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On the Road to Safety: Standardizing the RT-2S Brake Reaction Time Tester

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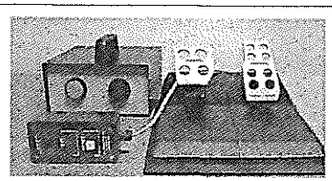
PURPOSE

•The purpose of this study was to standardize the RT-2S Simple Reaction Time Tester as a reliable and valid instrument for use in driving evaluations.
•Although brake reaction time alone will not accurately predict whether an older driver is fit or unfit to drive, it is a valuable component for the driving evaluator when considering all the elements in a comprehensive driving evaluation. In the past, brake reaction time has been measured by the *blue box*, a brake reaction timer manufactured by the American Automobile Association (AAA). The AAA brake reaction timer is no longer being manufactured, and therefore, there is a need for a new, reliable reaction timer. This will be done by comparing the brake reaction times collected on the RT-2S to norms established by the standardized AAA brake reaction timer.



DESCRIPTION

•Brake reaction time is typically measured as the time of the stimulus to the time an individual fully depresses the brake pedal. There are several processes involved:
- •First factor is the mental processing time, the time it takes for the individual to perceive a signal has occurred and to decide on a response.
- •Second factor is the time it takes the individual's muscles to perform the programmed movement to the brake.
- •Final component is the device response time. This is the time it takes the physical device to perform its response.
- •Simple brake reaction time is considered to be one response to one stimulus while choice reaction time is when an individual has to make a choice between two or more stimuli and possibly response with one or more reactions.

DESIGN

A correlational research design was used in this study since the information collected about the brake reaction times of different age groups will be compared to the information previously collected using the AAA Automatic Brake Reaction Timer. In this study, the independent variable is the age of participants, and the dependent variable is the brake reaction times of participants.

REFERENCES

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SAMPLE

Participants were recruited from the eastern United States during community health fairs. Demographic information of age, gender, and self reported health status is depicted in Table 1. Examination of race/ethnicity differences by gender were conducted using a Chi Squared test with continuity correction. Race/ethnicity was not found to be significant between the two groups (X^2 (1, n=396) = 1.018, p = .601). Similarly, age differences were examined by gender using an independent samples t-test and were found to be non-significant (t (394) = 1.430, p = .153). Prior to the study, the researchers obtained Institutional Review Board approval.

Table 1: Demographic Comparison by Gender

Participants	Male (n=124)	Female (n=272)
Age (mean ± sd)	47.89 ± 19.539	50.88 ± 19.192
Brake Reaction Time Average (1/100 sec, mean ± sd)	0.455 ± .0985	0.5176 ± .1628
Race/Ethnicity (n and %)		
White	n = 103 (83.1)	n = 193 (71)
Black	n = 13 (9.7)	n = 53 (19.5)
Hispanic	n = 9 (7.2)	n = 6 (2.2)
Asian		n = 20 (7.4)
Self Report Health Status (n and %)		
Fair	n = 23 (18.5)	n = 54 (19.9)
Good	n = 60 (48.4)	n = 117 (43.0)
Excellent	n = 41 (33.1)	n = 101 (37.1)
Age Categories (n and %)		
35 years or younger	n = 41 (32.3)	n = 74 (26.8)
36-55 years	n = 36 (28.3)	n = 76 (27.5)
56-65 years	n = 19 (15.0)	n = 47 (17.0)
65 years and up	n = 31 (24.4)	n = 79 (28.6)

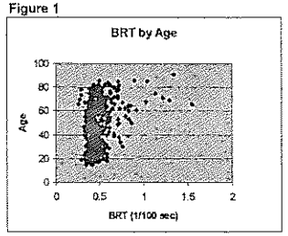
PROCEDURE

•All subjects sat in the same standard, immobile chair with the foot pedal module on the ground in front of them during testing.
•The test light box with illuminated red and green lamps was placed on a table directly in front of subjects within easy viewing distance.
•Each subject was asked to adjust his or her chair in relation to the foot pedal module to ensure the subject was able to easily and comfortably reach the foot pedal module, as if they were in their car.
•All subjects were given specific, consistent directions throughout all trials in the study. Subjects were instructed to place their right foot on the accelerator pedal and keep it depressed enough to maintain the illumination of the green lamp.
•Before testing began, all subjects were instructed to move their right foot from the accelerator pedal to the brake pedal and depress the brake pedal as rapidly as possible when the red lamp on the test light box illuminated.
•Timing between the illumination of the red and green lamps was randomly controlled by the researchers for two, three, or four seconds.
•During testing, each subject was given one practice test and three trials that were used for data analysis.

RESULTS

•Figures 1 and 2 depict a scatter plot distribution and histogram of participants average brake reaction times by age and gender. Age groupings were done in the same age brackets as with the AAA norms.
•Figure 3 shows a gender comparison of the average brake reaction times across the three trials. An average brake reaction time across trials was calculated and used to examine gender difference. These data indicate significant differences with male having a faster average brake reaction time by 0.062 seconds (t (394) = 3.1952, p < 0.01, CI 0.031-0.094).
•Weak but significant relationship between age and brake reaction time where younger drivers responded quicker than older drivers (r (n = 396) = 0.306, p < .01).
•An independent samples t-test was used to examine difference between younger (age ≤ 55 years) and older (age ≥ 56 years) drivers (t(401) = 4.593, p≤ .001, CI 95% .136-.054).

Figure 1



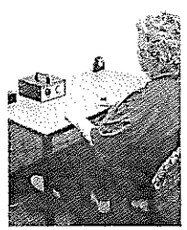


Figure 2

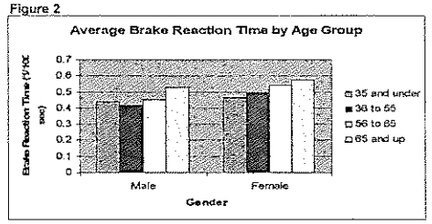
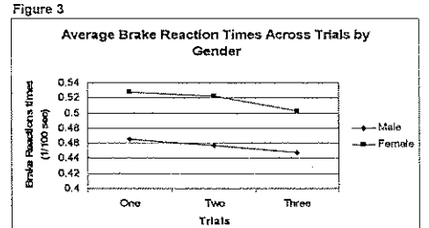


Figure 3



CONCLUSIONS

The brake reaction times of the different age groups tested increased with age with the exception of the 36 to 55 year old males. There was also a significant difference between younger and older drivers when compared between the two groups. This increase in brake reaction time with aging was expected.

The average brake reaction time for males was faster than the average time for females when tested using the AAA instrument. As with previous studies, males had a faster average brake reaction time than females.
Overall, the average of the brake reaction times collected using the RT-2S Simple Reaction Timer was slower than the average of the brake reaction times in the AAA norms. There are several potential reasons include the difference in the testing environment, a smaller sample size, or fewer number of trials.

An alternative interpretation is that the RT-2S is a more accurate reflection of an individual's simple brake reaction time. This is supported by the Gotlin et al. (2000) study. They stated their results "challenge" the AAA norms. The study group, females who had right anterior cruciate ligament reconstruction, improved over six weeks to equal the control group in brake reaction time. However, even after 6 weeks, neither the control or the reached the 50th percentile of the AAA norms. Since participants reported themselves as being "recreational athletes," it does raise the question of the validity of the AAA norms, particularly for females. Since the RT-2S times were overall slower than the AAA blue box, the female subjects in Gotlin's study would have been at least in the 50th percentile or more. Thus, it may be that the RT-2S more accurately reflects simple reaction times.

SUMMARY

In reality, attempting to determine the absolute brake reaction time for an individual is probably not possible. In any given situation, the human factor is characterized by great variability and the situations in which they operate a motor vehicle are so large that it impossible to assign a single number or even a range of numbers to the perception-response time in the context of driving.

Clearly, simple reaction timer cannot be the only or even large factor in the decision, but when evaluating drivers, particularly older adult drivers, having a simple reaction timer with valid simple reaction time norms, gives another piece of information that the driving evaluator can use for determining whether an individual is safe to operate a motor vehicle. If a simple brake reaction tool is used, then appropriate validity and reliability studies must be done.

Based on the findings of this study, the RT-2S Simple Reaction Time Tester is an appropriate replacement instrument for the AAA Brake Reaction Timer. In fact, it may be that the **RT-2S more accurately reflects** simple reaction times than the AAA blue box. The availability of this instrument will allow driving evaluators to continue or begin to assess the safety of older drivers and drivers who have physical or mental impairments. However, additional studies with a larger sample and a greater variety of geographical areas would be useful to confirm the reliability and validity of the RT-2S Simple Reaction Timer across all populations.