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Abstract

The aim of this study was to examine the content validity, construct validity and reliability of the newly developed Basketball Jump Shooting Accuracy Test (BJSAT). Basketball athletes from different playing levels (State Basketball League [SBL], n = 30, age: 22.7 ± 6.1 yr; SBL Division I, n = 11, age: 20.6 ± 2.1 yr) completed four separate trials of the Basketball Jump Shooting Accuracy Test (BJSAT) with each trial consisting of shot attempts from two- and three-point distances at pre-determined court locations. Each shot attempt was scored utilising a criteria where higher scores were given when greater accuracy was exhibited. The BJSAT detected a significant, *large* difference in accuracy between two- and three-point shots ($d = 0.99$, $p < 0.01$). Relative reliability across the repeated trials was rated as *moderate* for all athletes (intraclass correlation coefficient [ICC] = 0.71, $p < 0.01$) and *good* for the SBL athletes (ICC = 0.78, $p < 0.01$). Absolute reliability for all athletes was above the acceptable benchmark (coefficient of variation = 16.2%); however superior to skill tests available in the literature. In conclusion, the BJSAT is sensitive to two- and three-point shooting accuracy and can reliably assess jump shooting accuracy in basketball athletes.

Keywords: assessment, skill acquisition, team sport, technique

Disclosure of interest: The authors report no conflict of interest.

Introduction

Basketball requires athletes to execute a diverse range of physical and technical tasks during game-play (Abdelkrim, Chaouachi, Chamari, Chtara, & Castagna, 2010; Scanlan, Dascombe, Reaburn, & Dalbo, 2012). Athletes frequently perform passing, dribbling and shooting manoeuvres during repeated, high-intensity and low-intensity running bouts (Read et al., 2014). Shooting in particular is fundamental to offensive performance and strongly influences the outcome of basketball games. In this regard, winning probability increases when a team demonstrates superior accuracy from two- and three-point shooting distance compared to the opposing team (Ibáñez et al., 2008; Lorenzo, Gomez, Ortega, Ibanez, & Sampaio, 2010; Melnick, 2001; Özmen, 2016). There are a variety of shot types performed in basketball such as the lay-up, dunk and jump shot; however, the jump shot is recognised as the most common shot executed, accounting for 67% of all shot attempts in the 2014-15 National Basketball Association (NBA) regular season (Erculj and Strumbelj, 2015). Despite the importance of jump shooting performance to team success, there are few valid and reliable assessments to assess jump shooting accuracy in basketball athletes.

Existing assessments examine jump shooting accuracy however important testing considerations are lacking. When designing a skill test in sport, a key consideration is replicating the conditions in which the skill is commonly performed while also ensuring these conditions remain consistent for each athlete. For example, the Australian Football Kicking Test (AFK) assesses field kicking accuracy with temporal constraints placed on athletes from distances commonly disposed from during a game (Woods, Raynor, Bruce, & McDonald, 2015). Inter-subject variability

in test conditions has been observed in existing jump shooting tests due to underpinning methodological limitations. For instance, during the On the Move Shooting Test and 60-second dynamic two-point and three-point shooting tests, athletes receive a chest pass before each shot attempt, which introduces inconsistencies to the shooting conditions given each pass attempt cannot be precisely replicated across test trials (Pojskić, Šeparović, Muratović, & Užičanin, 2014; Thakur and Mahesh, 2016). Furthermore, the AAHPERD basketball test instructs athletes to attempt a minimum of one shot from five different locations in addition to a maximum of four lay-ups in a 60-second time frame. Variability is introduced between subjects in this test as athletes can choose the remaining locations after satisfying these basic conditions (Vernadakis, Antoniou, Zetou, & Kioumourtzoglou, 2004). Another limitation of current jump shooting assessments in basketball is the ambiguous information detailing the testing protocols presented in the current literature, which weakens test reproducibility (Robertson, Burnett, & Cochrane, 2014; Thakur and Mahesh, 2016). For example, the Spot Up Shooting Test instructs players to attempt five jump shots from different locations; however it is unclear whether all five shot attempts should be performed at each location in succession and the exact location of each jump shot is not explicably defined (Thakur and Mahesh, 2016). Meanwhile, the stationary two-point and three-point shooting tests assess accuracy from five different locations with each athlete attempting two shots from each location. However, it is unclear whether athletes attempt two shots in succession at each location or attempt a single shot at each location before returning to the beginning of the test and repeating the same protocol (Pojskić, et al., 2014). Moreover, while the majority of jump shooting assessments evaluate two- and three-point shots in isolation (Erculj and Supej, 2009; Pojskic,

Separovic, & Uzicanin, 2011; Slawinski et al., 2018), the existing tests that combine two- and three-point shots have not been validated (Kinc, 2008; Okazaki and Rodacki, 2012; Thakur and Mahesh, 2016).

A valid and reliable jump shooting assessment can have wide-ranging applications in basketball. Skill accuracy assessments can be utilised either on their own or as part of a multi-dimensional assessment included in the talent identification process (Robertson, et al., 2014) and to assist with skill development in basketball athletes. Individual limitations in jump shooting technique can be identified for each athlete which can help in the development of specific skill-enhancing strategies (Robertson, et al., 2014). A simple, repeatable skill assessment can also allow for progress in skill performance to be monitored which helps to assess the effectiveness of implemented training interventions (Sunderland, Cooke, Milne, & Nevill, 2006).

Before utilisation in the field, skill assessments should first be examined for validity and reliability. Validity refers to the degree in which a test measures the skill in question. Specifically, content validity refers to the ability of a test to mimic particular actions of a sport, such as comparing test outcomes between shots of varying difficulty (Aandstad and Simon, 2013). Furthermore, construct validity can be assessed by comparing skill outcomes of athletes competing at varying playing levels with superior shooting accuracy expected to be possessed by athletes competing at the higher level (Sampaio, Godoy, & Feu, 2004; Scanlan, Dascombe, & Reaburn, 2012). Meanwhile, determination of reliability across multiple trials indicates the consistency of an assessment to measure the outcome of interest (Robertson, et al., 2014). Relative reliability refers to the consistency of the position of individual scores relative to others in a group whereas absolute reliability simply concerns the consistency of scores by each individual (Weir, 2005). A common challenge when developing a skill test is

balancing the trade-off between validity and reliability where consistent testing conditions are present for each athlete while also ensuring the assessment possesses valid characteristics similar to those seen during game-play. Maintaining a balance between both test features can be difficult but important to achieve.

The current limitations in shooting tests developed for application in basketball such as inter-subject variability in testing conditions, ambiguous information regarding testing protocols and assessing two- and three-point shooting accuracy in isolation has led to the development of the Basketball Jump Shooting Accuracy Test (BJSAT). The BJSAT is designed to evaluate jump shooting accuracy across game-specific court locations in a replicable manner. Therefore, the aim of this study is to determine the content validity, construct validity and reliability of the BJSAT.

Methods

Participants

Male (n = 18) and female (n = 23) basketball athletes were recruited from two separate semi-professional State Basketball League (SBL) clubs. Athletes were either classified as SBL (n = 30, age: 22.7 ± 6.1 yr, playing experience: 14.2 ± 7.4 yr) or SBL Division I (n = 11, age: 20.6 ± 2.1 yr, playing experience: 11.4 ± 4.3 yr) based on the predominant competition played during the 2018 regular season. The SBL is the pre-eminent state basketball competition in Western Australia comprising of men's and women's competitions, while the SBL Division I is the competition directly below the SBL. Athletes competing in both competitions train together before being selected to play in either the SBL or SBL Division I each week. All playing positions were represented among the cohort, including guards (males = 6,

146 females = 13), forwards (males = 11, females = 7) and centres (males = 1, females =
147 3). All athletes provided informed consent, with athletes under the age of 18
148 providing written consent from their guardian. Athletes free from any injury or
149 illness that limited participation with those unable to participate verbally instructed
150 to notify the assessor. The study protocol was approved by an Institutional Human
151 Research Ethics Committee.
152
153 *Basketball Jump Shooting Accuracy Test Development*
154 The BJSAT was developed using shot location data derived from the 2013-14
155 NBA regular season which revealed the court locations where athletes attempted the
156 highest frequency of shots (Beshai, 2014). Though this data does not state the type of
157 shots attempted at these locations, due to the distance of the locations chosen for
158 inclusion in the BJSAT, it was expected that these were jump shots. Detailed
159 shooting location data such as this was only accessible from the NBA, renowned as
160 the premier basketball competition in the world. From these data, 4 x two-point and
161 4 x three-point shot locations were included in the BJSAT with an equal number of
162 shot attempts from the right and left sides of the court. In total, the test consisted of 8
163 x jump shot attempts at pre-determined locations on the court. One jump shot was
164 attempted from each of the eight shot locations in a predefined order (Figure 1). The
165 shot order of the BJSAT ensured athletes were alternating between two- and three-
166 point shooting distance and not performing consecutive jump shots from either
167 distance throughout the test. This feature of the BJSAT more closely replicates in-
168 game shooting patterns (Gomez, Gasperi, & Lupo, 2017) compared to jump shooting
169 assessments previously undertaken in basketball that involve successive shot

attempts from the same shooting distance (Erculj and Supej, 2009; Pojskic, et al., 2011; Pojskic, Sisic, Separovic, & Sekulic, 2017).

INSERT FIGURE 1 AROUND HERE

Testing Procedures

Testing sessions were conducted on indoor, hardwood basketball courts prior to scheduled training sessions. Testing was undertaken during the final week of a 4-month pre-season phase before the opening regular season game. During this phase, athletes were undertaking two training sessions per week each two hours in duration. Training was predominantly skill-based and focussed on match-play. Prior to testing, all athletes were given a demonstration of the BJSAT and performed a 2-min shooting warm-up from the shot locations included in the BJSAT. Athletes were instructed to attempt four shots with an even spread from the left and right sides of the court and from two- and three-point distance. A standardised 10-min warm-up consisting of light shuttle runs, bilateral countermovement jumps and dynamic stretching was also undertaken by all athletes. Each athlete completed four trials of the BJSAT with 2 min of passive rest between trials where athletes could walk around the other half of the court and recover before the next trial. If a jump shot was performed in the incorrect order, athletes were advised to continue the assessment with verbal instruction ensuring the correct order was followed for the remainder of the trial. Athletes began each trial at the midpoint between the half-court line and three-point line (Figure 1). At each shot location, a holding apparatus standing at a height of 1 m was positioned to deliver basketballs to the athletes. The male athletes used standard size 7 basketballs (Wilson Solution; Wilson; NSW, Australia) and the

female athletes used standard size 6 basketballs (TF-1000 Legacy; Spalding; KY, United States of America) to align with game regulations. All shots were attempted with athletes placing both feet within a marked area at each shot location (60 cm x 60 cm). If an athlete attempted a jump shot with one or both feet outside of the marked area, the athlete continued the trial; however verbal instruction was given immediately to ensure both feet were placed within the marked area for the remaining shot attempts. These approaches permitted standardised shooting conditions for all athletes.

Athletes were instructed to complete each trial of the BJSAT as fast as possible to replicate the intensity of jump shot attempts in games in that the athlete shooting the basketball often has little time when attempting the shot due to defensive pressure. Athletes were instructed to not wait and observe the outcome of each shot attempt and instead sprint to the next shot location after attempting each shot. A time limit for each trial was not placed on the athletes; however consistent verbal encouragement was given during each rotation to ensure athletes were moving as fast as possible between each shot location. Athletes took 28.1 ± 2.7 s to complete the BJSAT.

Basketball Jump Shooting Accuracy Test Scoring System

Four different scores could be awarded for each jump shot attempt in the BJSAT adapted from similar skill assessments in Australian football and basketball (Strand and Wilson, 1993; Woods, et al., 2015). For the BJSAT, scoring options ranged from 0-3 (Table 1). Two assessors scored the BJSAT with one assessor present for the testing session undertaken at each respective club. Both assessors were made aware of the testing and scoring protocols before administering the test.

Overall test performance for each trial was determined as the total score for each of the eight shots attempted. For example, if an athlete received a score of 2 points for each shot attempt in a particular trial an overall score of 16 was recorded. Each athlete received a mean BJSAT score for each trial and for the four trials combined. Jump shooting accuracy could therefore be monitored for trends such as a trial order effect.

INSERT TABLE 1 AROUND HERE

Statistical Analysis

Means and standard deviations were calculated for all BJSAT scores across each of the four trials separately. To evaluate content validity, a dependent t-test was performed to compare scores between two- and three-point shot attempts across all trials (Kinc, 2008). Construct validity of the BJSAT was assessed using an independent t-test to compare performance between athletes of different playing levels (SBL vs. SBL Division I) across all trials. Effect sizes (*d*) were calculated for each pairwise comparison based on the following classifications: *trivial* = 0-0.19, *small* = 0.20-0.49, *medium* = 0.50-0.79 and *large* = >0.80 (Cohen, 1992). The mean typical error (TE) and smallest worthwhile change (SWC) were calculated for the four trials combined. Four trials were conducted to examine the reliability of the BJSAT. Between-trial reliability of the BJSAT was assessed by determining relative reliability indicated by intra class correlation coefficient (ICC) and absolute reliability indicated by coefficient of variation (CV) measures with 95% confidence intervals (CI). For all ICC calculations, a two-way mixed model was undertaken because of the suitability this model provides to research involving repeated

measures. The following criteria were used to classify ICC outcomes: *poor* = <0.50; *moderate* = 0.51-0.75; *good* = 0.76-0.90; and *excellent* = >0.90 (Koo and Li, 2016). A CV <10% was taken as an acceptable benchmark (Atkinson and Nevill, 1998). Parametric assumptions of normality and homogeneity of variance were assessed and confirmed prior to running inferential statistics. Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) software (v 25.0; IBM Corp., Armonk, NY, USA). Statistical significance was set at $p \leq 0.05$.

Results

Mean ± standard deviation scores during the BJSAT according to shot distance (two-point vs. three-point) and playing level (SBL vs. SBL Division I) for all trials combined are shown in Figures 2 and 3. There was a significant, *large* (d = 0.99, p = < 0.01) difference in BJSAT score between two-point and three-point shots. There was a non-significant, *trivial* (d = 0.17, p = 0.57) difference in BJSAT score between gender. There was also a non-significant, *trivial* (d = 0.15, p = 0.70) difference in BJSAT score between playing levels. The mean TE of the BJSAT across all trials was 2.2 while the SWC was 1.6 (0.2) and 4.0 (0.5) respectively.

*** INSERT FIGURE 2 AROUND HERE***

*** INSERT FIGURE 3 AROUND HERE***

Mean ± standard deviation, ICC, and CV with 95% CI for BJSAT score are presented in Table 2. Analysis of all athletes across the four trials demonstrated *moderate* relative reliability (n = 41, ICC = 0.71, p < 0.01), which strengthened when

only the SBL athletes were analysed (n = 30, ICC = 0.78, p < 0.01) and weakened when only the SBL Division I athletes were assessed (n = 11, ICC = 0.31, p = 0.20). Absolute reliability was above the accepted benchmark for all athletes (CV = 16.2%), the SBL athletes (CV = 17.5%) and the SBL Division I athletes (CV = 12.1%). Males (n = 18, ICC = 0.72, p < 0.01) and females (n = 23, ICC = 0.73, p < 0.01) both demonstrated *moderate* relative reliability while absolute reliability was above the accepted benchmark for both males (CV = 16.9%) and females (CV = 15.8%). Two-point shooting accuracy demonstrated greater reliability (ICC = 0.68, p < 0.01, CV = 19.8%) compared to three-point shooting accuracy (ICC = 0.58, p < 0.01, CV = 20.0%).

INSERT TABLE 2 AROUND HERE

Discussion

This study presents the development of a jump shooting accuracy assessment, which was deemed to possess adequate content validity. When evaluating the content validity of the BJSAT, athletes scored significantly better in two-point shot attempts compared to three-point shot attempts. The BJSAT was sensitive to the distance accuracy trade-off demonstrated in previous shooting tests with accuracy greater in two-point shots compared to three-point shot attempts, mimicking a pattern observed during game-play where two-point shooting accuracy is often superior to three-point accuracy (Kinc, 2008; Özmen, 2016). Previous evidence demonstrates basketball athletes tend to be less accurate from greater shooting distances due to an increase in release angle and velocity on the basketball and decline in release height (Okazaki and Rodacki, 2012). Athletes adopt these movement strategies when shooting from longer

distances leading to greater instability on the basketball and consequently detrimental shooting performance outcomes (Okazaki and Rodacki, 2012). Our findings confirm a *large* difference exists between the shooting accuracy of athletes from two-point distances compared to three-point distances during the BJSAT highlighting the assessment's ability to detect differences in shooting accuracy between shots of varying difficulty while replicating in-game shooting demands. The BJSAT replicates these demands because jump shot attempts throughout the test alternate between shooting location and distance. During basketball game-play, jump shots are sparsely attempted from the same location or distance repeatedly with shots attempted from a range of locations and distances (Gomez, et al., 2017). The BJSAT is one of the few current assessments that combine shot attempts from two- and three-point distance (Kinc, 2008; Okazaki and Rodacki, 2012; Thakur and Mahesh, 2016), however unlike these existing assessments, shooting performance from two- and three-point distance in the BJSAT have been validated. While the holding apparatus utilised in the BJSAT were not game specific and delivered the basketballs at different heights to each athlete, this equipment ensured testing conditions remained as consistent as possible for all athletes in a practical, time efficient manner while keeping the focus of the test on the skill of jump shooting.

Construct validity provides insight into the ability of an assessment to discriminate between athletes competing at different playing levels. A non-significant, *trivial* difference was observed between gender ($d = 0.17$, $p = 0.57$). Little difference in jump shooting accuracy was forecasted between male and female athletes because both genders were recruited from a state-level competition, testing was undertaken at the same point in the season and similar training programs were

being undertaken at the time of testing. Interestingly, only a non-significant, *trivial* difference (d = 0.15, p = 0.70) was also evident in BJSAT score between SBL and SBL Division I athletes. The low sensitivity of the BJSAT to differentiate between athletes of higher and lower playing levels may have been due to methodological limitations in athlete recruitment rather than an inability to discriminate between athletes possessing higher and lower shooting accuracy. The largest limitation in athlete recruitment was the similarity between playing levels in that both groups of athletes undertook similar training programs, with many athletes competing at both levels throughout the season. A pre-determined number of athletes was not sought for each playing level and position, rather that each was represented by both genders. As all athletes participating in this study were recruited from two SBL teams, it is possible the poor sensitivity in differentiating between the SBL and SBL Division I athletes may have been due to the samples demonstrating homogenous skill outcomes. Rather it is plausible other attributes differentiate playing level in these athletes given higher-level basketball competition often necessitates superior physical (e.g. jump power) (Abdelkrim, Chaouachi, et al., 2010) technical (e.g. dribbling speed) (Torres-Unda et al., 2013) and tactical (e.g. number of positioning movements) (Abdelkrim, Castagna, El Fazaa, & El Ati, 2010) attributes. Future research should further explore the discriminatory capacity of the BJSAT to differentiate shooting accuracy between athletes from playing levels who possess notable differences in shooting ability such as national and state competitions.

Skill tests should possess acceptable validity as well as adequate reliability before being adopted in practice. The BJSAT was shown to possess *moderate* relative reliability, comparable to previously reported shooting tests such as the two- (ICC = 0.82) and three-point (ICC = 0.85) tests developed by Pojskic et al. (2011). While the

BJSAT possesses weaker ICC than the tests developed by Pojskic et al. (2011), tests developed previously exclusively examined only two- or three-point shots, whereas the BJSAT requires athletes to execute shots from both distances in combination. The variability in shooting distance and location in the BJSAT conceivably would reduce the relative reliability observed. However it is this variability in shooting distance and location that makes the BJSAT more representative of in-game shooting demands because shots are attempted from a range of distances and locations during games (Gomez, et al., 2017). Research has also examined novel skill assessments in other sports, reporting either similar or lower relative reliability than observed in our study. For instance, the Nine-Ball Skills Test is used in golf and assesses the ability to land nine different shot types at a certain location, demonstrating an ICC of 0.67 (Robertson, Burnett, Newton, & Knight, 2012). Meanwhile soccer passing, shooting and dribbling tests assessing skill precision across two separate trials revealed ICC ranging from 0.38-0.77 for different skills (Russell, Benton, & Kingsley, 2010). Relative reliability of the BJSAT were shown to be comparable with tests in other sports and slightly below those reported in basketball due to the modest variability across the repeated trials when all athletes were evaluated. There was evidence of a trial order effect with accuracy scores improving and stabilising across the first three trials of the BJSAT (Table 2). Practitioners therefore are encouraged to administer up to three trials of the BJSAT to habituate athletes with the shooting locations and order of the test. Undertaking a longer familiarisation of the BJSAT or shooting warm-up may also help habituate athletes sooner with the BJSAT. Novel assessment conditions and pre-planned shooting locations may have influenced the shooting accuracy of athletes during the initial trial, thereby allowing a familiarisation exposure.

Compared to previous two- (CV = 28.3%) and three-point (CV = 42.8%) assessments in basketball, the BJSAT displayed superior absolute reliability (CV = 16.2%); however these remained above the accepted benchmark due to greater than normal variation from the mean accuracy scores across each of the four trials (Atkinson and Nevill, 1998). The BJSAT displayed comparable absolute reliability to skill assessments developed in other sports including golf (CV = 27.5%) (Robertson, et al., 2012) and soccer (CV = 4.6-23.5%) (Russell, et al., 2010). It is natural for skill assessments to demonstrate larger CV as this reflects technical performance within sport as superior athletes often demonstrate inconsistencies with skill accuracy throughout competition, such as inconsistencies in jump shooting accuracy between basketball games (Zhang et al., 2017).

The findings support the use of the BJSAT in practice, however our study was subject to some limitations. First, each athlete on a basketball team does not attempt the same amount of jump shots each game with shot attempts influenced by factors such as playing position (Zhang, et al., 2017). Additionally, the shots were attempted across a short duration, which is not commonly experienced during basketball game-play; however was necessary due to the practical requirements for efficient testing procedures. Second, the shot locations included in the BJSAT were derived from NBA data which may not be reflective of common shot locations in other competitions such as the SBL. Shooting location data used for the BJSAT was taken from the NBA given these data were not accessible from other competitions, including the SBL. Third, the assessment is pre-planned whereas shots are attempted in response to various stimuli during game-play. Therefore, performance in the BJSAT may not be reflective of all in-game scenarios encountered by athletes, such as shooting with the presence of a defender or in response to a particular game

394 situation. The BJSAT is pre-planned with a determined shot order to ensure
395 consistent testing protocols for all athletes. Fourth, shooting performance in the
396 BJSAT was not correlated with 2018 field goal percentage due to a lack of reliable
397 match performance statistics. As a result, it is encouraged that future research
398 examines the correlation between BJSAT and within competition shooting
399 performance. Finally, our findings are indicative of male and female state-level
400 basketball athletes and therefore may not be representative of other populations.
401 Consequently, further research is encouraged confirming the validity and reliability
402 of the BJSAT in athletes from teams competing at different playing levels and age
403 groups. Further research is also recommended examining the effects of gender on
404 shooting performance in the BJSAT in different playing levels.
405 The BJSAT may be used by basketball coaches, strength and conditioning
406 staff, sport scientists, and athletes as a tool to quantify and track intra-individual
407 jump shooting accuracy. The BJSAT was unable to discriminate between playing
408 level however was shown to be sensitive to shooting distance and reliable from the
409 court locations and distances contained in the assessment, as shown by the *moderate*
410 relative reliability outcomes. Absolute reliability of the BJSAT however was above
411 the accepted benchmark while the mean TE was 2.2 across all four trials and the
412 SWC was 1.6 (0.2) and 4.0 (0.5), therefore practitioners are encouraged to monitor
413 the position of each athlete's score relative to other members of the team.
414 Practitioners are also encouraged to utilise the BJSAT to evaluate jump shooting
415 accuracy in playing levels who possesses more pronounced differences in shooting
416 ability to observe whether the assessment can discriminate in this manner. These
417 findings illustrate the BJSAT may be utilised in monitoring shooting accuracy from
418 various game specific shooting locations and distances. Furthermore, the BJSAT can

assist practitioners in reliably assessing shooting accuracy across different points in time such as for monitoring rehabilitation progress, assessing skill technique interventions and assisting in team selection.

Conclusion

The BJSAT is a valid jump shooting accuracy test that is sensitive to shooting distance with athletes demonstrating superior accuracy from two-point compared to three-point attempts. Meanwhile, the BJSAT detected *trivial* differences in jump shooting accuracy of athletes competing at different, but relatively homogeneous, playing levels describing the construct validity of the assessment. The BJSAT demonstrated acceptable relative reliability across multiple trials in basketball athletes of varying playing levels. As a result, practitioners can utilise the BJSAT in monitoring jump shooting accuracy at progressive stages of a season for various purposes such as evaluating skill technique or rehabilitation interventions. Absolute reliability of the BJSAT however was above the accepted benchmark therefore practitioners are encouraged to monitor shooting accuracy performance of each athlete relative to other team members across a period of time.

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References

Aandstad, A., & Simon, E. V. (2013). Reliability and validity of the soccer specific INTER field test. *Journal of Sports Sciences, 31*(13), 1383-1392.

Abdelkrim, N. B., Castagna, C., El Fazaa, S., & El Ati, J. (2010). The effect of players' standard and tactical strategy on game demands in men's basketball. *Journal of Strength and Conditioning Research, 24*(10), 2652-2662.

Abdelkrim, N. B., Chaouachi, A., Chamari, K., Chtara, M., & Castagna, C. (2010). Positional role and competitive level differences in elite level men's basketball players. *Journal of Strength and Conditioning Research, 24*(5), 1346-1355.

Atkinson, G., & Nevill, A. M. (1998). Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. *Sports Medicine, 26*(4), 217-238.

Beshai, P. (2014). *Buckets: Basketball shot visualisation*. University of British Columbia. Retrieved from https://pdfs.semanticscholar.org/8413/cc6a30ce8813a60bb85a1d039bc5ad70e39a.pdf

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

Erculj, F., & Strumbelj, E. (2015). Basketball shot types and shot success in different levels of competitive basketball. *PLoS One, 10*(6), 1-14.

Erculj, F., & Supej, M. (2009). Impact of fatigue on the position of the release arm and shoulder girdle over a longer shooting distance for an elite basketball player. *Journal of Strength and Conditioning Research, 23*(3), 1029-1036.

Gomez, M. A., Gasperi, L., & Lupo, C. (2017). Performance analysis of game dynamics during the 4th game quarter of NBA close games. *International Journal of Performance Analysis in Sport*, *16*(1), 249-263.

Ibáñez, S. J., Sampaio, J., Feu, S., Lorenzo, A., Gómez, M. A., & Ortega, E. (2008). Basketball game-related statistics that discriminate between teams' season-long success. *European Journal of Sport Science, 8*(6), 369-372.

Kinc, F. (2008). An intensive combined training program modulates physical, physiological, biomotoric, and technical parameters in women basketball players. *Journal of Strength and Conditioning Research, 22*(6), 1769-1778.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropratic Medicine, 15*(2), 155-163.

Lorenzo, A., Gomez, M. A., Ortega, E., Ibanez, S. J., & Sampaio, J. (2010). Game related statistics which discriminate between winning and losing under-16 male basketball games. *Journal of Sports Science and Medicine, 9*(4), 664-668.

Melnick, M. J. (2001). Relationship between team assists and win-loss record in the National Basketball Association. *Perceptual and Motor Skills, 92*(2), 595-602.

Okazaki, V. H., & Rodacki, A. L. (2012). Increased distance of shooting on basketball jump shot. *Journal of Sports Sciene and Medicine, 11*(2), 231-237.

Özmen, M. U. (2016). Marginal contribution of game statistics to probability of winning at different levels of competition in basketball: Evidence from the

Euroleague. *International Journal of Sports Science and Coaching, 11*(1), 98-107.

Pojskić, H., Šeparović, V., Muratović, M., & Užičanin, E. (2014). The relationship between physical fitness and shooting accuracy of professional basketball players. *Motriz: Revista de Educação Física, 20*(4), 408-417.

Pojskic, H., Separovic, V., & Uzicanin, E. (2011). Reliability and factorial validity of basketball shooting accuracy tests. *Sport Scientific and Practical Aspects, 8*(1), 25-32.

Pojskic, H., Sisic, N., Separovic, V., & Sekulic, D. (2017). Association between conditioning capacities and shooting performance in professional basketball players: An analysis of stationary and dynamic shooting skills. *Journal of Strength and Conditioning Research, 32*(7), 1981-1992.

Read, P. J., Hughes, J., Stewart, P., Chavda, S., Bishop, C., Edwards, M., & Turner, A. N. (2014). A needs analysis and field-based testing battery for basketball. *Strength and Conditioning Journal, 36*(3), 13-20.

Robertson, S. J., Burnett, A. F., & Cochrane, J. (2014). Tests examining skill outcomes in sport: A systematic review of measurement properties and feasibility. *Sports Medicine, 44*(4), 501-518.

Robertson, S. J., Burnett, A. F., Newton, R. U., & Knight, P. W. (2012). Development of the Nine-Ball Skills Test to discriminate elite and high-level amateur golfers. *Journal of Sports Sciences, 30*(5), 431-437.

Russell, M., Benton, D., & Kingsley, M. (2010). Reliability and construct validity of soccer skills tests that measure passing, shooting, and dribbling. *Journal of Sports Sciences, 28*(13), 1399-1408.

Sampaio, J., Godoy, S. I., & Feu, S. (2004). Discriminative power of basketball game-related statistics by level of competition and sex. *Perceptual and Motor Skills, 99*(3), 1231-1238.

Scanlan, A. T., Dascombe, B. J., Reaburn, P., & Dalbo, V. J. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of Science and Medicine in Sport, 15*(4), 341-347.

Scanlan, A. T., Dascombe, B. J., & Reaburn, P. R. (2012). The construct and longitudinal validity of the Basketball Exercise Simulation Test. *Journal of Strength and Conditioning Research, 26*(2), 523-530.

Slawinski, J., Louis, J., Poli, J., Tiollier, E., Khazoom, C., & Dinu, D. (2018). The effects of repeated sprints on the kinematics of 3 point shooting in basketball. *Journal of Human Kinetics, 62*(1), 1-11.

Strand, B. N., & Wilson, R. (1993). *Assessing sport skills* Champaign, IL: Human Kinetics.

Sunderland, C., Cooke, K., Milne, H., & Nevill, M. (2006). The reliability and validity of a field hockey skill test. *International Journal of Sports Medicine, 27*(5), 395-400.

Thakur, T. S., & Mahesh, C. (2016). Enhancement in shooting ability of basketball players through meditation. *Research Journal of Physical Education Sciences, 4*(4), 1-4.

Torres-Unda, J., Zarrazquin, I., Gil, J., Ruiz, F., Irazusta, A., Kortajarena, M., . . . Irazusta, J. (2013). Anthropometric, physiological and maturational characteristics in selected elite and non-elite male adolescent basketball players. *Journal of Sports Sciences, 31*(2), 196-203.

Vernadakis, N., Antoniou, P., Zetou, E., & Kioumourtzoglou, E. (2004). Comparison of three different instructional methods on teaching the skill of shooting in basketball. *Journal of Human Movement Studies, 46*(1), 421-440.

Weir, J. P. (2005). Quantifying test retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength and Conditioning Research, 19*(1), 231-240.

Woods, T. E., Raynor, J. A., Bruce, L., & McDonald, Z. (2015). The use of skill tests to predict status in junior Australian football. *Journal of Sports Sciences, 33*(11), 1132-1140.

Zhang, S., Lorenzo, A., Gómez, M., Liu, H., Gonçalves, B., & Sampaio, J. (2017). Players' technical and physical performance profiles and game-to-game variation in NBA. *International Journal of Performance Analysis in Sport, 17*(4), 466-483.

Table 1. Scoring criteria for the Basketball Jump Shooting Accuracy Test.

Score	Description
3	Basketball travels through the basket without touching the rim or backboard.
2	Basketball makes contact with the rim or backboard before travelling through the basket.
1	Basketball makes contact with the rim or backboard but does not travel through the basket.
0	Basketball does not make contact with the rim or backboard and does not travel through the basket.

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Table 2. The mean ± standard deviation score and reliability statistics across four trials of the Basketball Jump Shooting Accuracy Test (BJSAT), according to playing level and shooting distance.

Group	n	BJSAT score					Reliability statistics		
		Trial 1	*Trial 2*	*Trial 3*	*Trial 4*	*Total*	*ICC (95% CI)*	*p*	*CV%*
Athlete group									
All Athletes	41	10.9 ± 2.6	12.7 ± 3.0	12.7 ± 2.5	12.5 ± 2.7	48.8 ± 7.9	0.71 (0.53-0.83)	<0.01*	16.2
SBL	30	10.9 ± 2.7	13.0 ± 3.1	12.6 ± 2.7	12.6 ± 2.6	49.1 ± 8.6	0.78 (0.61-0.88)	<0.01*	17.5
SBL Division I	11	11.0 ± 2.1	11.8 ± 2.7	12.8 ± 2.0	12.4 ± 3.1	48.0 ± 5.8	0.31 (-0.72-0.79)	0.20	12.1
Shot distance									
Two-point	41	6.0 ± 1.6	6.9 ± 2.0	6.9 ± 2.1	7.0 ± 1.7	26.8 ± 5.3	0.68 (0.48-0.81)	<0.01*	19.8
Three-point	41	4.9 ± 1.7	5.8 ± 1.7	5.8 ± 1.4	5.7 ± 1.8	22.0 ± 4.4	0.58 (0.33-0.76)	<0.01*	20.0

Note: SBL = State Basketball League; ICC = intraclass correlation coefficient; CI = confidence intervals; CV = coefficient of variation; * indicates statistical significance.

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Figure Captions

Figure 1. Layout of the Basketball Jump Shooting Accuracy Test.

Figure 2. The mean ± standard deviation Basketball Jump Shooting Accuracy Test (BJSAT) score at different shot distances.

Figure 3. The mean ± standard deviation Basketball Jump Shooting Accuracy Test (BJSAT) score for athletes competing at State Basketball League (SBL) and SBL Division I levels.