Reliability of a Novel Method for Evaluating and Predicting Base Stealing Performance

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Introduction

Talent identification is often used in a variety of sports by coaches, scouts, and scientists. Talent Identification can be defined as the process of identifying current athletes with the potential to progress into elite athletes (Unnithan et al., 2012). Concerning baseball, there are specific skills that coaches and scouts look for in athletes (i.e. power, strength, and body composition). However, one of the attributes that stands out is the ability to run at high speeds. Managers, coaches, and scouts acknowledge that running speed is an important factor in the game’s outcome (Coleman and Amonette, 2014). Speed has been defined as the rate at which an individual is able to move their body a set distance (Baechle, 2000). Speed involves two impactful factors, which are stride frequency and stride length. Stride frequency is the total amount of strides it takes to cover a certain distance and stride length is the distance traveled within one stride while running. Thus, sprinting at high speeds requires a high degree of skill and coordination to accomplish (Dyriw, 2001).

One way scouts and coaches may evaluate speed for talent identification is the 60-yard dash. Although the 60-yard dash may be used as a determinant of speed, it may also be limited in its practical applicability and usefulness for predicting baseball performance. During a baseball game, a player seldom runs 60 yards continuously in a straight line. Yet, the 60-yard dash is one of the most common procedures used to assess performance (Coleman and Lasky, 1992). The 60-yard dash may also be limited in its ability to predict baseball performance and more specifically base stealing success. To the knowledge of the current authors, the relationship between the 60-yard dash and base stealing performance has not yet been evaluated. It seems intuitive that it may be limited on its performance predictability as it only serves as an assessment of speed and does not provide any indication of the athlete's ability to react to the pitcher and make a decision to proceed with the steal attempt.

Base stealing has been described as an important offensive skill in baseball (Loughin and Bargen, 2008). Successful base stealing not only requires adequate running speed, but also sufficient perceptual skills in order to react to a
visual stimulus and begin running when a pitcher commits himself to throwing a pitch. Successful acquisition and processing of visual information about a pitcher’s motion is required for a base runner to achieve an optimal reaction time and successfully steal the base (Kato, 2007). As a result, reaction time appears to be an important key into unlocking a base runner’s base stealing potential (Dan Iulian, 2012). Previous research suggests that reaction time is directly proportional to the task complexity, a concept also known as Hick’s Law. From this concept, one might conclude that the more complex a task is, the slower the reaction time will be (Mickeyienë et al., 2008). Base stealing may be classified as a complex task dependent on the motions of the pitcher, who may be intentionally misleading. A pitcher can work toward preventing a stolen base by throwing over to an occupied base, by delivering the pitch more quickly, or by being deceptive with his motion (Loughin and Bargen, 2008). Thus, reaction time may vary depending on how the runner processes perceptual information derived from the pitcher.

There seems to be a lack of empirical evidence providing justification that reaction time is a key aspect to successful base stealing. Additionally, the methods of monitoring base stealing performance have traditionally been somewhat rudimentary in the baseball world. On many occasions, coaches and scouts may use hand-held timing devices to determine how fast a runner is on the base paths. However, this approach does not allow a coach or scout to evaluate the reaction time of the athlete. Moreover, a hand-held timing approach may also allow for increased biological variability, as reaction time of the coach or scout to push a button is also included. Therefore, the purpose of this study was to determine the within session reliability of a novel method for monitoring and evaluating base stealing performance that includes a measure of reaction time. A secondary purpose was to compare the electronic time of the novel method and the coaches’ held-held timing values for base stealing.

Methods

Subjects in this study consisted of twenty-five healthy collegiate baseball players between the ages of 18 and 23. Prior to activity, all subjects read and signed informed consent documents approved by the LaGrange College Institutional Review Board.

All data collection for this study was completed on the same day. Subjects completed a standardized warm-up, which consisted of dynamic and static stretches focusing on all muscle groups. Following the warm-up, subjects completed a more specialized warm-up practicing their base stealing technique at 50% and 75% of perceived maximal effort.

Evaluation of base stealing performance was completed via electronic infrared timing gates (Brower Timing Systems, Draper, UT) (Figure 1). In order to evaluate reaction time, a touch pad was placed under the pitcher’s lead foot (Figure 2).
Timing was initiated as the pitcher lifted his foot off of the touch pad. The first set of timing gates was placed directly next to the base runner and the final gate was placed even with the front border of second base. The lead off for the base runners was standardized at 12 feet. When the runner traveled through the first gate, the time recorded was defined as the reaction time (time from pitcher lifting foot off of touch pad to runner passing through the first gate). When the runner traveled through the final gate by sliding into second base, the overall time was recorded (Figure 3) Figure 4 illustrates the placement and complete set up of the electronic timing gates and touch pad.

Figure 1. Electronic timing gate equipment used for base stealing assessment.

Figure 2. Pitcher standing on the touch pad to initiate timing, while the base runner waits by the first set of timing gates.
Figure 3. Player sliding into the final electronic timing gate.

Figure 4. Schematic depicting the placement and complete set-up of the electronic timing gates.
In order to enhance the ecological validity of the test, the pitchers in the study were directed to attempt to pick-off runners as if they were in a live game. Therefore, the runners were forced to react to the pitcher as they would in a real game. If a base runner was picked off the test was stopped and then repeated. All subjects performed two trials with a right and left-handed throwing pitcher for a total of four trials. The times from trial 1 and trial 2 for each pitcher type were analyzed to determine the within session reliability.

Simultaneous to the timing gate data collection, two-baseball coaches collected and recorded base stealing times via hand-held stopwatches (Accusplit Survivor, Pleasanton, CA). In an effort to evaluate potential human error associated with the hand-held stopwatch method, the times collected by the coaches’ hand-held stopwatches were compared to the infrared timing gate system times. Similar to the novel assessment method, the hand-held timing method was also evaluated for within session reliability.

All statistical analyses were completed using SPSS version 17.0 (IBM, New York, NY, USA). Reliability of both data collection methods was determined with intraclass correlation coefficients (ICC) and coefficients of variation (CV) to construct relative and absolute measures of reliability. Comparisons between coaches’ hand-held stopwatch times and electronic timing gate times were completed with independent samples t tests. In an effort to protect against Type I error, a Bonferroni correction was applied as multiple t tests were conducted. Thus, the statistical significance was set at 0.025. Additionally, Cohen’s d effect sizes were determined to provide effect size estimates and an indication of practical significance. Effect size magnitudes were interpreted using the scale provided by Hopkins (2014). Briefly, Hopkins describes an effect size of 0.0-0.19 as trivial, 0.2-0.59 as small, 0.6-1.19 as moderate, 1.2-1.99 as large and beyond 2.0 as very large.

Results

Data from the reliability analysis and descriptive statistics of the novel assessment technique are shown in Table 1. While good relative reliability was found in RT (Reaction Time) and FT (Full Time), absolute reliability measures were elevated in RT. Statistically significant differences were found between FT and CT (Coach’s Time) with large effect size estimates (right p=0.000, d=1.28 and left p=0.000, d=1.49).
Table 1. Results from reliability analysis and descriptive statistics of base stealing assessment.

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<thead>
<tr>
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<th>Right Handed Pitcher</th>
<th>Left Handed Pitcher</th>
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<tbody>
<tr>
<td>ICC RT</td>
<td>0.74</td>
<td>0.84</td>
</tr>
<tr>
<td>ICC FT</td>
<td>0.84</td>
<td>0.75</td>
</tr>
<tr>
<td>CV RT</td>
<td>32.3</td>
<td>35.5</td>
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<tr>
<td>CV FT</td>
<td>4.4</td>
<td>4.8</td>
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<tr>
<td>Average RT (s)</td>
<td>0.34± 0.11</td>
<td>0.39± 0.11</td>
</tr>
<tr>
<td>Average FT (s)</td>
<td>3.98± 0.19</td>
<td>4.08± 0.19</td>
</tr>
</tbody>
</table>

(Disscusion)

The primary purpose of this investigation was to determine the within session reliability of a novel method for evaluating base stealing performance. The primary finding of this study was that subjects maintained their position within the group over repeated measurements in RT and FT, creating good relative reliability. Some of the RT’s varied for each subject, so the absolute reliability measure for RT was elevated. This finding is supported by R.A. Schmidt and T.D. Lee (1999), who stated that RT may be influenced by the complexity of the task. The complexity of RT increases due to the visual mechanical differences a right and left-handed pitcher may show in an attempt to confuse the base runner. Further investigation would be required to determine the actual contributions to increased variation associated with reaction time, as it can be derived from pitcher induced variability and the variability associated with the potential base stealer. While elevated CVs are due to increased variability, this may also indicate increased measurement sensitivity of the novel method. This increased sensitivity may be a marginal difference, but it may be large enough to determine the success of a base stealing performance. However, further research would be required to validate this notion.

A secondary purpose of this investigation was to compare the times collected from the coaches’ hand-held stopwatches to those of the novel method. As stated previously, RT has been indicated as a factor that may influence base stealing performance. Research done by Mroczek et al. (2013) supports RT being a key factor for efficiency in completing a task. In their study on volleyball players, RT was crucial for the players to successfully reach a spiked ball to save the point. In the same manner, RT can be the difference between a successful or unsuccessful base stealing attempts. Unfortunately, the traditional method does not measure RT, only FT. The data showed that there were statistical differences found between CT and FT with large effect size estimates. The statistical
and practical difference between CT and FT could be due to error in measurement of the traditional CT method and/or increased measurement sensitivity of the novel method. Further research into inter-rater reliability of CT could rule out potential error due to tester variability. Also, validating both methods using high-speed cameras could provide insight into measurement error from both methods evaluated in this study. Regardless of the cause, this difference could be important for coaches when making a decision of when to pursue steal attempts.

Based on the results of this investigation, the novel method for determining base stealing is recommended along with or in substitution for the traditional method. This recommendation is primarily based on the increased sensitivity of the novel method and because the novel method gives a measure of RT. Coleman and Lasky (1992) recommend the 60-yard dash as a measure of speed for baseball players, but the current authors recommend using this measure with caution. As previously stated a baseball player may never continuously run 60-yards in a straight line during gameplay, therefore the 60-yard dash may be limited on its' predictability for base running or any other speed related success during gameplay. Thus, the current authors recommend utilizing a more appropriate test with a more baseball-specific distance than the 60-yard dash. It is also recommended that attempts are made to reduce tester error and variability. Based on the results of the current investigation this may be done by utilizing infrared timing gates. While it is unlikely that opposing teams would let you test their players, testing one’s own athletes with the most valid instruments will decrease error and provide an advantage in success prediction and determination of coaching strategy. In efforts to gain an advantage, collecting performance times of opposing players from the dugout with the traditional stopwatch method is still recommended, but minimizing potential data collection error is also recommended. Therefore, a combination of methods may provide the best and most practical solution. Future researchers should evaluate the ability of the novel method to predict base stealing success in simulation and actual game scenarios. The information given by the novel technique in the current investigation may aid scouts or coaches in predicting base stealing success and overall performance in baseball players.

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References: