender on simple Visual reaction time (VRT) and Auditory reaction time (ART) is advised. The RT of medical students, who are the cream of society, aids in gaining a broad understanding of the RT of the Jammu region. As a result, this study was carried out to investigate gender bias in RT and scientifically contribute to RT.

Objectives:

1) To compare medical students' simple visual and auditory reaction times to red colour and beep tone.
2) To compare female and male medical students' simple visual and auditory reaction times.

Material and Methods

Cross-sectional observational research was done after ethical permission (IEC/GMC/Cat-C/2021/531 dated 24/05/2021) on 250 (split into two groups of 125 female (Group 1) and 125 male (Group 2) healthy first-year medical students in the 2020-21 batch between the ages of 17 and 20.

Exclusion Criteria:

1. The background of smoking and alcoholism.
2. Those with a history of hearing and vision problems.
3. Medications are known to impact cognitive function.
4. Those diagnosed with severe disease in the past or current.

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All participants provided written consent based on knowledge. Anand Agencies Pune designed the audiovisual RT equipment used in RT recording. The device runs on 220 volts AC. A digital chronoscope on the examiner's side measures the RT. It has a precision of 0.001s.[6] After connecting the instrument to the power source, the subject was instructed to sit in front of it. During August and September 2021, it was conducted between 3:30 and 4:30 p.m. in a human laboratory with enough lighting and a quiet ambience. The visual stimulus consisted of red-coloured illumination. The auditory stimulation consisted of a beep/tone sound. Separately, visual and audio stimuli were presented. To prevent the effect of the lateralised stimulus, frontal visual and audio stimuli were presented to the individuals. Sitting comfortably and relaxed on the chair, all tests were taken. Subjects' responses were collected following a thorough explanation of the technique and familiarisation with the test. The participant was told to press the response key with their index fingers on their hand and release the key as soon as a blinking red light or beeping sound was detected. The subject's best reading was determined by calculating the mean of three tasks.

Statistical Analysis: Statistical data analysis was conducted using the unpaired t-test with the help of the SPSS 26.0 version software. A p-value less than 0.05 were considered statistically significant.

Results

This study examined 250 first-year medical students of comparable age and good health. Group 1 consisted of 125 female participants, whereas Group 2 had 125 male participants. Each individual's height, weight, and BMI were assessed. Height, weight, and body mass index (BMI) were all significantly different between males and females ($p < 0.0001$). Analysed data are presented in tables [Table 1-6] below. We discovered that subjects' VRT for Red (R) (Mean: 0.199±0.033 sec) and Tone (T) (Mean: 0.082 ±0.009 sec) were statistically significant ($p < 0.001$). Moreover, the variation of VRT in males (Mean: (R) 0.192±0.026 sec, was statistically significant than in females (Mean: (R) 0.206±0.037 sec) ($p = 0.001$). However, the variation in ART in males (Mean: Tone (T) 0.081±0.009 sec) and females (Mean: Tone (T) 0.082±0.008 sec) was not found to be statistically significant ($p = 0.246$).

Table 1: Distribution of study subjects by gender

S. No	Group	Gender	Frequency	Per cent
1	1	Females	125	50.0
2	2	Males	125	50.0
Total			250	100.0

Table 2: Distribution of demographic characteristics of investigated subjects (Group 1 and 2 combined)

Parameter	Number	Mean	SD	Minimum	Maximum
Age (Years)	250	18.0080	0.6941	17.00	20.00
Weight (Kg)	250	55.7680	6.2080	45.00	74.00
Height (cm)	250	165.0840	10.7508	145.00	180.00
BMI (Kg/m^2)	250	20.4492	1.6852	16.20	25.40

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Table 3: Comparison of demographic characteristics of female (Group 1) and male (Group 2) individuals

Parameter	Gender	Number	Mean	SD	Significance	
					t-value	p-value
Age (Years)	Females	125	18.1040	0.7114	-4.137	0.097
	Males	125	17.8320	0.6316		
Weight (Kg)	Females	125	50.7040	2.3211	22.341	<0.0001
	Males	125	60.8320	4.5058		
Height (cm)	Females	125	155.1680	3.9772	38.110	<0.0001
	Males	125	170.0000	4.2464		
BMI (Kg/m^2)	Females	125	21.0417	1.3578	-5.927	<0.0001
	Males	125	19.8568	1.7753		

Table 4: Difference in Visual and Auditory Reaction Times for Simple RT Tasks Across All Subjects

Reaction Time (RT)	Number	Mean RT (Sec)	SD (Sec)	t-value	p-value
Visual RT (Red Color)	250	0.199	0.033	54.200	< 0.001
Auditory RT (Tone)	250	0.082	0.009		

Table 5: Comparison of VRT (Red Color) VS ART (Tone) in Group 1 and Group 2

Group	Gender	Number	Mean RT (Sec)	SD (Sec)	t-value	p-value
Group 1	VRT(Females)	125	0.206	0.037	36.162	< 0.001
	ART(Females)	125	0.082	0.008		
Group 2	VRT (Males)	125	0.192	0.026	44.372	< 0.001
	ART (Males)	125	0.081	0.009		

Table 6: Comparison of VRT (Red colour) and ART (Beep/Tone) in Group 1 VS Group 2

Group	Reaction Time	Number	Mean RT (Sec)	SD (Sec)	t-value	p-value
Group 1 vs Group 2	VRT(Females)	125	0.206	0.037	-3.373	0.001
	VRT (Males)	125	0.192	0.026		
Group 1 vs Group 2	ART(Females)	125	0.082	0.008	1.163	0.246
	ART (Males)	125	0.081	0.009		

Discussion

Visual reaction (VRT) and auditory reaction time (ART) are non-invasive procedures used to evaluate the sensory and motor activity of the central nervous system (CNS). In addition, it

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gives information on the CNS's integration capacity for sensory and motor impulses. A delay in reaction time indicates brain injury, mental illness, or other psychopathologies. On people with diabetes, people with schizophrenia, noise-exposed employees, and others, combined investigations of VRT and ART have been performed.

The notion of RT was initially described by Abu Rayhan al-Biruni.[7] Dutch scientist Franciscus Cornelis Donders (1865) was the first to systematically measure human RT using the telegraph-like device invented by Charles Wheatstone in 1840. No significant traceable thread existed in the literature discussing human RTs measured before his findings.[8] Very few studies in the medical literature can determine RTs in medical students. Thus, the purpose of this study was to see if there is a gender influence on RTs among medical students.

In the current study, participants' VRT for Red (R) and ART for Tone (T), with 0.199±0.033 seconds and 0.082±0.009 seconds, respectively, exhibited a statistically significant difference ($p < 0.001$). In addition, the variation of men's VRT was more significant than that of women's ($p = 0.001$), with a mean of 0.192±0.026 seconds for males and 0.206±0.037 seconds for women. In contrast, there were no statistically significant differences between the sexes in terms of ART ($p = 0.246$).

When comparing two types of stimuli in study subjects, ART outperformed VRT, consistent with earlier research.[5,9] This is due to the more significant number of synapses in the visual pathway than in the auditory pathway. The optical path takes 20-40ms to travel, but the auditory pathway takes just 8-10ms.[10] VRT is possibly more than ART because visual reactions entail chemical ways for information processing, primarily for converting from a photon to a bioelectric stimulus, which takes longer than restoring from a pressure wave to bioelectric stimulation.[11] In contrast, Yagi etal.[12] research indicate that RT to visual stimuli is quicker than to auditory stimuli. Consequently, this work provides evidence that ART is shorter than VRT, even when confounding variables are eliminated in medical students.

Numerous researchers have investigated the effect of gender on AVRT (audiovisual reaction time) and produced similar results indicating that females had longer RTs than men.[13-15] According to our study, male medical students had quicker RTs than female medical students, consistent with other research. A possible explanation for gender disparities in reaction times is that men and women use different processing strategies. As a result of evolution, men may rely on their RT to protect themselves and their families from predators when out foraging for food. Other jobs that need less attention and a considerable evolutionary drop in response times might be performed by women. Several research has demonstrated the superiority of women.[16] Alternative ideas include that women with a more diminutive frame and body size may have shorter axons that match their limb length, leading to faster transit times, and positively affecting the RTs of women with smaller frames. On the other hand, the contemporary woman is involved in every imaginable way, just like her male counterparts.[2]

Limitations of the study:

Exercise or regular physical activity was not included, even though other researchers have shown it impacts RT. More research is needed to incorporate physical activity, age range, and other anthropometric factors.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Conclusion

As a result of our investigation, we discovered that VRT for Red colour was significantly higher than ART for Tone in the study population. This might be because visuals' mental processing time is longer than hearing. In the case of the VRT, males have a faster reaction time than females, although their ART reaction time is comparable.

Males respond to changes in their surroundings faster than females. Among the potential mechanisms are:

1. Males have more muscle fibres than females, allowing them to do physical tasks faster.
2. Males have a shorter time lag between the appearance of a stimulus and the onset of a motor reaction to a stimulus than females.

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ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

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