



ORIGINAL RESEARCH

The effects of acute bout of cycling on auditory & visual reaction times



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KEYWORDS

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Visual reaction time;
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Summary *Aim:* The purpose of this study was to investigate the effects of an acute bout of cycling exercise on auditory choice reaction time, visual choice reaction time, auditory complex choice reaction time and visual complex choice reaction time.

Methods: 29 subjects were randomly divided into experimental and control groups. The subjects of the experimental group carried out a single bout of submaximal cycling exercise. The auditory choice reaction time, visual choice reaction time, auditory complex choice reaction time and visual complex choice reaction times were measured before and after the exercise session. The reaction time tests were taken from the subjects by using Speed Anticipation and Reaction Tester (SART) software. In the control group, the reaction time tests were performed by the subjects with an interval of 30 min.

Results: In the experimental group, the percentage changes of mean auditory choice and complex choice reaction time values were significantly decreased in comparison with the control group ($P < 0.05$). Although the visual choice and complex choice reaction times were decreased after the exercise, the changes were not significant ($P > 0.05$).

Conclusion: An acute bout of cycling exercise improved the speed of auditory and visual reaction times in healthy young females. However, these positive changes were significantly observed only in the auditory reaction time tests in comparison with the control group.

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Introduction

Reaction time (RT) is a common measure that indicates how long does it take a person to prepare and initiate a

movement (Magill, 2004). As RT involves central and peripheral components, it is used as a parameter reflecting cognitive and motor function (Ozyemisci-Taskiran et al., 2008). There are three different types of RT tasks; simple

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RT, choice RT and discrimination RT. Not only are these types of RT tasks used in laboratory experiments and sport environments, but also they exist in everyday life. Traffic light is a good example of choice RT task which is more common in everyday life. It has three possible signals and each of them needs a different reaction (Magill, 2004). Therefore, RT as a measure of information processing is a highly important parameter that is affected by several factors such as age, gender, arousal, fatigue and also physical activity.

Aerobic exercise as a popular type of physical activity has several benefits for individuals in all age ranges. In addition to prominent effects on cardiovascular and muscular adaptations, aerobic exercise also affects cognitive performance. Several studies have assessed the effects of aerobic exercise on cognitive function by means of RT (Collardeau et al., 2001, Davranche et al., 2006). However, the results of these studies are inconclusive.

Some authors analyzed RT and its fractions by using electromyography (EMG) (Ozyemisci-Taskiran et al., 2008; Audiffren et al., 2008), while others measured RT as a whole by means of computer-based methods (Collardeau et al., 2001, Garg et al., 2013). These methods are readily accessible and can be used as an inexpensive and alternative method for measuring RT.

Since the choice RT task is more common in everyday life; therefore we used it to assess the effects of cycling as an aerobic exercise on cognitive function of young adults. For this reason, we used a custom-made computer-based method for measuring visual and auditory choice and complex choice RTs. Therefore, the present study was designed to investigate the effects of acute bout of cycling on auditory and visual choice and complex choice RTs.

Methods & materials

Participants

Twenty-nine participants, considering inclusion/exclusion criteria, took part in this study. The subjects were selected among the students (in the age range of 20–30) who did not participate in either aerobic or resistance exercises in the preceding year. These healthy individuals were right handed females and did not have any acute or chronic diseases or hearing or visual problems. The subjects who were unable to do cycling or were consuming any medications which could affect their cognitive function were excluded from the study. Participants were asked to abstain from consuming caffeine or drinking alcohol during 12 h before initiation of the test session. The subjects were randomly divided into two experimental (fourteen subjects, mean age: 23 ± 2 years) and control (fifteen subjects, mean age: 23.07 ± 1.94 years) groups.

The study was approved by the ethics committee of Tehran University of Medical Sciences and informed written consents were obtained from all of the subjects.

Study procedure

Auditory and visual choice and complex choice reaction times were recorded using Speed Anticipation and Reaction

Tester (SART) software (Shadmehr and Amiri, 2012). Inter-rater and Intra-rater reliability of the SART software had already been assessed (Nuri et al., 2012). This custom-made software was installed on a laptop computer which was connected to a 24 inch LCD monitor and a four button joystick. The participants were asked to sit 2 m away from and in front of the LCD screen which was used for displaying RT tests.

Reaction time tests, which were taken from all the subjects, consisted of two auditory choice and complex choice RT tests and two visual choice and complex choice RT tests. The order of presenting RT tests was randomly chosen by the examiner.

After creating a profile for each individual, four different colored circles were displayed on the LCD screen. Each circle was matched with a key on the laptop's keyboard. Pressing each of the relevant laptop's keys by an examiner resulted in showing a visible light of each circle for visual RT tests or playing a particular sound for auditory RT tests.

Visual RT tests

In the visual choice RT test, subjects were asked to hold the four-button joystick and press the relevant button whenever each colored circle was lit.

For the visual complex choice RT test, participants were asked to press the button in the opposite direction for a given colored circle. For example, if the yellow circle was lit, instead of pressing the yellow circle on the left side of the joystick, the subject was asked to press the key button on the right side which was blue.

Auditory RT tests

Four different sounds with specific frequency (1000 Hz, 3000 Hz, 5000 Hz & 7000 Hz) were used to examine auditory choice and complex choice RT. Each frequency was shown with a different colored circle on the screen. By pressing each laptop's key by the examiner, a particular sound was played and the subject was asked to stop the sound by pressing the matched colored button on the joystick. For the auditory choice complex RT test, the same sounds were played but the subject was asked to press the button in the opposite direction for each sound.

It should be noted that before the initiation of the test session, the subjects were familiarized with the test instruments. Several trials of each RT test were carried out by the subjects in order to be familiarized completely with the RT tasks. The number of the trials was depended on each subject's desire. Therefore, the participants performed each RT trials as much as they wanted.

Each subject completed 30 repetitions (3 sets of 10 trials) for each RT test before and after the exercise protocol. Making errors more than 10% of repetitions in each RT test due to choosing incorrect button was considered as subject's error and the test was repeated.

Submaximal aerobic exercise

After assessing visual and auditory choice and complex choice RTs, the participants in the experimental group

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