RELIABILITY OF AN EYE-FOOT REACTION TIME TEST IN CHRONOJUMP-BOSCOSYSTEM

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Original scientific paper

Abstract
The purpose of this study was to determine the absolute and relative reliability as well as usefulness of an eye-foot reaction (EF RT) test using the Chronojump-Boscosystem. The study was participated by 7 college male (age: 20.0 ± 1.85 yrs; height: 170.4 ± 9.75 cm; weight: 60.7 ± 11.6 yrs; %bodyfat: 7.70 ± 2.87) and 18 female (age: 18.7 ± 1.47 yrs; height: 159.0 ± 4.11 cm; weight: 54.9 ± 10.5 kg; % bodyfat: 22.7 ± 6.11) university physical education students. They underwent right and left EF-RT test for 2 sets. Each set consists of 3 random trials completed within 30 seconds. Absolute reliability was determined using typical error as %CV. Relative reliability was identified using intraclass correlation coefficient (ICC). Test usefulness was established using smallest worthwhile change (SWC). Results revealed that EF RT on right foot showed a %CV = 0.00, ICC = 0.74 and SWC = 0.00. On the other hand, left EF RT posted a %CV =0.00, ICC = 0.86 and SWC = 0.00. In conclusion EF RT test in Chronojump-Boscosystem demonstrated good absolute reliability for right and left foot. Relative reliability for right EF RT was poor while left EF RT was good. For test usefulness, both right and left EF RT suggested marginal utility.

Keywords*: eye-foot reaction time, open source technology, Chronojump-Boscosystem, physical education*

INTRODUCTION

Eye-foot reaction time (EF RT) represents an interval time from the presentation of stimulus to the eye towards a foot behavioral response. In sports performance, EF RT plays a critical role in balance, control, speed and timing. Researchers found out that EF RT ability can discriminate level of athletic competency (Montés-Micó, Buno, Candel, & Pons, 2000). In another light, EF RT has been related to central nervous system insensitivity in patients with traumatic brain injury (Gould, Ciuffreda, Yadav, Thiagarajan, & Arthur, 2013). A simple EF RT can be measured using a commercially sold equipment which may seem costly to some practitioners. In the recent decade, there has been an increasing trend in the development open source technology (OST) for sports training and monitoring. OST presents a flexible and cost-efficient alternative to its users. One OST in sports is the Chronojump-Boscosystem. The Chronojump-Boscosystem consists of a open source hardware, software and various contact mechanisms which can detect time based measurements (Blas, Padullés, López del Amo, & Guerra-Balic, 2012)

Reliability is an important parameter for test utility. Absolute and relative reliability are two types of reliability (Baumgartner, 1989). Absolute reliability refers to degree of individual variation from repeated measurements. On the other hand, relative reliability is the degree of individual positional maintenance in a sample with repeated measurements. To provide a more meaningful interpretation of test reliability, Hopkins (2000a) suggested using typical error (TE) to identify real changes from technological or biological error. The purpose of this study was to establish the reliability and applicability of the Chronojump-Boscosystem EF RT Test.

METHODS

Participants
7 college male (age: 20.0 ± 1.85 yrs; height: 170.4 ± 9.75 cm; weight: 60.7 ± 11.6 yrs; %bodyfat: 7.70 ± 2.87) and 18 female students (age: 18.7 ± 1.47 yrs; height: 159.0 ± 4.11 cm; weight: 54.9 ± 10.5 kg; % bodyfat: 22.7 ± 6.11) from a university physical education class volunteered to participate in the study. The students have no any reported orthopaedic problem that would impair their participation in the study. They were asked to avoid alcohol, strenuous activity 48 hours before the session. No nutritional recommendation was provided. Participants signed a written informed consent prior to further participation. The procedures of the study agreed with the Declaration of Helsinki for Human Experimentation.

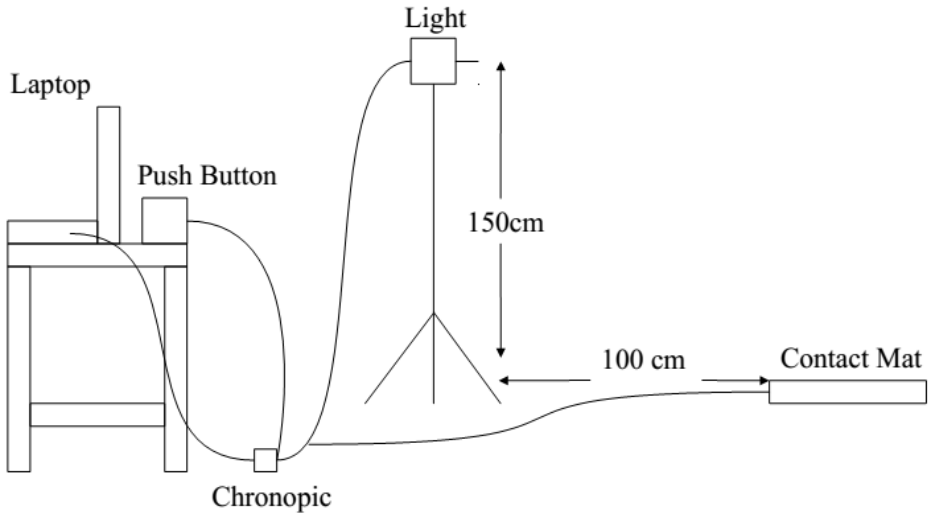
Procedures
The study occurred for two sessions. The first session was a familiarization session at an outdoor area that consisted of a generalized warm-up and

two trials of EF RT for each limb. In the second session, the participants visited the exercise science laboratory between 0700-1000 hrs. Upon arrival at the laboratory, the participants' anthropometrics were measured. Height was measured to the nearest 0.1 value using a stadiometer (SECA 201, SECA, GmBH & Co Kg, Hamburg, Germany). Weight and percentage body fat to were derived using a bioelectric impedance analysis equipment (Tanita BC-1000, Tanita Inc., USA) up to the 0.1 value. After, the participants were instructed to perform a 5-minute light jogging. This was succeeded by dynamic stretching exercises (Lunge Reach, Reverse Lunge Twist, Leg Swing, Toe Touch & Knee Hug to Quadstretch) of 2 sets of 5 repetitions per limb. A 3-minute rest was allowed after dynamic stretching. After 3 minutes, the participants performed the EF RT test. In this test, a participant stands with his/her right foot serving as the lead. Stance is shoulder width and body should be in the middle of light stimulus. Lead foot was 2.54 cm while the trail foot was 5.08 cm away from the platform. Knee angle was bent at approximately 70-80 degrees for both limbs. Both heels were kept flat on the floor. Upon seeing the stimulus (green LED light) randomly activated by the tester, the participant steps on the right plaform as fast as possible. This process is repeated for two more times until 3 random trials are completed within 30 seconds. This was succeeded by 30 second rest interval. This time was also used for lead foot transition. After, 3 trials were facilitated using the left foot. Another 30 second rest was allowed to switch leg for the second set of EF RT Test. The participants performed 3 more trials on the right and left foot respectively with a 30 second interval rest and lead foot transition. Additional trials were administered when tester detects any technical error (e.g. faulty foot contact on platform) or participant positional error (e.g. lead heel is off the floor). The mean time of three measurements for 2 sets in each leg were utilized for analyses.

Equipment

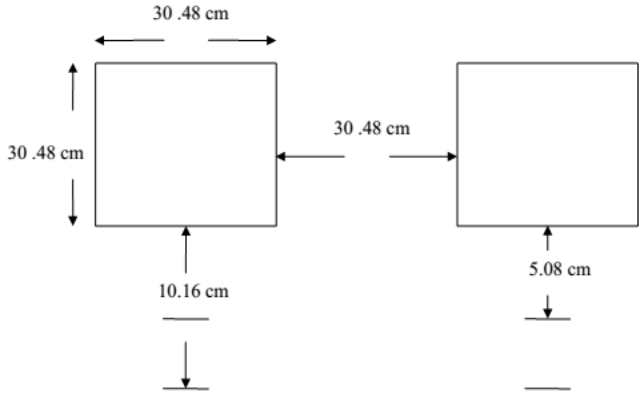
Simple EF RT test was measured using the Chronojump - Boscosystem. Chronojump - Boscosystem consists of an open source software, open hardware (Chronopic 3) and a contact mechanism. For this study, a 1 cm diameter push button was used to activate the 5 mm green LED light. Two enclosures measuring 3.8 cm x 7 cm x 10 cm were also used for push button and light covering. Diagram 1 displays the test equipment set-up for the Eye-Foot Reaction Time Test.

Diagram 1. Eye-Foot Reaction Time Test Equipment



Two parallel contact platforms (30.48 cm x 30.48 cm) were utilized as time mechanism in the study. Platforms were placed 150 cm away from the light source. There was a 30.48 space in between platforms. 5.08 cm and 10.16 cm markers for the lead foot and trail foot were also placed away from each platform. Diagram 2 shows the platform and marker distances.

Diagram 2. Contact Platform Set-Up



Statistical Analyses

Mean and standard deviation were used to present the data. Absolute reliability was determined using typical error as %CV. Relative reliability was measured using intraclass correlation coefficient (ICC). Usefulness of test was identified using smallest worthwhile change (0.2 x between-subject standard deviation) and typical error. Statistical analyses were computed using log transformed data in a reliability excel file by Hopkins (2000b).

RESULTS

Mean and standard deviation for set 1 and set 2 of right foot were 0.453 ± 0.04 secs and 0.455 ± 0.04 secs respectively. Left foot set 1 was 0.455 ± 0.04 secs. Set 2 was 0.452 ± 0.05 secs. For the right foot, %CV was 0.00 with ICC = 0.74. Typical error (TE) was 0.53. SWC was equivalent to 0.00. On the other hand, left foot reaction time posted a %CV of 0.00. ICC and TE was 0.86 and 0.40 respectively. SWC was 0.00.

DISCUSSION

The purpose of this study was to identify the reliability and usefulness of a simple EF RT test using Chronojump-Boscosystem platform. According to Atkinson et al. (1999), a %CV of less than 10% serves as a criterion value for an acceptable level of absolute reliability. In this study, both right and left foot reaction times presented a 'good' absolute reliability. For relative reliability, ICC of .80 above is deemed acceptable (Atkinson et al., 1999). For the right foot, relative reliability was poor. On the other hand, left foot reaction time acquired good reliability. One possible explanation for poor relative reliability of the right foot may be attributable to the order of the lead foot test. The right foot was ordered first and may have incurred a familiarization error to the participants. For test usefulness, Pyne (2003) suggested the SWC. A good test is rated as 'good' if TE is less than SWC. When TE is greater than SWC, the test is rated as ' marginal'. If TE is about the same as SWC then the test is useful. In this study, both right and left foot reaction times showed marginal utility.

There are some limitations that have to be noted in the test. First, the author used a population involving physical education students which are less exposed to physical activities demanding quick response time. Second, male and female students were also mixed in the test population. Physical activity orientation and gender may have contributed to possible biological error (Gould et al., 2013; Kosinski, 2013). Thirdly, although a test familiarization was administered before the actual experimentation, extra familiarization trials during the experimentation day may reduce possible familiarization error. Future studies addressing these limitations should be warranted.

Chronojump-Boscosystem is an open-source platform that can integrate various contact mechanisms and generate time-based results. To the researcher's knowledge, this is the first EF RT test study that utilized an open source technology. In conclusion, the EF RT test on Chronojump-Boscosystem displayed a good absolute reliability for the right and left foot. In terms of relative reliability, right foot test reliability was poor. However, left foot relative reliability was good. For test usefulness, both right and left foot reaction time test presented marginal use.

Acknowledgement

The author would like to express his gratitude to the participants of the study.

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Received: 05. November 2014
Accepted: 11. December 2014