Original Article

Simple and Discrimination Reaction Time in Young 7–17-year-old athletes

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Abstract

The purpose of this research is to investigate the relation between simple reaction time and discrimination reaction time among athletes. Another aim of this study is to investigate how reaction time changes according to the development of the child, as some of the subjects are stable for some years. The sample of the research are 600 athletes aged 7-17 years old and 116 athletes aged 10-17. The instrument that is used is an improvised program in the computer where simple reaction time and discrimination reaction time is recorded. For the analysis of the data descriptive statistics, Pearson Correlation, and Linear Regression are used. The results showed that there are statistically significant differences and correlations among the subjects. This study will attribute to the scientific community as interesting findings arise.

Key-words: simple reaction time, discrimination reaction time, athletes, age, basketball

Introduction

There are a lot of stimuli in which people have to react to (Taskin, 2016). The interval between the appearance of a visual, an auditory or a tactical stimulus and a movement, is called reaction time (Raichur 2013). Raichur, (2013) claims that reaction time includes cognitive, metacognitive and kinetic functions. More specifically, there are functions as the stimulus' editing, the plan for giving an answer and the appropriate movement to the stimulus (Raichur, 2013). Before reaction time there is a period in which people get ready for action (Niemi & Näätänen, 1981). Reaction time, according to Sokolova, Rukšėnas, & Burle, (2013) is faster when the stimulus appear than when it disappears. The subject's uncertainty for action at the stimulus plays also an important role (Niemi & Näätänen, 1981).

There are three kinds of reaction time: simple reaction time, choice reaction time and discrimination reaction time. Simple reaction time is a reaction in just one stimulus (Raichur, 2013· Solanki, Joshi, Shah, Mehta, Gokhle, 2012). Choice reaction time is the reaction of the subject which is corresponding to the stimulus that appears (Raichur, 2013· Solanki et al., 2012). Specifically, the subject has to push that button which shows the letter that appears in the screen. In discrimination reaction time there are a lot of stimuli and in some of them the subject has to answer, whereas in other stimuli not (Kosinski, 2008). Kosinski (2008), claims that the slower reaction time is the choice reaction time and simple reaction time is faster than discrimination reaction time. Kosinski (2008), adds that discrimination reaction time is about 384 ms, whereas simple reaction time is about 220 ms. Reaction time is also discriminated into functions. According to Senel & Eroglu (2006) when a stimulus appears the person has to understand and decode the stimulus whether it is visual, auditory or tactical, has also to take the right decision and then react successfully by giving the right answer to the stimulus.

Reaction time happens when a stimulus (visual, auditory, tactical) appears and the person has to react to it (Harrar & Harris, 2008· Ng & Chan, 2012). There are visual, auditory and tactical stimuli. Visual stimuli is when light appears, auditory stimuli is when the person has to react in a sound and tactical stimuli is when the person has to react in a stimulus which they understand by touching. Some researches show that reaction time in an auditory stimulus is faster than in a visual stimulus (Berezovsky, Jarvey, Popelka, & Lewandowski, without date· Shelton & Kumar, 2010). Mohan Chandra, Ghosh, Barman, Iqbal, & Sadhu, (2010), Shelton & Kumar, (2010) claim that reaction time in visual stimuli is about 180-200 ms, whereas in auditory stimuli is about 140-160 ms and Raichur (2013) mentions that the normal reaction time for the auditory stimulus is about 170 ms, whereas for the visual stimulus 250 ms. Auditory stimuli are faster than the visual stimuli (Raichur, 2013). This happens as audition reaches brain without wasting of time, something that does not happen with visual stimuli. The most researches mention reaction time in visual or in auditory stimuli, but there are also some less researches that mention the reaction in a tactical stimulus such as the reaction of a finger when the person feels a vibration in a palm or in a finger (Frith & Done, 1986). Simple reaction time of a tactical stimulus, as Frith & Done (1986) mention is faster than in a visual stimulus. Forster, Cavina-Pratesi, Aglioti, & Berlucchi (2002), claim that the participants in their research reacted faster when visual and auditory stimuli happen at the same

time than when one of them happens. Kosinski, (2008) also claims that the reaction in an auditory stimulus is faster than in a reaction in a visual stimulus. This may happen because auditory stimulus needs half of the time to reach brain than a visual stimulus (Kosinski, 2008). Simple reaction time as choice reaction time in a sudden and intense auditory stimulus is faster, as such a stimulus make the subject react faster (Nijhuis, Janssen, Bloem, Van Dijk, Gielen, Borm, & Overeem, 2007· Jaśkowski και Włodarczyk 2006).

There are some individually, social, psychological traits or other factors that influence reaction time, they either increase them or decrease them. For example, exercise makes reaction time decrease (Kosinski, 2008), whereas fatigue makes it increase (Kosinski, 2008· Matchock & Mordkoff, 2007). High IQ also influences reaction time, as information decoding happens in a faster way (Akarsu, Çalışkan, & Dane, 2009· Reed & Jensen, 1993), also some personality traits as extroversion make reaction time decrease (Kosinski, 2008). Exercise, as mentioned before, influences reaction time by decreasing it (Kosinski, 2008· Senel & Eroglu, 2006). High temperature makes reaction time increase (Mohan Chandra et al., 2010) and so do alcohol, sickness, brain injury, learning disorder, whereas attention makes reaction time decrease (Kosinski, 2008). Two factors that do also influence reaction time is the warning for the stimulus that is coming, that makes reaction time decrease and feint that makes reaction time increase (Kosinski, 2008). According to Kosinski (2008) the weaker the stimulus is, the reaction time increases. Reaction time is also influenced by age, sex, diet, training, number and frequency of the stimuli (Senel & Eroglu, 2006). Raichur, (2013) mentions that reaction time is influenced by central or regional vision, by personality, by lack of food.

Reaction time plays also an important role in sports, as it is a cognitive skill that can discriminate the level of athletes. Mori, Ohtani, & Imanaka, (2002) claim that reaction time plays also an important role in karate, as without reaction time the athletes cannot beat their opponent. Studies show that athletes were faster in their reaction time than people who were not athletes (Akarsu et. al., 2009· Kaya, 2016· Senel και Eroglu, 2006). Reaction time may be faster 0,12 seconds when the person exercises (Kaya, 2016). According to Senel & Eroglu (2006), reaction time is negatively influenced by athletes' fatigue.

Age also plays a role in reaction time. At the age of 9 and 10, Kaya (2016) claims that there is the biggest improvement of reaction time. After the age of 65 reaction time becomes even slower (Kosinski, 2008). It is also worth mentioning that the bigger someone is, the more difficult is to understand a lot of stimuli at the same time, something that does not happen when the person is younger (Kosinski, 2008). Kosinski (2008) also claims that the mean of reaction time in auditory stimuli in young people between the ages of 15-19 is about 158 ms, whereas the reaction time in visual stimuli is about 187 ms.

Apart from age that plays an important role in a person's reaction time, another trait that is also important is the person's sex. A lot of researches show that men are faster than women in both visual and auditory stimuli (Kosinski, 2008· Shelton & Kumar 2010· Solanki et. al., 2012· Teleb & Al Awamleh, 2012· Tun & Lachman, 2008). Kosinski, (2008) claims that the difference between the genders is getting decreased in recent years. Kosinski, (2008) also adds that the difference in reaction time between men and women is normally from the moment the stimulus appear until the first movement of the muscles. Teleb και Al Awamleh (2012), mention that although men are faster than women in reaction time, women are more accurate. Tun & Lachman, (2008) claim that in choice reaction time men are also faster than women. Athletes that were men were also faster in both visual and auditory stimuli than women that were athletes, as Teleb και Al Awamleh (2012) mention. Reaction time in auditory stimuli is faster than reaction time in visual stimuli (Berezovsky et al., without date· Mohan Chandra et al., 2010· Senel & Eroglu, 2006· Shelton & Kumar, 2010).

This research aims to compare the simple reaction time and discrimination reaction time among athletes. This research has also the purpose to investigate the reaction time when a child develops.

Material & methods

Participants

For the first project, the sample of this survey consists of 600 athletes aged 7-17 years old, whereas for the second project, it consists of 116 athletes aged 10-17 years old. The athletes participated in the PAOK "Junior" basketball program. These athletes are minors, and therefore, consent forms were handed out to their parents, informing them about the purpose of and need for the survey, in order for them to give their consent for the conduct of the survey.

Instruments

The data collection tool was an improvised computer program, which estimated the simple reaction time and the discrimination reaction time. Regarding the simple reaction time, each participant was required to press a keyboard button, when a visual stimulus was displayed on the screen. In terms of the discrimination reaction time, the subject had to press the keyboard button only when a specific visual stimulus was displayed. The program estimates the interval from the display of the stimulus until the reaction of the subject.

Statistical analysis

In order to analyze the research data, descriptive statistics, Pearson Correlation, and Linear Regression were used. In more detail, after the natural numbers that referred to the reaction time and age variables had been converted to logarithms, linear regression was used, in order to investigate the relationship of age to simple reaction time, and also the relationship of age to discrimination reaction time.

Results

The results that emerged from this survey show that age plays a very important role with regard to reaction time, whether it is simple or discrimination. In more detail, the results that were derived, demonstrated the effect of age on simple reaction time in children aged from 7 to 17 years old; the higher the age up to adulthood, the lower the simple reaction time of the athletes. In figure 1, the total number of subjects is shown for the first project and with regard to simple reaction time. In this Figure, a declining curve can be observed.

Figure 1. Simple reaction time with regard to the total number of subjects.

This resulted in a more linear relationship, after identifying the averages of the variables, converting them to logarithms, and taking Figure 2. Through the application of simple regression, a statistically significant effect was identified, of age on the simple reaction time of athletes aged from 7 to 17 years old, with $F=75.277$, $p<.05$, and $b1=-.945$. R^2 is equal to .893, and therefore, this effect is justified by 89.3%.

Figure 2. Simple reaction time with regard to age (logarithms).

A similar process was also followed in the second project and the measurement of discrimination reaction time. The logarithms of discrimination reaction time and age demonstrated a more linear model. Through the application of simple regression, a statistically significant effect was again identified, of age on the discrimination reaction time of athletes aged from 7 to 17 years old, with $F=41.276$, $p<.05$, and $b1=-.934$. R^2 is equal to .873, and therefore, this effect is justified by 87.3%

Figure 3. Discrimination reaction time with regard to age (logarithms).

A statistically significant correlation was identified between simple reaction time and discrimination reaction time, with $r=.892$, $p<.05$. Finally, within the sample, subjects were identified that remained constant over a time period, and their reaction times were tested at different time points. Nevertheless, the subjects who remained constant did not belong to specific age groups. Hence, through descriptive statistics, it becomes clear that the simple reaction time of children is improved, as they grow up and the project is repeated. Indicatively, this particular situation is highlighted in Figure 4, where a specific child appears to have a declining reaction time from the age of 9 years old to the age of 15 years old.

Figure 4. The simple reaction time of a subject over time.

Discussion

The results that emerge from this survey are interesting with the key finding referring to the fact that age is one of the most important factors that have an effect on both simple reaction time and discrimination reaction time. This finding is in line with the relevant literature, where it is reported that, the older the person, the higher the reaction time (Kosinski, 2008), while the greatest development in reaction time takes place from 9 to 10 years old up to adulthood (Kaya, 2016). A lower number of individuals were observed in the discrimination reaction time of the second project, compared to the simple reaction time of the first project, and the individuals that remained constant in different years, were not all constant at the same ages. In this survey, it is interesting that there is a gradual declining trend in simple reaction time at the ages from 7 to 17 years old and in discrimination reaction time at the ages from 10 to 17 years old, respectively. A pupil at the age of 7 years old shows a relatively fast reaction time, which is improved and becomes faster up to his or her adulthood. A key finding also refers to the fact that, in individual athletes who remained constant over different time periods, and appeared to show a faster reaction time, this was possibly due to a learning effect, while, in literature, it is reported that practice improves reaction time (Kosinski, 2008; Senel and Eroglu, 2006). Another possible cause is that, in this case, as well, age has an effect; the higher the age of a young athlete from 7 to 17 years old, the lower his or her reaction time. Another interesting fact in need of investigation refers to the study of a fixed group of individuals over time, in order to identify the reaction time in these groups.

Conclusion

Actually, the main objective of coaches/trainers who are also researchers is to optimize the basic skills and maximize the performance of an athlete. Basketball is a sequence of stimuli; an athlete should react to these

stimuli, in order for him or her to correspond effectively the requirements of the game. A faster reaction time to a stimulus can improve speed and performance during an activity. A performance enhancement program may include exposure to suitable visual stimuli, repeated exposure to stimuli during training sessions, with a visual stimulus serving as an information signal. The utilization of results derived from all the athletes can contribute to a team's performance optimization, which takes place through the implementation of actions and projects that can improve the reaction time and concentration of athletes, and prevent them from being distracted by external stimuli. This will result in an improvement of the individual skills of each athlete, as well as of the team as a whole.

References

- Akarsu, S., Çalışkan, E., & Dane, Ş. (2009). Athletes have faster eye-hand visual reaction times and higher scores on visuospatial intelligence than nonathletes. *Turkish Journal of Medical Sciences*, 39(6), 871-874.
- Berezovsky, A., Jarvey, E., Popelka, R., & Lewandowski, R. The Effect of Moderate Cardiovascular Exercise on Auditory Reaction Time.
- Frith, C. D., & Done, D. J. (1986). Routes to action in reaction time tasks. *Psychological research*, 48(3), 169
- Forster, B., Cavina-Pratesi, C., Aglioti, S. M., & Berlucchi, G. (2002). Redundant target effect and intersensory facilitation from visual-tactile interactions in simple reaction time. *Experimental Brain Research*, 143(4), 480-487.
- Harrar, V., & Harris, L. R. (2008). The effect of exposure to asynchronous audio, visual, and tactile stimulus combinations on the perception of simultaneity. *Experimental brain research*, 186(4), 517-524.
- Jaśkowski, P., & Włodarczyk, D. (2006). Task modulation of the effects of brightness on reaction time and response force. *International Journal of Psychophysiology*, 61(2), 98-112.
- Kaya, M., (2016) Effect of Reaction Developing Training On Audio-Visual Feet Reaction Time.
- Kosinski, R. J. (2008). A literature review on reaction time. *Clemson University*, 10.
- Matchock, R. L., & Mordkoff, J. T. (2007). Visual attention, reaction time, and self-reported alertness upon awakening from sleep bouts of varying lengths. *Experimental brain research*, 178(2), 228-239.
- Mohan Chandra, A., Ghosh, S., Barman, S., Iqbal, R., & Sadhu, N. (2010). Effect of exercise and heat-load on simple reaction time of university students. *International Journal of Occupational Safety and Ergonomics*, 16(4), 497-505.
- Mori, S., Ohtani, Y., & Imanaka, K. (2002). Reaction times and anticipatory skills of karate athletes. *Human movement science*, 21(2), 213-230.
- Ng, A. W., & Chan, A. H. (2012). Finger response times to visual, auditory and tactile modality stimuli. In *Proceedings of the International MultiConference of Engineers and Computer Scientists* (Vol. 2, pp. 1449-1454).
- Niemi, P., & Näätänen, R. (1981). Foreperiod and simple reaction time. *Psychological Bulletin*, 89(1), 133.
- Nijhuis, L. B. O., Janssen, L., Bloem, B. R., Van Dijk, J. G., Gielen, S. C., Borm, G. F., & Overeem, S. (2007). Choice reaction times for human head rotations are shortened by startling acoustic stimuli, irrespective of stimulus direction. *The Journal of physiology*, 584(1), 97-109.
- Raichur, N., (2013) Assessment of Audio-Visual Reaction Time in drivers. *Journal of Bioscience & Technology*, 4 (1), 508-512.
- Reed, T. E., & Jensen, A. R. (1993). Choice reaction time and visual pathway nerve conduction velocity both correlate with intelligence but appear not to correlate with each other: Implications for information processing. *Intelligence*, 17(2), 191-203.
- Senel, O., & Eroglu, H. (2006). Correlation between reaction time and speed in elite soccer players. *Age*, 21, 3-32.
- Shelton, J., & Kumar, G. P. (2010). Comparison between auditory and visual simple reaction times. *Neuroscience and Medicine*, 1(1), 30.
- Sokolova, R., Rukšėnas, O., & Burle, B. (2013). Differences between reaction time to stimulus onset and offset: evidence for post-perceptual effects. *Psychology*, 48(1), 70-78.
- Solanki, J., Joshi, N., Shah, C., Mehta, H. B., & Gokhle, P. A. (2012). A study of correlation between auditory and visual reaction time in healthy adults. *International Journal of Medicine and Public Health*, 2(2), 36
- Taskin, C. (2016). The Visual and Auditory Reaction Time of Adolescents with Respect to Their Academic Achievements. *Journal of Education and Training Studies*, 4(3), 202-207.
- Teleb, A. A., & Al Awamleh, A. A. (2012). Gender Differences in Cognitive Abilites. *Current Research in Psychology*, 3(1), 33.
- Tun, P. A., & Lachman, M. E. (2008). Age differences in reaction time and attention in a national telephone sample of adults: education, sex, and task complexity matter. *Developmental psychology*, 44(5), 1421.