Original research

Assessing the validity of a video-based decision-making assessment for talent identification in youth soccer

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ABSTRACT

Objectives: To investigate the construct and discriminant validity of a video-based decision-making assessment for talent identification in youth soccer.
Design: Observational study.
Method: A total of 328 academy youth soccer players (tier one, tier two, and tier three) from three developmental stages (late childhood, early adolescence, and mid-adolescence) participated in this study. The control group consisted of 59 youth athletes with no soccer experience in the last five years. Players completed a video-based decision-making assessment on an iPad, with response accuracy and response time recorded for various attacking situations (2 vs. 1, 3 vs. 1, 3 vs. 2, 4 vs. 3, and 5 vs. 3).
Results: The video-based decision-making assessment showed some construct validity. Response times were significantly faster in early and mid-adolescent players when compared to those in the late childhood group. Furthermore, an overall decline in decision-making performance (i.e. decrease in response accuracy and increase in response time) was observed from the 2 vs. 1 to the 4 vs. 3 situations. The video-based decision-making assessment lacked discriminant validity as minimal differences between academies were evident for response accuracy and response time. Only response accuracy was able to discriminate youth academy soccer players from the control group to some extent.
Conclusions: Coaches and sporting professionals should apply caution when interpreting data from practical, video-based decision-making assessments. There is currently limited conclusive evidence supporting the effectiveness of these assessments for talent identification.

Practical implications

- Practical video-based decision-making assessments that use non-specific response actions lack the required validity for talent identification.
- A soccer player's perceptual-cognitive skills can likely only be measured using task representative assessments that replicate real-world perception-action couplings.
- Video-based decision-making assessments may play a role in the talent detection process where it is possible to direct youngsters from the general population who demonstrate favourable perceptual-cognitive skills towards soccer.

1. Introduction

Association football (soccer) is a popular team invasion sport where many youngsters pursue their aspirations of becoming elite performers. The attainment of soccer-specific expertise is multifactorial,[1] with the unique individual-dependent interaction between environment and the imposed task demands underpinning successful performance.[2] On an individual level, players' performance characteristics – including their anthropometry, physical fitness, soccer-specific skills, perceptual-cognitive skills, and psychological traits – are used as a measure of soccer-specific expertise.[3] Researchers, coaches, and sporting professionals typically implement both objective[4,5] and subjective[6,7] assessments to quantify players' performance characteristics. While these data frequently inform selection decisions into high-level academy programs, a significant limitation of current methodologies is the lack of valid perceptual-cognitive skills data.

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Perceptual-cognitive skills (e.g. anticipation, pattern recognition, game intelligence, and decision-making) are integral to a player's ability to make decisions and execute soccer-specific skills during competitive match-play, where the performance environment is complex and rapidly changing.[8,9] During competitive match-play, decision-making involves players perceiving and interpreting environmental information – relative to the positioning of the ball, their teammates, and opposing players – and executing specific actions appropriate to the imposed task demands.[10,11] Importantly, players in invasion sports like soccer, perform skills in a reciprocal and sequential manner (e.g. controlling the ball following a pass from a teammate, dribbling the ball into space, and taking a shot on goal), meaning that a phase of play can involve frequent decision-making moments that are continually adapted according to perceptual information in the performance environment. Due to the complexity of the perceptual-cognitive skills underpinning decision-making in match-play, designing task representative methodologies that truly encompass the entire decision-making process is difficult.[12]

Advancements in video technology has offered researchers the opportunity to develop task representative perceptual-cognitive and decision-making assessments. To date, these assessments have involved players either verbalising/writing the most appropriate response[13–15] or executing a soccer-specific skill[16–18] after viewing video footage of a simulated match-based situation. Collectively, high-level soccer players within these tasks better anticipate the actions of their opponents, more effectively adapt their visual search strategies according to the complexity of the situation, initiate a response action quicker, and make more favourable decisions, compared with their low-level counterparts. Although these findings provide valuable insights into youth soccer players' perceptual-cognitive skills, applying such methodologies in talent identification is not straightforward. As coaches have limited opportunities to comprehensively assess promising players, the use of large projection screens, pressure sensors, eye-tracking technology, and verbal reports are often impractical. In addition, there is limited data on many of the employed assessments' construct validity,[14,15] making it difficult to determine whether the assessment is measuring what it claims to measure. Consequently, it is warranted that future research examines multiple components of video-based decision-making assessments' validity and determines practical methods for delivering these assessments in talent identification.

Therefore, the current study's primary aim was to evaluate the use of mobile technology as an alternate method of delivering video-based decision-making assessments for talent identification. First, the influence of developmental stage, the number of years playing soccer, and situation on decision-making performance was examined (i.e. construct validity). It was hypothesised that older players would have superior decision-making performances (i.e. a higher response accuracy and a faster response time) when compared with younger players. Furthermore, it was hypothesised that superior decision-making performances would be associated with a greater number of years playing soccer. It was also expected that situations involving more players (i.e. a higher number of stimulus-response choices) would result in lower response accuracy and slower response time, when compared with situations involving less players. Second, it was determined if the practical video-based decision-making assessment could discriminate players based on their academy status (i.e. discriminant validity). It was hypothesised that high-level academy players would display better decision-making performances than low-level academy players. It was also expected that all academy players would outperform a group of non-soccer players on the assessment.

2. Methods

Participants were 328 male youth soccer players from three academy systems: tier one players were members of a A-league academy (n = 119, age = 12.1 ± 2.6 y), tier two players were members of a National Premier League academy (n = 171, age = 13.2 ± 1.7 y), and tier three players were members of a local academy (n = 38, age = 14.2 ± 1.5 y). An additional 59 youth athletes (age = 14.3 ± 1.2 y) with no competitive soccer experience in the last five years formed the control group. All participants were assigned to one of three developmental stages depending on their chronological age: late childhood (8.0–10.9 y), early adolescence (11.0–13.9 y), and mid-adolescence (14.0–16.9 y). Prior to completing the decision-making assessment, all players recorded their number of years playing soccer (range = 1–12 y). Participants and their parents or legal guardians were informed of the aims and the requirements of the research prior to providing written consent. The Institutional Ethics Research Committee approved this study.

A decision-making assessment was developed using videos from previous studies.[16,17] The videos were embedded into a customised iOS application using C# programming language and deployed to an iPad Mini 2 (Model A1432, Apple Inc., California, USA) using Xcode's (Version 9.1, Apple Inc., California, USA) integrated development environment. The application contained a standardised walkthrough (task description, instructions on how to respond, and a troubleshooting guide) to ensure players understood the task at hand and to account for individual differences in the responsiveness to a novel assessment. From the original pool of 58 videos, 35 were randomly selected for the decision-making assessment. One video from each situation was used as familiarisation trials, with the remaining 30 (2 vs. 1 = 4, 3 vs. 1 = 9, 3 vs. 2 = 6, 4 vs. 3 = 5, and 5 vs. 3 = 6) presented in a random order. A one second freeze frame preceded the videos to allow players to discover the location of the ball, teammates, and opposing players. The average duration of the attacking situations was 5.7 ± 1.2 s. A yellow training bib identified the key decision-maker that was pivotal to the outcome of each situation. The assessment paused at the critical decision moment, the (occlusion) point where the yellow player received the ball and was required to decide on an appropriate response. Responses were presented in the form of interactive buttons, with pass options appearing in the last known location of the yellow player's teammates, the dribble button on top of the yellow player, and the shoot button in the location of the goal. The number of available responses varied from two to five depending on the number of participating players. All players were instructed to quickly select the response that would directly lead to a goal scoring opportunity (i.e. a response where the yellow player could score a goal or assist a teammate in the scoring of a goal). A goal scoring opportunity was available in all videos.

Response accuracy was measured on a multiple point scale. Two nationally accredited coaches (one Football Federation Australia Pro Diploma coach and one Football Federation Australia A Licence coach) and one internationally accredited coach (Union of European Football Associations A licence) independently decided on the scoring of each video. Three points were allocated to the response that would directly lead to a goal scoring opportunity. Typically, three-point responses involved the player wearing the yellow bib shooting at goal, dribbling past a defender to shoot, or passing the ball to an unmarked teammate to shoot. Two points were allocated to responses that could indirectly lead to a goal scoring opportunity. These responses included a sequence of play requiring one or two passes to create a shooting chance or dribbling the ball to create space for teammates to shoot at goal. One point was allocated to any responses that allowed the team to maintain possession of the ball. It was deemed unlikely that these responses would lead to a goal scoring opportunity. Zero points were allocated to any response
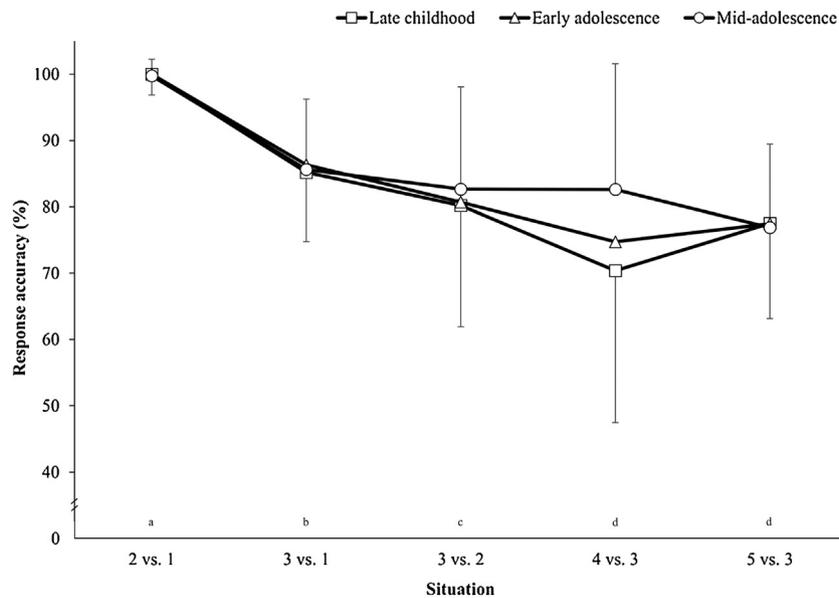
Fig. 1. The effect of developmental stage and situation on youth academy soccer players' response accuracy. Situations with the same superscripts are not significantly different (p > 0.05).

that would result in a loss of possession. Zero-point responses usually involved the yellow player shooting or dribbling while closely marked or selecting a passing option where the receiving players were heavily marked. Overall, the three coaches agreed on the scoring of the videos (83%). Response time was recorded as the duration between the occlusion of a video and the player selecting a response on the iPad.

A Kolmogorov–Smirnov test and visual inspection of the Q–Q plots/histograms identified a non-normal distribution of the dependent variables and a considerable number of outliers. A lack of agreement on how to define outliers in the research exists. However, this study used an outlier labelling rule (lower limit = percentile $25 - 3 \times$ interquartile range; upper limit = percentile $75 + 3 \times$ interquartile range) to identify any extreme response accuracy and time values — an observation outside these limits is expected to occur in only one out of 425,000 observations.[19] These outliers were removed from subsequent analyses as their data likely represented input errors (i.e. missed the response button, lapse in attention etc.). Although there was a violation in the assumptions of multivariate normality, generalised linear models were preferred over non-parametric statistics in accordance with the Central Limit Theorem. This theorem states that the sample distribution of the sample mean approximates normal distribution when the sample size is sufficiently large, which is the case for the current study.[20] A repeated measures multivariate analysis of covariance examined the construct validity of the assessment. This analysis determined the influence of developmental stage (between-participants factor), situation (within-participants factor), and the number of years playing soccer (covariate) on response accuracy and response time (dependent variables). The control group was not included in construct validity analyses. Due to an insufficient representation of each academy in the late childhood group, discriminant validity was only investigated in early and mid-adolescent players. Two repeated measures multivariate analysis of variance examined the influence of academy status (between-participants factor) and situation (within-participants factor) on response accuracy and response time (dependent variable) in early and mid-adolescent players. Bonferroni *post-hoc* corrections were applied to allow for multiple comparisons and to determine individual differences. As Mauchly's test of sphericity indicated a violation of the homogeneity of variance assumption for generalised linear models, and given the previous violation of the assumptions of normality, multivariate effects were interpreted using Pillai's trace corrections,[21] and within-participants effects using Huynh-Felt corrections when $\varepsilon > 0.75$ and Greenhouse-Geisser when $\varepsilon < 0.75$. An alpha of p < 0.05 was set for all analyses. Partial Eta Squared effect sizes (η^2_p) were evaluated as small = 0.01, moderate = 0.06 and strong = 0.14.[22] All statistical analyses were conducted using SPSS software (Version 24.0, IBM Corporation, USA).

3. Results

A significant interaction effect of developmental stage and situation was evident for response accuracy and response time (F = 1.92, p = 0.014, η^2_p = 0.07). A significant interaction effect was also evident for the number of years playing soccer and situation on response accuracy and response time (F = 2.70, p = 0.017, η^2_p = 0.05). Multivariate effects were identified for developmental stage (F = 5.73, p < 0.001, η^2_p = 0.04), the number of years playing soccer (F = 6.28, p = 0.002, η^2_p = 0.04), and situation (F = 26.16, p < 0.001, η^2_p = 0.43) on response accuracy and response time. Univariate effects were evident for the interaction between developmental stage and situation on response time (F = 4.05, p < 0.001, η^2_p = 0.03). Univariate effects were also evident for the interaction between the number years playing soccer and situation on response accuracy (F = 3.95, p = 0.012, η^2_p = 0.01) and response time (F = 3.77, p = 0.009, η^2_p = 0.01). Multiple comparisons revealed no differences for response accuracy in each developmental stage (Fig. 1). Response times were faster in the early and mid-adolescent players when compared to those in the late childhood group. Response accuracy and response time significantly differed between situations, except between 4 vs. 3 and 5 vs. 3 (Fig. 2).

A significant interaction effect for academy status and situation on response accuracy and response time was evident (early adolescence: F = 2.10, p = 0.002, η^2_p = 0.10, and mid-adolescence: F = 2.37, p < 0.001, η^2_p = 0.14). Significant multivariate effects were identified for academy status (early adolescence: F = 5.38, p < 0.001, η^2_p = 0.09, and mid-adolescence: F = 8.53, p < 0.001, η^2_p = 0.17) and situation (early adolescence: F = 106.03, p < 0.001, η^2_p = 0.85, and mid adolescence: F = 93.19, p < 0.001, η^2_p = 0.86). Univariate effects were also evident for the interaction between academy
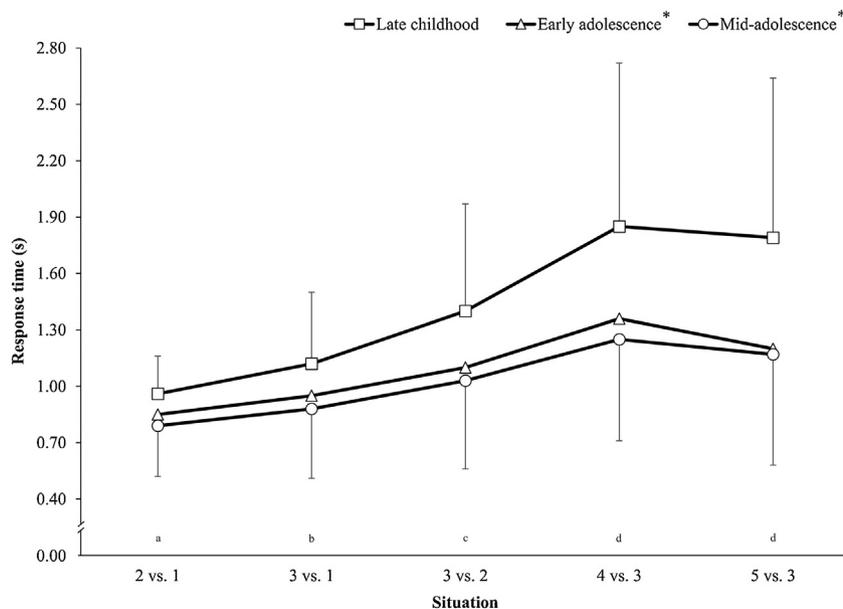
Fig. 2. The effect of developmental stage and situation on youth academy soccer players' response time. * indicates a significant difference (p < 0.05) from the late childhood group. Situations with the same superscripts are not significantly different (p > 0.05).

Table 1
Early and mid-adolescent youth soccer players' decision-making performances from three academies and a control group.

Dependent variable	Early adolescence				Mid-adolescence			
	Tier one	Tier two	Tier three	Control	Tier one	Tier two	Tier three	Control
Response accuracy (%)	*	*	*		*	*	*	
2 vs. 1	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	99.5 ± 3.4	100.0 ± 0.0	99.2 ± 4.6
3 vs. 1	85.4 ± 10.4	87.0 ± 10.1	84.8 ± 11.8	80.9 ± 11.3	83.6 ± 10.8	87.0 ± 9.1	84.9 ± 14.7	81.9 ± 13.3
3 vs. 2	77.2 ± 15.3	81.3 ± 13.5	83.3 ± 13.6	80.8 ± 14.0	79.4 ± 17.0	83.3 ± 15.6	86.7 ± 10.2	78.7 ± 14.4
4 vs. 3	79.3 ± 20.2	74.9 ± 23.6	67.0 ± 26.0	49.7 ± 21.8	86.4 ± 17.5	81.5 ± 18.3	79.1 ± 23.9	51.1 ± 27.6
5 vs. 3	79.8 ± 14.7	75.9 ± 13.3	81.0 ± 14.4	71.8 ± 14.7	74.8 ± 14.3	76.4 ± 12.3	75.9 ± 10.4	74.3 ± 13.1
Response time (s)		**				**		
2 vs. 1	0.97 ± 0.19	0.81 ± 0.22	0.85 ± 0.23	0.84 ± 0.31	0.93 ± 0.33	0.70 ± 0.17	0.86 ± 0.30	0.82 ± 0.23
3 vs. 1	1.10 ± 0.36	0.89 ± 0.33	0.99 ± 0.46	0.90 ± 0.40	1.11 ± 0.45	0.76 ± 0.25	0.83 ± 0.36	0.93 ± 0.44
3 vs. 2	1.38 ± 0.51	1.03 ± 0.43	1.00 ± 0.34	0.91 ± 0.33	1.28 ± 0.52	0.89 ± 0.39	1.02 ± 0.45	1.00 ± 0.42
4 vs. 3	1.50 ± 0.60	1.32 ± 0.55	1.31 ± 0.55	1.34 ± 0.64	1.51 ± 0.70	1.12 ± 0.41	1.19 ± 0.43	1.37 ± 0.49
5 vs. 3	1.40 ± 0.56	1.15 ± 0.55	1.15 ± 0.39	1.17 ± 0.54	1.51 ± 0.67	1.02 ± 0.49	1.05 ± 0.47	1.16 ± 0.55

Note: Data presented as mean ± SD. *Denotes a significant difference from the control group (p < 0.05). **Denotes a significant difference from the tier one academy.

status and situation on response accuracy (early adolescence: F = 5.28, p < 0.001, η^2_p = 0.09, and mid-adolescence: F = 8.14, p < 0.001, η^2_p = 0.16). Situation significantly influenced response accuracy (early adolescence: F = 84.52, p < 0.001, η^2_p = 0.35, and mid-adolescence: F = 61.32, p < 0.001, η^2_p = 0.33) and response time (early adolescence: F = 50.03, p < 0.001, η^2_p = 0.24, and mid-adolescence: F = 50.03, p < 0.001, η^2_p = 0.24). Multiple comparisons revealed that early and mid-adolescent academy players were more accurate when compared with the control group (Table 1). Tier two academy players responded significantly faster than the tier one academy players.

4. Discussion

The current study examined the construct and discriminant validity of a video-based decision-making assessment for talent identification. The assessment showed construct validity as developmental stage, the number of years playing soccer, and situation influenced decision-making performance. As hypothesised, the older players were faster at responding in each situation, when compared with their younger counterparts. However, response accuracy was similar in all developmental stages. The number of years playing soccer could explain the

differences in decision-making performance between developmental stages. Decision-making performance also declined (i.e. lower response accuracy and slower response time) as situation complexity increased (i.e. a higher number of participating players and a closer attacker to defender ratio). Notably, the video-based decision-making assessment had limited discriminant validity in youth academy soccer players. While the assessment was able to discriminate youth academy soccer players from the control group using response accuracy, it lacked the sensitivity to determine inter-academy differences in decision-making performance. As a result, the current study's video-based decision-making assessment has limited practicality for talent identification.

The video-based decision-making assessment demonstrated two theoretical constructs. First, decision-making performance increased across developmental stages, with older players responding significantly faster than younger players in each situation. This was expected as response time naturally improves as the motor system develops.[23] Within the current study, it appeared that the improvement in decision-making performance were also associated with the number of years playing soccer. This was anticipated as increased exposure to soccer-related activities and position-specific training allows players to gain a greater understanding

of the game and more efficiently process contextual information to determine the probability of certain events occurring.[24,25] Second, decision-making performance declined (i.e. response accuracy decreased and response time increased) with increasing situation complexity. From a theoretical standpoint, increasing the stimulus-response choices imposes greater processing demands on players as they are required to interpret more environmental stimuli prior to executing a response.[26,27] These increased processing demands coupled with a close attacker to defender ratio results in players requiring more time to determine the response action that would directly lead to a goal scoring opportunity.

The video-based decision-making assessment lacked discriminant validity and was unable to replicate previous studies who used the same videos in a laboratory setting.[17] While this finding was likely the result of the reduced specificity in the perception-action coupling (i.e. touching an iPad screen when compared with executing the soccer-specific skills), it highlights that video-based decision-making assessments cannot uniformly identify performance level differences in youth soccer players. Alternatively, the 'best' decision-makers in the current sample may be competing outside of the tier one academy, possibly due to selection biases (a tendency to favour physical advanced players) limiting their involvement in high-level talent development programs.[28] Importantly, other studies that use video-based decision-making assessments with non-specific response actions present limited evidence to support their employed methodological designs' construct validity.[14,15] This is concerning as they are often used in talent identification settings, where the proposed measured must be representative a player's involvements during competitive match-play or at least be indicative of their potential to attain greater perceptual-cognitive expertise in the future.

Inherently, there are several key limitations that confound the use of video-based decision-making assessments for talent identification purposes. Without the use of virtual reality, it is rather difficult to capture a realistic viewing perspective where players can explore the performance environment. The use of a third-person viewing perspective manipulates players' visual-search behaviours so that they focus on the free space available as opposed to the movements of their teammates and opposing players.[29] Also, video-based assessments often remove key contextual information that influences the decision-making process (e.g. teammates' soccer-specific skills, phase of play, coaches' tactical instructions, score etc.). Finally, removing the execution of a soccer-specific skill will decrease the assessments' task representativeness and likely conceal the perceptual-cognitive skills underling superior decision-making performance.[30] Collectively, the data obtained from this assessment may only provide an indication of players' general perceptual-cognitive abilities rather than their specific perceptual-cognitive skills that are a characteristic of greater soccer expertise. Therefore, the use of video-based decision-making assessments – that are characterised by less realistic viewing perspectives or remove key contextual information – in talent identification is questionable.

5. Conclusion

Overall, the video-based decision-making assessment demonstrated some construct validity, but lacked the sensitivity to determine inter-academy difference in decision-making performance. Developmental stage, the number of years playing soccer, and situation complexity all influenced decision-making performance. While the current study's assessment was developed to provide a practical measure of perceptual-cognitive and decision-making skills, the removal of a specific response action limited the use-fulness of the assessment for talent identification purposes. Based on this study's findings, there is a clear need for future research to identify task representative perceptual-cognitive/decision-making assessments that possess both construct, discriminant, and practical validity for talent identification.

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