

A Gender-based Comparative Study of Visual and Auditory Reaction Time on 1st Year Medical Students “Before” and “After” Caffeine Intake

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Abstract

Introduction: The present study is a gender-based comparison of the auditory and visual reaction time (RT) in male and female 1st year medical students, before and after the administration of caffeine present in coffee.

Purpose: This study is aimed at checking out if there exist inherent gender differences in the visual and auditory RTs in the subjects and supplementing the study, by also studying the effect of caffeine presents in coffee on the RTs.

Materials and Methods: The study was conducted on 42 males and 35 females 1st year medical students. The 77 students were not habitual coffee drinkers and were tested for auditory and visual RT before and after the administration of caffeine present in coffee.

Results: We found that auditory and visual RTs did not differ significantly in either gender both before and after the administration of caffeine.

Conclusion: In this study, no significant differences in RTs were observed in either gender. Both genders performed equally well in their RTs, before and after the intake of caffeine.

Key words: Auditory reaction time, Caffeine, Coffee, Gender, Visual reaction time

INTRODUCTION

Reaction time (RT) is the time that elapses between a person being presented with a stimulus and the person initiating a motor response to the stimulus. It is a simple and effective method of studying central neuronal processing and is a simple method of determining sensory-motor association, performance, and cortical arousal. Apart from the time required for sensory-motor association, this is the time required by the brain for perceptual decision-making and motor planning.^[1]

In daily life, one has to respond to various situations immediately and as the RT indicates the time taken by an

individual to react to external stimulus, it can be important in case of various activities that are carried out on a day-to-day basis. These activities can be both of “normal” and “crucial” in nature. Normal ones could be like response to a phone call, a doorbell, and game consoles on computers or may be whistle of pressure cooker. Crucial ones could be like driving, maneuvering a fighter plane, responding to enemy fire, or even preventing an accident from occurring.

Literature, as well as plenty of studies, has conflicting reports about differences in RTs between males and females. Some studies are more favorable for men while some support female dominance and prowess. The present study was taken with a view in mind to explore the gender bias in the RT and shed more light in the matter.

Caffeine is one of the most commonly used substances found in everyday beverages such as tea and coffee. The scientific name for caffeine is 1,3,7-trimethylxanthine.^[2] It is an alkaloid compound and is actually a bitter substance

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found in coffee beans, cocoa beans, and many other plant products. Caffeine has mild cortical stimulation effects and appears to be beneficial, resulting in more clear thinking, and less fatigue. Desirable effects such as improvement of physical and cognitive functions are seen with low doses of caffeine. Judiciously used within safe limits it is known to have many beneficial effects. The USFDA considers moderate intake of caffeine to be “safe.” Beneficial effects of caffeine which increased motor and mental performances are seen with about 65–130 mg of caffeine in a single dose. Around 300 mg/day of caffeine in an adult is considered to be safe.^[3,4]

The usage of caffeine is also considered to be addictive in nature. Certain amount of habituation develops from the regular usage of caffeine. Daily use of caffeine is known to cause dependence for this substance in the form of nervousness, headache, and irritation.^[5] However, grossly the benefits of moderate caffeine usage mostly outweigh the disbenefits.

After considering the above effects of caffeine, we decided to include it in the present study and thus have add-on information about the effects of caffeine present in a standard cup of coffee on visual and auditory RTs on the male and female subjects.

MATERIALS AND METHODS

The study was conducted in Grant Government Medical College on 42 males and 35 females 1st year medical students. Entire batches of 200 students were requested to enroll for the study. However, those who turned up for the study at their own “will” were primarily considered. The present study was conducted in the department of physiology, Grant Medical College, Mumbai, when the authors were posted in that institute. Informed consent from the subjects and approval from the institutional ethics committee were taken to conduct the study.

The 77 subjects being 1st year medical students were mostly of the same age range. Habitual coffee drinkers were excluded from the study to discard the effects of caffeine dependence. Too obese or too lean subjects were excluded from the present study. Studies were done on the female subjects after excluding the menstrual and premenstrual period of the subjects.

The coffee sachets from a well-known coffee brand were taken. We considered the fact that beneficial dose of caffeine for increased mental and motor performance is about 65–130 mg of caffeine.^[6] Hence, 2 g of coffee powder was used to make one cup of coffee which contained around 63 mg of caffeine. Thus, our coffee dose

came to near ideal doses.

Both the male and the female medical students were tested for RTs “before” and 30 min “after” the intake of coffee as the effects of caffeine are known to be more pronounced within the 1st h of coffee intake.^[7] RT measurements were done in the form of auditory reaction time (ART) and visual reaction time (VRT).

RT apparatus (Anand Agencies, Pune) was used for the study. It has a built-in 4 digit chronoscope and displays accuracy of 1 ms. Recordings were taken in the morning time. Subjects came with routine normal breakfast. Recordings were taken “before” and 30 min “after” the intake of standard cup of coffee as mentioned before. ART was recorded for auditory beep sound stimulus and VRT for red light stimulus. To avoid the effect of lateralized stimulus, the subjects were given visual and auditory stimuli from the front. They were instructed to release the response key with their dominant hand as soon as they perceived the visual or auditory stimulus. Subjects were given adequate exposure to get acquainted with the working of the apparatus before starting with the actual test.^[8,9]

Statistical analysis for the study was done using the popular software GraphPad Prism 5 software.

RESULTS

As the present study had 42 male and 35 female students, unpaired *t*-test was used for comparing the data between the two genders both before and after coffee intake. Data are presented here as mean \pm standard deviation. $P > 0.05$ indicated statistically non-significant differences in the variances between the male and female medical students in both the pre- and post-coffee tests for ART and VRT.

Results are summarized in Table 1 (before caffeine intake) and Table 2 (after caffeine intake).

Data were analyzed separately as “before” and “after” caffeine intake. In both the cases, gender was not found to significantly affect either the auditory or visual RT.

DISCUSSION

The purpose of this study was to check if there exists an effect of gender on RTs between subjects. In our study, we included medical students as the subject of the study. Different studies examining the effect of gender on RTs have yielded contradictory findings. Some studies have pointed out to a female superiority^[10,11] while others have

Table 1: Comparison of ART and VRT on 42 male and 35 female medical students “before” intake of caffeine

Before caffeine intake	Males (n=42)	Females (n=35)	P value
ART	243.5±10.43	243.0±10.35	>0.05
VRT	200.2±7.77	199.8±10.22	>0.05

ART and VRT values are in ms and expressed as mean±SD. ART: Auditory reaction time, VRT: Visual reaction time. SD: Standard deviation

Table 2: Comparison of ART and VRT on 42 male and 35 female medical students “after” intake of caffeine

After caffeine intake	Males (n=42)	Females (n=35)	P value
ART	231.5±12.38	228.8±11.32	>0.05
VRT	186.6±12.01	183.0±11.60	>0.05

ART and VRT values are in ms and expressed as mean±SD. ART: Auditory reaction time, VRT: Visual reaction time. SD: Standard deviation

been more generous in exhibiting a male advantage.^[12-14]

The gender differences in RTs if they exist could reflect differences in processing strategy employed by the two genders. It might also be an effect of evolution which has seen males going out and hunt out for food for their families and thus relying on their RT to escape from potential wild animals and so on. Females, on the other hand, could be involved into tasks requiring lesser alertness and consequential evolutionary decrease in RTs. However, these postulations supporting male advantages in RTs could easily be counteracted on by alternate theories which see the fact that women endowed with a smaller frame and body size could have shorter axons corresponding to their limb length, leading to smaller transit time and hence having a positive impact on the RTs. Further, the modern women being involved in various activities at par with men have seemed to evolve in every possible manner equivalent to their male counterparts. Certain studies have also indicated that the females have a faster processing ability and hence have a shorter RT as compared to their male counterparts.^[11]

In our study, no significant differences in RTs were observed in either gender. Male as well as female medical students did not differ much in their capability to react to either visual or auditory stimuli. Both genders fared equally well in their RTs both before and after the intake of caffeine. Decrease in RTs with caffeine intake was analogous in both the genders.

Keeping in mind the gender-based variability of RT seen in different studies, we undertook the present study to study the effect of gender on RTs. We also supplemented it with the introduction of caffeine to see if intake of caffeine modified the outcome in any way. Evidence for behavioral

effects of caffeine is well documented in literature. It is associated with increased subjective alertness. Mental performance where speed, endurance, or vigilance was required showed reported benefits from caffeine intake.^[15] Studies done by Tharion *et al.*^[16] on both auditory and visual stimuli showed caffeine to significantly ignore distracting or irrelevant stimuli, thus helping the subjects focus more on the task, thereby giving rise to improved RTs. Keeping this in mind, we tried to see if improvement in RTs was significantly different in males and females.

The study thus sets aside the assumption that there exist gender-based differences in RTs and also reinforces it by studying the effect of consumption of caffeine in the form of coffee on the auditory and visual RT.

CONCLUSION

In this study, no significant differences in RTs were observed in either gender. Both genders performed equally well in their RTs, before and after the intake of caffeine. The present study thus undertaken tried to shed light on the conflicting reports and lacunae present in literature about the RTs in male and female subjects. It also busted the myth of male superiority in certain occupations and sports, by statistically refuting any differences in RTs in either gender.

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