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Effect of Age and Gender on Reaction Time

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Abstract

The response time to stimuli, known as Reaction Time (RT), is influenced by factors such as age, gender, and type of stimuli. This study focused on examining the effect of age and gender on RTs in Response to visual cues. The research included 110 participants, aged between 11 to 65 years, divided into intervals of 5 years with equal representation of males and females. Each participant completed an average of five RT trials. The study's findings show that RT performance improved from childhood to adolescence, peaked in young adulthood, and gradually declined in later life. Although male participants had slightly longer RTs than females, the difference was not statistically significant. These findings may have practical implications in designing interfaces in the workplace and for new devices to facilitate task performance.

Keywords: Reaction time; Age; Gender

Introduction

The time needed to respond consciously to various external stimuli can be measured and is known as Reaction Time (RT). RT can be affected by human-related factors, including but not limited to age and gender. Males often have shorter and less variable RTs than females. RT has been used as a test of cognitive functions for over a century [1]. The type of stimuli affects the RT differently in males and females [2,3]. Specific RT tasks that employ a semantic, verbal, or auditory stimulus (e.g., numbers, letters, or spoken words) are more effective on women. In contrast, responses to stimuli of a spatial or visual nature (e.g., a flashing light on a screen) are more effective in men [4]. Men's superiority in visual and spatial abilities is sometimes attributed to differences in cognitive strategies [5,6]. Two of the most common RT tests are Simple Reaction Time (SRT) and Choice Reaction Time (CRT). In SRT tasks, there is only a single stimulus, repeated over trials, and in CRT, there are multiple stimuli, each having its respective response. The advantage of the RT tests is that they are relatively simple and quick to administer, yet they provide a useful measure of cognitive functioning. Previous studies on reaction time for gender and age do not consider a wide range of age differences. It has not been established whether these differences in reaction time are valid for children and adolescents. Many studies on gender differences in RT for different ages used small samples, restricted age ranges, or even inadequately matched age groups. The objective of this study was to evaluate the effect of age and gender on reaction time based on visual stimuli for participants between the ages of 11 to 65 years.

Background

Gender differences in reaction have been the subject of several investigations over the past few decades. Previous research indicates that gender differences exist in cognitive abilities unrelated to overall intelligence. [7-10]. Research has shown that females tend to perform better than males on tests of verbal ability and episodic memory, whereas males outperform females on visuospatial and quantitative ability [8,10]. Considerable research has been devoted to the study of gender differences in RT, and it is often reported that males have faster RTs than females. This effect has been found in several samples, ranging from university students 18-25 years of age [11] to representative samples of middle-aged and older adults [12]. Many of the studies concerned with the effect of gender differences in RT and age had small samples [13], restricted age ranges [13,14], or inadequately matched age groups [15]. This study aims to evaluate the effect of age and gender on reaction time with a large sample size and wide age range.

Methodology

One hundred and ten participants were recruited for this study. The

participants' age ranged from 11 to 65 years and were divided into intervals of 5 years. Each interval included ten participants, five males and five females. An average of five reaction time trials were taken as each participant's reaction time. An online reaction time testing software, as shown in Figure 1, was used to determine reaction time. The participants pressed the mouse button when the traffic light turned green, and the reaction time testing software recorded the reaction time. This exercise was repeated five times, and the average was computed as the reaction time for each participant.

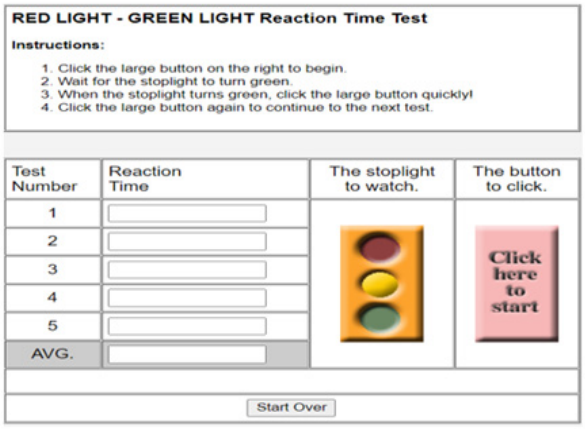

Figure 1: Reaction time testing software.

Results

Age

The analysis of the reaction time based on the age intervals is given in this section. Each age interval has ten participants with an equal mix of male and female participants. The results show that the mean RT initially decreased from 11 to 15 years to the interval of 21 to 25 years and increased from the age interval of 46-50 years to 61-65 years. While the first three age intervals experienced a decline in the mean RT, the last four age intervals experienced an increase in the mean RT. The age interval of 21-25 years had the fastest mean reaction time. The mean RTs for the age interval are shown in Figure 2. An ANOVA test was performed to compare the mean RT between the age intervals. The level of significance was based on a predetermined alpha level of 0.05. The ANOVA test shows a significant difference between the mean RT for the age intervals.

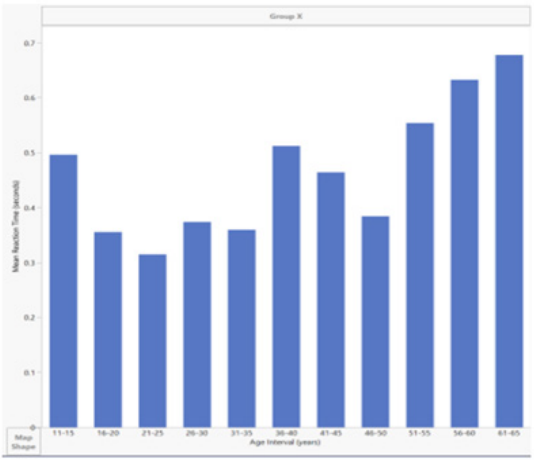

Figure 2: Mean reaction time based on the age intervals.

Further analysis performed on the mean RT using a post-hoc ANOVA (Turkey-Kramer test) shows that the age interval of 61-65 years significantly differed from the age intervals 16-20, 21-25, 26-30, 31-35, and 46-50 years. The 61-65 interval had a mean increase of reaction time by 90%, 115%, 81%, 88%, and 76%, compared to other groups, respectively. Table 1 shows the connecting letter report. Levels not connected by the same letters are significantly different. The mean reaction time of age intervals 21-25 significantly differs from the mean reaction time of the age intervals of 56 to 60 years, with the reaction time double that of the 21 to 25 years age interval.

Table 1: Connecting letters report for mean reaction time based on age intervals.

Level				Mean
61-65	A			0.67768
56-60	A	B		0.63259
51-55	A	B	C	0.55395
36-40	A	B	C	0.51212
Nov-15	A	B	C	0.49632
41-45	A	B	C	0.46425
46-50		B	C	0.38414
26-30		B	C	0.37386
31-35		B	C	0.35942
16-20		B	C	0.3553
21-25			C	0.31492

Gender

The analysis of the reaction times based on gender is given in this section. Figure 3 shows the gender comparison of the reaction times. The mean RT for all the male participants was faster than the mean RT for the female participants; the reaction time for females increased by 8%.

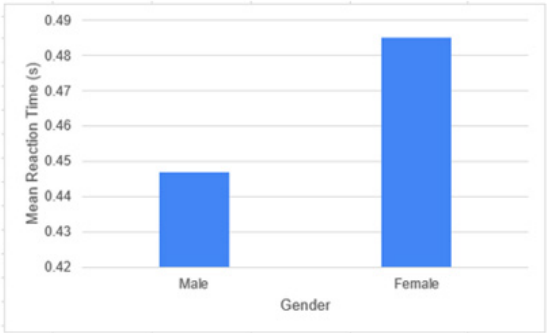

Figure 3: Mean reaction time based on gender.

Age and Gender

The mean reaction time between the genders based on age intervals is shown in Figure 4. Gender comparison within the age intervals indicates that females have a faster mean RT in age intervals of 11 to 15, 41 to 45, 51 to 55, 56 to 60, and 61 to 65. In contrast, males reacted faster in the other age intervals time. An ANOVA test was performed within each age interval between the genders. Only age intervals of 11 to 15 and 41 to 45 were found to be significantly different, with an increase in reaction time by 95% and 87% from females to males, respectively.

Figure 5 shows the reaction time of the male participants across all the age intervals. The fastest reaction time can be found in the age intervals of 21 to 25 years, and the slowest reaction time is in the age intervals of 61 to 65 years. An ANOVA test was performed to compare the mean RT between the age intervals in males to test for significance with an alpha value of 0.05. The ANOVA test shows a significant difference between the mean RT for the age intervals in males. Further analysis performed on the mean RT using a post-hoc ANOVA (Turkey-Kramer test) shows that the age interval of 61-65 years was significantly different from 21 to 25 years, with an increase in reaction time of 43%. The reaction time of the females in all the age intervals

is shown in Figure 6. The age interval of 21 to 25 years had the fastest reaction time, Table 2 while the age interval of 56 to 60 had the slowest reaction time. An ANOVA was performed between the age intervals for females with an alpha value of 0.05. The ANOVA test results did not show any significance between the age intervals.

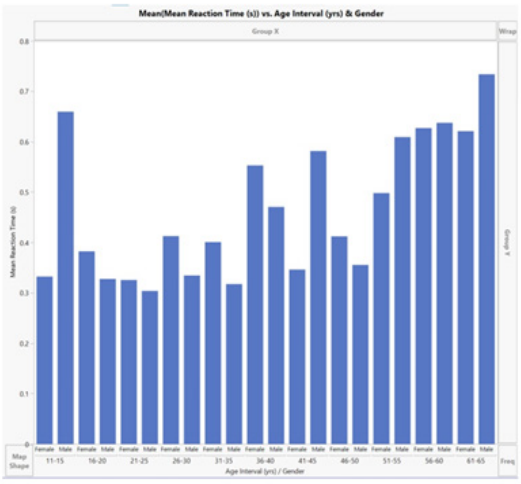

Figure 4: Gender comparison within age intervals.

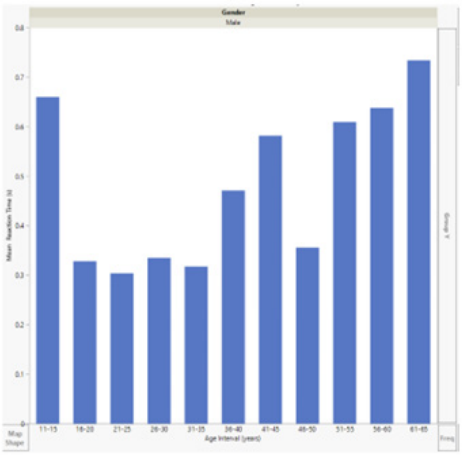

Figure 5: Reaction time for males for different age intervals.

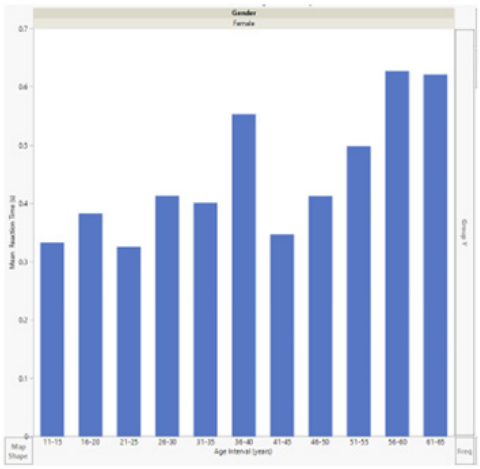

Figure 6: Reaction time for females for different age intervals.

Table 2: Connecting letters report for males.

Level			Mean
61-65	A		0.7341
Nov-15	A	B	0.6599
56-60	A	B	0.6379
51-55	A	B	0.6096
41-45	A	B	0.5819
36-40	A	B	0.471
46-50		B	0.3558
26-30		B	0.3347
16-20		B	0.3278
31-35		B	0.3178
21-25		B	0.304

Discussion

A study conducted by the United Kingdom Health and Lifestyle Survey [16] analyzed the differences in age and gender for a simple RT and reported that the RT remained approximately the same until age 50. This report agrees with our study as the post-hoc ANOVA analysis shows no statistical difference in the mean RT ranging from age intervals 11-15 to 46-50 years. Our study reports that the mean RT for males was faster than for females. This result agrees with several studies on gender differences in RT [17-20]. The findings regarding age effects on the mean RT align with the evidence from the life span studies. Like the previous studies [21-23], we found that the mean RT trajectories are characterized by an improvement in adolescence and a much slower deterioration through the adult age range. Some of these effects may be due to a difference in the ability to sustain attention at different ages. From the analysis, the age interval of 21-25 years had the fastest overall mean RT, fastest mean RT for males, and fastest mean RT for females. It can be concluded that people respond faster to stimuli as they advance into adolescence. Our findings confirmed the commonly reported pattern of increasing speed in RT from adolescence to young adulthood, followed by a decrease in the speed of RT through adulthood. Our study added to the existing knowledge by comparing and analyzing the RT of genders within and between age intervals.

Strengths and Limitations

One main strength of this study is that it provides a large sample analysis of age and sex effects, including both adolescence and adults. Small sample sizes, narrow age ranges, or both often hindered previous studies that investigated RTs. These shortcomings often prevented investigators from performing proper statistical analyses to test their hypotheses. One limitation is that the data do not provide information about the developmental change in RT but only about differences between participants of different ages. Older adults are more likely to suffer from impaired vision. They are more likely to refuse to participate, being aware of their problem. This study employed only the simple RT, an expansion of the study in the future could include other forms of stimuli.

Conclusion

This study aimed to evaluate the effect of age and gender on reaction time based on visual stimuli for participants aged 11 to 65 years. The results show significant differences in reaction time based on age intervals, with the age interval of 21-25 years having the fastest mean reaction time. Furthermore, the study found that the mean reaction

time increased significantly in the age intervals of 46-50 to 61-65. The reaction times for males and females show no significant differences, with the males performing slightly better than the females. The findings of this study contribute to a better understanding of the impact of age on reaction time and highlight the importance of considering age differences in the design of cognitive tasks.

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