# SIMPLE REACTION TIME CHARACTERISTICS AMONG MALE AND FEMALE COLLEGE ATHLETES

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**INTRODUCTION:** Reaction time has been of interest to researchers for many years, with the first study on reaction time being performed in 1868 (Koster, 1969). Visual simple reaction time (SRT) was originally reported at 190 milliseconds (ms) and 200ms for college-aged individuals (Galton, 1890; Koster, 1969). Physically active individuals appear to have faster RT than sedentary individuals (Brisswalter, Arcelin, Audiffren & Delignieres, 1997). This increase of RT does seem to have an upper limit though. For example, practice may improve sport specific choice reaction time, however, it does not appear to improve SRT regardless of the level of play (collegiate or professional) (Kida, Oda & Matsumura, 2005).

It has been well established that males have faster RT than females (Der & Deary, 2006; Noble, Baker & Jones, 1964), however, there is very little recent research regarding reaction time difference among gender in sport. In a recent literature review of athletic populations, Silverman (2006) concluded that the disparity of SRT between genders may be diminishing due to an increase in sport participation and training for females in recent history. In 1985, Thomas & French concluded differences in motor performance variables (including reaction time) were due to social expectations of genders while growing up. It was typical for boys to be expected to play sports and to play "rough and tumble" style games while females were discouraged from such acts. It was therefore hypothesized that these social expectations may cause gender differences in brain formation.

After the first few years of life, the brain is altered by removing connections that are used infrequently (Blakemore & Choudhury, 2006), as well as myelinating nerve axons to improve conduction velocities (Yakovlev & Lecours, 1967). The differences in styles of play at young ages, with males reinforcing nerve connections and myelination development and females style of play not reinforcing these adaptions, are thought to lead to the reported 3.4% slower brain nerve conduction velocities in females (Reed, Vernon & Johnson, 2004). These phenomena may be one possible cause of the disparity in RT between genders. Only recently have young girls started to play sports competitively leading to earlier training and participation. This participation in sport may reinforce the neural connections needed to produce comparable RT's between genders.

To the authors' knowledge, only a single study has investigated gender reaction time differences in the same sport. The differences of RT between genders is well known, but there is minimal research into RT of females in sport, such as softball, women's tennis and women's basketball. Therefore, the purpose of this investigation is to determine the SRT of multiple sports, and compare the SRT of males and females of the same sport including baseball, softball, men's and women's basketball, and men's and women's tennis.

**METHODS:** One hundred and one male and female collegiate athletes aged between 18 and 21 years old participated in the present investigation. Sports involved in the study included baseball, softball, men and women tennis, men and women basketball, women soccer, and men and women throwers attending either East Tennessee State University or Milligan College. Prior to the initiation of the Fall 2016 semester, each athlete's SRT was tested as part of a greater athlete

monitoring program. The study was approved by East Tennessee State University Institutional Review Boards and all subjects provided written consent.

Reaction time was determined using a highly sensitive reaction measurement device accurate up to 10 milliseconds known as an RTbox (RTbox version 6, Ohio State University) connected to a Macintosh laptop (Mac OS X, Apple Inc.), and a Dell computer monitor (E2216HV, Dell Inc.). Athletes were asked to sit at the computer with the RTbox placed directly in front of them on a desk, 12 inches away from a monitor. Following initial instructions, the athletes were prompted to press and release a single button with their index finger following every flash that occurred in the center of the computer monitor. A total of fifteen trials were completed for each athlete. Time between each flash was set to 3+random second interval to limit the reaction time being a result of anticipation rather than and true measurement of reaction.

Data were screened for outliers using box plots and normality was determined using a Shapiro-Wilk test. A 2X5 (gender x sport) factorial ANOVA was computed to determine any group differences. Following significance, a post-hoc analysis was computed for any significant main or interaction effects with a Holm's sequential adjustment. Cohen's d effect size statistics were calculated for post-hoc comparisons to determine the magnitude of difference. Cohen's d effect size was interpreted as trivial (0.0), small (0.2), moderate (0.6), large (1.2), very large (2.0), and nearly perfect (4.0) (Hopkins, 2002).

**RESULTS:** All reaction time data were considered normally distributed. Outliers were determined as any response exceeding .4 seconds. A 2 x 5 (gender x sport) RM ANOVA showed statistically significant differences for gender $F(1, 70) = 10.518$, $p = .002$ and no differences for sport $F(5,70) = 0.339$, $p = .887$ or an interaction effect $F(1,70) = 1.181$, $p = .281$. Post hoc comparisons with a Holm's sequential adjustment revealed that women athletes displayed significantly slower reaction times when compared to their male counterparts participating in: baseball vs softball ($p < .001$, Cohens $d = .37$, 95% CI = -.017 to -.006), basketball ($p < .001$, Cohens $d = 1.16$, 95% CI = -.035 to -.024), and tennis ($p < .025$, Cohens $d = .384$, 95% CI = -.016 to -.001) (Figure 1).

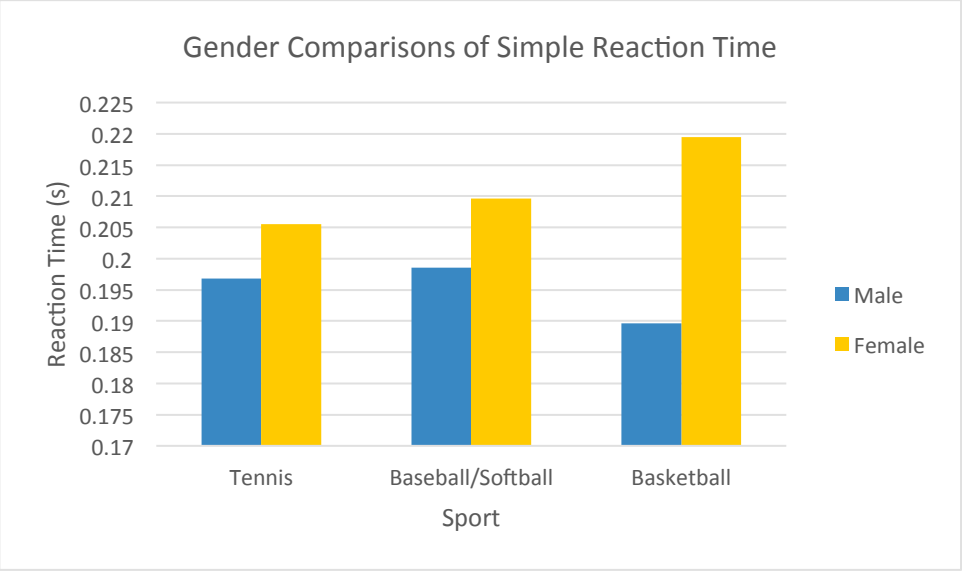


***Figure 1.*** Comparison of average reaction times between male and female collegiate

athletes from closely related sports.

**DISCUSSION:** The authors' analysis of the data support the previously shown difference between males and females concerning RT (Der & Deary, 2006; Noble et al., 1964). Though the authors hypothesized that a significant difference would be shown between sport and an interaction effect shown between gender and sport, none was seen. This only servers to bring up more questions as to the nature of RT and its relationship with gender and sport.

One limitation of this study is that the RT assessment is dissimilar to sport-specific situations. An interesting follow-up would be to test athletes' RT to a sport-specific stimulus, such as a softball pitch or tennis serve, with an appropriate situational response. Furthermore, future study should be directed to elucidate critical time periods for both males and females across a variety of sport that reflect the complexity of these unique situations. For example, the pitching distance, speed, and angle of release can be markedly different between the sports of softball and baseball. This difference in sport characteristics may greatly affect the way in which decisions are made and the time in which players can react.

The athletes in the present study were also taken from different levels of collegiate athletics - Milligan College competes in the National Association of Intercollegiate Athletics (NAIA), while ETSU is active in NCAA Division I athletics. Perhaps a more homogenous subject group would have shown different results. The authors recommend future research in the area of RT with respect to individuals in differing levels of competition, and also the difference between these levels in game speed, or the time windows in which quick reaction is imperative for sporting success.

**REFERENCES**

Ando, S., Kida, N., & Oda, S. (2001). Central and peripheral visual reaction time of soccer players and nonathletes. *Perceptual and motor skills*, *92*(3 Pt 1), 786.

Blakemore, S. J., & Choudhury, S. (2006). Development of the adolescent brain: implications for executive function and social cognition. *Journal of child psychology and psychiatry*, *47*(3□4), 296-312.

Brisswalter, J., Arcelin, R., Audiffren, M., & Delignieres, D. (1997). Influence of physical exercise on simple reaction time: effect of physical fitness. *Perceptual and motor skills*, *85*, 1019-1027.

Chung, P., & Ng, G. (2012). Taekwondo training improves the neuromotor excitability and reaction of large and small muscles. *Physical therapy in sport*, *13*(3), 163-169.

Dane, S., & Erzurumluoglu, A. (2003). Sex and handedness differences in eye-hand visual reaction times in handball players. *International Journal of Neuroscience*, *113*(7), 923-929.

Der, G., & Deary, I. J. (2006). Age and sex differences in reaction time in adulthood: results from the United Kingdom Health and Lifestyle Survey. *Psychology and aging*, *21*(1), 62.

Eckner, J. T., Kutcher, J. S., & Richardson, J. K. (2010). Pilot evaluation of a novel clinical test of reaction time in National Collegiate Athletic Association Division I football players. *Journal of athletic training*, *45*(4), 327-332.

Galton, F. (1890). Exhibition of instruments (1) for testing perception of differences of tint, and (2) for determining reaction-time. *The Journal of the Anthropological Institute of Great Britain and Ireland*, *19*, 27-29.

Hopkins, W. G. (2002). A scale of magnitude for effect statistics.

Kida, N., Oda, S., & Matsumura, M. (2005). Intensive baseball practice improves the Go/Nogo reaction time, but not the simple reaction time. *Cognitive brain research*, *22*(2), 257-264.

Koster, W. G. (Ed.). (1969). *Attention and performance II: proceedings of the Donders Centenary Symposium on reaction time, held in Eindhoven, July 29-August 2, 1968*. Amsterdam: North-Holland Publishing.

Nakamoto, H., & Mori, S. (2008). Sport-specific decision-making in a Go/NoGo reaction task: difference among nonathletes and baseball and basketball players. *Perceptual and motor skills*, *106*(1), 163-170.

Noble, C. E., Baker, B. L., & Jones, T. A. (1964). Age and sex parameters in psychomotor learning. *Perceptual and Motor skills*, *19*(3), 935-945.

Reed, T. E., Vernon, P. A., & Johnson, A. M. (2004). Sex difference in brain nerve conduction velocity in normal humans. *Neuropsychologia*, *42*(12), 1709-1714.

Silverman, I. W. (2006). Sex differences in simple visual reaction time: A historical meta-analysis. Sex roles, 54(1-2), 57-68.

Thomas, J. R., & French, K. E. (1985). Gender differences across age in motor performance: A meta-analysis. Psychological bulletin, 98(2), 260.

Yakovlev, P. I., & Lecours, A. R. (1967). The myelogenetic cycles of regional maturation of the brain. Regional development of the brain in early life, 3-70.