LITHUANIAN SPORT UNIVERSITY
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NEW TOOLS FOR TALENT IDENTIFICATION

FINAL MASTER‘S THESIS

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CONFIRMATION OF INDEPENDENT COMPOSITION OF THE THESIS

I hereby declare, that the present final Master's thesis *New tools for talent identification in basketball*

1. Has been carried out by myself;
2. Has not been used in any other university in Lithuania or abroad;
3. Have not used any references not indicated in the paper and the list of references is complete.

10-05-21 *Stefan Ivar Hendriks*

CONFIRMATION OF LIABILITY FOR THE REGULARITY OF THE LITHUANIAN/ FOREIGN LANGUAGE

I hereby confirm the correctness of the Lithuanian language used in the final thesis.

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FINAL MASTER'S THESIS SUPERVISOR'SASSESSMENT

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TABLE OF CONTENTS

SUMMARY

New tools for talent identification in basketball.

Key words: Perception-action, pattern recognition, spatial awareness, decision-making

Aim: To assess the validity and reliability of a video-based test that might assist basketball coaches in the talent identification process since there are currently no proven and reliable tests available.

Objectives:

1. Evaluate validity of video-based decision-making test.
2. Evaluate reliability of video-based decision-making test.

Research methodology: Videos of decision-making moments during basketball matches were cut from various basketball games using NACSport Scout+ and Klipdraw and edited in Dartfish, and combined in Limesurvey and distributed across authors network of coaches. 227 people completed the video test. Participants (n=193) were asked to put an answer A/E they would think is the best solution for that basketball scenario. Timing statistics were kept, and participants were asked about playing level, experience.

Results: 12/14-year-olds were outperformed significantly (P= 0,008) by the participants aged 15/16, as well by the participants aged 17/18 (P=0,017) on number of correct answers. Within age groups, only significant results were that professional 17/18-year-olds outperformed the other 17/18-year-olds. All other comparisons skill/age/answers/time proved insignificant.

Conclusions:

1. Test can be used to distinguish between chronological age groups on number of correct answers but not on time used.
2. Test cannot be used to distinguish between skills group.
3. Test can be used to distinguish between skill within age group U17/18 on number of correct answers but not on time used.
4. Created video-based test for decision-making with the purpose of talent identification is reliable.

SANTRAUKA

Nauji įrankiai talentų identifikavimui krepšinyje

Raktiniai žodžiai: Suvokimas-veiksmas, eigos atpažinimas, erdvinis suvokimas, sprendimo priėmimas

Tikslas: Įvertinti vaizdo įrašų pagrindu sudaryto testo pagrįstumą ir patikimumą, kuris gali padėti krepšinio treneriams talentų atpažinimo procese, šiuo metu nesant panašių patikimų testų.

Tikslai:

1. Įvertinti vaizdo įrašų pagrindu sudaryto sprendimų priėmimo testo pagrįstumą.
2. Įvertinti vaizdo įrašų pagrindu sudaryto sprendimų priėmimo testo patikimumą.

Tyrimo metodologija: Sprendimo priėmimų momentų krepšinio rungtynių metu vaizdo įrašai buvo iškirpti iš įvairių rungtynių naudojant NACSport Scout+ ir Klipdraw ir sumontuoti naudojant Dartfish programas, įtraukti į Limesurvey puslapyje patalpintą testą bei išplatinti per autoriui pažįstamus trenerius. 227 žmonės atliko šį testą. Dalyviai (n=193) turėjo pasirinkti vieną iš atsakymų pažymėtų raidėmis A-E, kuris atspindėtų geriausią sprendimą duotoje krepšinio situacijoje. Testo atlikimo laikas buvo fiksuojamas bei dalyviai buvo paprašyti nurodyti savo patirtį ir lygį.

Rezultatai: 12-14 metų dalyviai pasirinko statistiškai reikšmingai mažiau teisingų atsakymų nei 15-16 (P= 0,008) metų bei 17-18 metų (P=0,017) dalyviai. Amžiaus grupių viduje vienintelis statististiškai reikšmingas rezultatas nustatytas 17-18 metų amžiaus grupėje, kurioje profesionalaus lygio krepšininkai pasirinko daugiau teisingų atsakymų nei aukšto ir žemo lygio krepšininkai. Visi kiti skirtumai tarp dalyvių lygio, amžiaus ir laiko buvo statistiškai nereikšmingi.

Išvados:

1. Testas gali atskirti dalyvių chronologines amžiaus grupes pagal teisingų atsakymų skaičių, bet ne testo atlikimo laiką.
2. Testas negali būti naudojamas atskirti dalyvius pagal jų lygio grupes.
3. Testas gali būti naudojamas atskirti dalyvių lygius 17-18 metų amžiau grupėje pagal teisingų atsakymų kiekį, bet ne testo atlikimo laiką.
4. Sukurtas vaizdo įrašų pagrindu testas skirtas identifikuoti sprendimų priėmimo talentui yra patikimas.

INTRODUCTION

Forty percent of players selected to their respective countries national team in the youth ages (Kalén, 2019) make it all the way through to the last youth team selection in the under 20 age categories. This means that over half the team selected, on average, will not make it to professional level. This shows that current talent identification processes are in dire need of refinement. Commonly used selection criteria include body dimensions measuring, speed and jumping testing as well as technical skills tests.

In general, early maturated players tend to outperform players that have not reached puberty or are in an earlier stage of puberty with less developed muscles and coordination and body features. However, basketball is played as a team sport with various roles and responsibilities, so a multitude of factors play a role in deciding the outcome of the game. Managers look for players that can combine superior athletic capabilities with other factors.

One of the deciding factors of winning a game in basketball is having less turnovers (Gomez et al., 2008) than the opposing team. To obtain this goal, players must lose the ball less and make more correct decisions both with and without the ball (Zhang, 2018). This decision-making skill in other sports has been researched with participants performing a decision-making test. This research aims to inspire future research into talent development into an argument that a more diverse approach should be used, as indicated in meta-analysis by Johnston (2018), while calling for action on improving the accuracy of the tests, as well as the variety.

Therefore, the main aim of our project is to assess the validity and reliability of a video-based decision-making test that might assist basketball coaches in the talent identification process.

Our objectives were to create a new test that hopefully could provide a baseline tool and measurement for talent identification purposes, and to further the discussion in basketball identification that talent has many shapes or forms, and the approach should be diversified and more holistically approached. This type of research has been used in other sports, but a definitive version for basketball has not been established.

We raised a hypothesis that test can identify reliably and validly between level of playing, and age in both the number of answers correctly answered on the test, as well as that older participants and higher-level participants should be faster in answering.

1. LITERATURE REVIEW

1.1. Talent identification in sports and the importance of decision-making talent identification

The beauty and attractiveness of basketball lies in the high scoring nature of the game. Fans come to the arenas to see dazzling displays of athleticism, teamwork, and surprises. Teams battle one another to try to create a scoring advantage and keep the opponent scores to a minimum. To try and find an advantage in this race, teams and coaches start to look to players to complete their teams in different ways. One of those ways is the value a good decision-making player can bring to a team. Since one of the key indicators of winning a basketball game is having a low number of turnovers (Zhang, 2018).

This race to find the best players is not only applied on the professional level, but also within youth sports. Teams reckon that if you develop your own high caliber players you do not need to buy them on the player market. To find promising players, teams use Talent Identification systems, most comely referred to as TIDS. Most common tests include physical preparation, anthropomorphic measures, and technical tactical tests to compare players among peers and are often based on coaches' expertise (Roberts et al., 2019).

The criticism on talent identification is this, that if we regard someone as not talented at the respective test the players were subjected too, coaches and organizations tend to leave players behind, stamped with a non-talent identity. To provide a more holistic option, if coaches knew that their player has already shown proven high-level skills, it could lead to more adept coaching, allowing for more mistakes and freedom to grow, as well as playing time over their more physically mature peers at that age (Kalén et al, 2020).

Since research shows that people tremendously differ on their maturation process, and late bloomers tend to get overlooked. One of the dangers of early talent identification is that younger, more physically mature players get selected to higher level teams, they get exposed to higher level coaches, tournaments and experiences, while the late bloomer is stuck in second level teams, have less attention paid to them, do not get invited to travel teams and thus, by the time they start reaching their physical peak, and their coordination, decision making and strength level suddenly matches and compliments one another instead of obstructing each other, a lot of opportunities have already passed (Rubajzcyk et al, 2017).

As Baker (2018) mentioned, talent is innate, and coaches in every form of sport look to accelerate the process of developing players by putting them into more competitive surroundings as soon as they believe they have identified a talent. One of the solutions of talent identification is by “bio-banding” (Cummings et al., 2017), the completion of teams for training or competition in youth sports based on size and maturity status instead of chronological age. This poses the question, that if selection through the body’s maturity status is applied, why not incorporate the psychological and technical tactical aspects, as well as decision making.

Since more than 60% of modern research is based on examining physical profiles, mostly (65%) based on male athletes. Here we explore the validity and reliability of a video-based decision-making assessment tool, to provide measures for chronological age. Such a tool would suggest that by identifying players that show prowess in perception expertise compared to their peers should be regarded as talented in this regard. This talent, combined with other forms of anthropomorphically analysis, combined with skills tests and psychology tests could lead to a longer-term outlook on the development of players. Since the trend in basketball has always been harder faster stronger and preferably taller, better decision makers could be kept in the higher-level teams for more exposure based on their skills rather than their physical appearance at that time.

Traditionally, talent is identified on the premise of observable factors that are measurable and comparable. By now a lot of people understand that if you run 100 meters in under 10 seconds, that is considered very fast. Youth level domination however does not necessarily translate to pro level players (Barreiros et al, 2014). This concept however, of comparing one athlete to another, is being done in lots of different ways: blood testing, rate of peak velocity tests, wingspan measurements but most of these tests fail to include an important factor in team sports, decision making. This is understandable, since there is currently no clear cut and proven way to accurately measure, compare and describe an athlete’s decision making in basketball thus far. This is our starting point for this research.

Important is to factor that being able to make the correct decision also requires a person to quickly eliminate solutions on the court that seem incorrect, like for example passing to a player on the other team. Empiric evidence (Gorman et al., 2015) has shown that experts in their field, whether that is chess or basketball, have a higher accuracy in making the correct decision needed.

Decision making in sports is partially based on precise encoding on the visual input of spatio-temporal information available. Because of its big role in coordinating movement and action anticipation (Vicario et al, 2019) it requires continuous anticipation, recognizing patterns as soon as they start to shape form. Experienced players can look at the starting positions of the players and start including likely patterns that subsequently follows the state they are observing, basketball patterns and tactics have a 24 second time limit due to the shot clock rule limitations in higher level basketball, so anticipation for those patterns tend to have an evolving pattern (FIBA Rules, 2020).

As Leite (2014) showed, the amount of defensive pressure a team puts on their opponent changes the way the collective team behaves during a game, with different change of speeds, and more irregular displacements. This is another factor that must be considered. This is confirmed by Sakselin (2020), who noted that the defenders influence the visual search behavior and therefor the decision-making process. As well by Gibson (1979), who found out that human action results from a cyclic process of perception of contextual information to guide action, and action to detect the contextual information. Representational momentum is included in everyday life like during film clips showing big groups of people (Thornthon & Hayes, 2004), people filter out the information necessary to them and disregard the non-useful information.

However, recognition skill only explains a portion of the total amount of processes that are associated with successful anticipatory performance in a natural setting. Moradi (2014) found that the specificity of learning a new task such as basketball shooting by inexperienced high schoolers was closely related by the visual context of the training. If the visual was under target conditions, they performed similar, however if a new visual condition was presented to them, their performance dropped.

There are a multitude of approaches to talent identification. In China, the pathway for development is based on eight pillars, with expert players themselves rating Social Context, Sports Context, Intra-individual Skills, Tactical Factors, Physical capacities, Inter-individual skills and technical factors all above anthropomorphic measures in the arbitrary units of importance by way of Meaning units (Bonal et al, 2020). This shows that all over the world, different methods are used to find talent, to describe talent, and to develop talent.

In rugby, expert players outperform novice players on recollection of pattern that were structured, leading to assume that in talent identification, structured patterns as well as unstructured patterns should be included in future talent identification research (Sherwood, 2019). In soccer, age seems to be a major factor on general perceptual-cognitive abilities, especially in talented players. It should be also noted, that in soccer, sport-specific creativity tasks were positively associated with higher activation levels in the brain that promote functions such as information processing, visual and motor imagery and the integration of both somatosensory and sensorimotor information (Fink et al., 2019). But Bennett et al. (2018) cautioned that decision making tests by way of videos provide limit evidence for the effectiveness of making reliable assessments.

In basketball, the amount of space on the court is limited, the more space a player can take up, the more impact he or she can have on the game. Stature and superior anthropomorphic measures are a deciding factor in performance in youth basketball (Ramos 2019) as well as superior physical performance was an indictive of a higher playing level in adults (Ferioli 2019). Youth basketball players already show significant differences in lower leg length, shoulder width and thigh circumference compared to fencing, judo, swimming, table tennis and volleyball youth players (Zhao et al., 2019).

As Höner (2014) found that in a standardized interpretation of motor diagnostics, as age increasing also higher results on other motor performances such as dribbling was required for participants to be rated high in the talent category in soccer tests. As there is a large correlation (Kamandulis, 2013) between fitness level and specific coordination such as speed agility and leg power, the complex movement of making a basketball pass or dribble after deciding so cannot be reduced to a single motor ability. Since the cognitive, perceptual, and psychomotor abilities are involved with such decisions on the court, they have to be acknowledged as part of the actual movement.

As Bourbousson (2010) noted, movement patterns and couplings in basketball conform to a certain space-time pattern, also called dyads. Those dyads can be unique but most of the time they keep in line with the universal principles of self-organizing systems. Hence, player 1 from team A will be defended by player 1 from team B, and while team A is trying to create space for an opening from team B, team B is trying to prevent this from happening. This results in a set number of possibilities and patterns that experts can predict. The interrelation with teams contracting and expanding their position on the court, during combinations, set play or fast break acts according to a stretch index and can be predicted up to a certain point of intuit, if a player is without a defender and with the ball, he will likely shoot and the other will react to the shot (Bourbousson, 2010).

As Abbott (2004) stated, the whole process must be considered for both training and talent identification, since they are intertwined, proposing that the process is reconceptualized as a whole, with placing greater emphasis on the psychological capacities of a child to develop in sports, and the factors this process includes paving the way for a more holistic approach in identification and development.

Previous and different sport experience plays a factor in talent identification too, as shown by Arede (2019), who argued and proved that an early stimulus with other sports helps create a foundation for later movement skills in talented basketball players. Overall, late specialization and different early sport experiences greatly affect basketball skill acquisition and help adaptation for later contexts with technical movements, tactical challenges and might even present an advantage is possible sport achievement (Santos et al, 2017).

1.2. Talent identification using a video tool

In soccer (Bennet, 2018) found that a video-based decision-making tool did not provide enough discriminant validity and coaches should apply caution from these types of assessments. However, in Australian Football, Woods et al. (2015) created a video task for decision making that could discriminate successfully between the talent and non-talent identified participants at 92% and 76% success rate. Panchuk et al. (2018) used immersive video to test if that type of training improved the decision-making capabilities of elite basketball players (youth) with mixed results.

As Hadlow (2018) designed a Modified Perceptual Training Framework. Video tools for perceptual training have a predicted transfer effect on competitive performance based on three key design factors: the targeted perceptual function, ordered low to high, the stimulus correspondence, in a generic to sport specific spectrum, and response correspondence, also ranging from generic to sport specific. Since multiple stimuli are happening during the observing of a basketball match, multiple perceptual skills must be considered. The higher a designed test scores on the training to competition correspondence, the more likely it is that the training will transfer to competition. In decision making research in basketball however, no such clear framework exists yet.

As Broadbent (2015) mentioned, in perceptual-cognitive skills training there should be a high level of similarity between the actual training method, be it on a computer or other platform with use of 3D glasses or virtual reality and the real-life performance. The results of the study by Pagé et al. (2019) shows promise in their indication that computer screen training promotes transferable but non generalized while virtual reality leads to generalized gains as well as transferable basketball gains.

Study by Wu et al. (2013) proved that experts compared to novices have a higher stability in gaze fixation and a more reliable locus of fixation. Inferior parietal lobule and inferior frontal gyrus had increased activity than the novice athletes during action anticipation in a free throw task during functional brain activity recording with functional magnetic resonance tools. During brain network analysis, the change in parameters were significantly related by experience or total number of training years by participants. High-level players displayed higher global efficiency, shorter path length in their network (Pi et al., 2019). To improve perceptual skill, impairment of peripheral vision training shows promises in changes in information pickup (Ryu et al., 2016). Since teams are formed based on chronological age in youth teams, players that are born later in the year and have a late puberty tend to be double disadvantaged compared to their peers (Rubajczyk et al., 2017).

1.3. Decision making action anticipation

The ability to understand and therefore predict the movements of the opponent during a match is essential at any level of sport. The advantage being that if you correctly predicted the movement of your opponent, you could take the initiative by anticipating instead of waiting and seeing what the opponent does and then reacting to that. We predict those movements by the opponent by not only our own experience of action observation network AON by accumulation of movement during training/playing by also by other components that in a small but precise way correct the posture and therefore cues of others, seeing and recognizing mistakes in those postures (Abreu, 2012).

According to transcranial magnetic stimulation studies (Aglioti et al., 2008) it was showed that elite athletes have inherent resonant action systems that are anticipatory by nature. The elite athletes could predict the outcome of a shot even with visual impairment better than non-elite athletes. They could do so by an increased activation of medial prefrontal motor areas that activated when observing erroneous behavior in the movements observed. This proves that the brain discriminates between correct and faulty performance in the motor system. More creative players have a wider attentional focus with more fixations but shorter in duration than lesser creative players in soccer (Roca et al., 2018).

In visual tracking studies done by Lin et al (2020), skilled basketball players handle dynamic visual information better than college peers. This ability to track multiple objects simultaneously contributed directly to a higher likeliness of successfully assist or to steal the ball. Noted, while increasing the number of objects needed to track, performance dropped significantly. This supports the notion that high skilled athletes are not only adept at tracking their target, but also in filtering the information of what to track, look for in pattern recognition.

As Gorman (2013) found, expert basketball players display an aptitude unlike non basketball playing peers to recall patterns, predicting movements or actions within basketball with less errors, both in static and moving recall tasks as well as in traditional (where pattern by participant is likened to original target image) as well as anticipatory recall (where participants needed to input the sequence of patterns after target image was displayed). However, even expert need enough information to be able to make accurate judgments or predictions when anticipating the fate of a basketball shot, even though this amount is less than is needed for novice players (Li, 2020).

1.4. Perceptual cognitive skills and expert performance

During maturation, the imitative nonimitative (a child reproducing what it sees) motor learning implies a covert simulation of that movement or action, such actions need to be performed to fully learn a new movement or action. As the 5 stages of skill acquisition model by Dreyfus (2004) proved, is that expert performers have intuitive decision-making skills with involved deciding. Sillero Quintana et al. (2007) investigated 473 young basketball players in the Spanish federation over a period of 5 years, with participants displaying excellent scores in visual acuity and stereoscopic vision.

To achieve excellence, athletes use specific mechanisms of specific anticipatory resonance that are very finely tuned (Aglioti, 2012), found using transcranial magnetic stimulation while investigation the action anticipation dynamics and the underlying neural correlation in basketball players. They found that while predicting the outcome of a shot, professional athletes have a time specific motor activation by reading the kinematics of the body. Since the sensorimotor abilities of elite athletes are more developed than their non-elite peers and untrained individuals.

As Gorman (2011) mentioned, in basketball related video tests for anticipation in perception, using static snippets of videos, only expert basketball players could anticipate what pattern should follow the static image provided, while on moving video also recreational basketball players could anticipate likely next state of patterns that were provided. During occlusion research, basketball players outperformed volleyball players in detecting action compatibility in poses that were shown before realisation of free throw actions.

Gorman (2012) also proved, that experts in the key features of basketball domain related patterns were able to encode player positions significantly faster, suggesting that previous research might have underestimated the scope of the impact the expert advantage an expert basketball player has in pattern recall, by not only being able to recreate positions, also project future positions from both standstill and moving images significantly more accurate and faster, even when challenged (Gorman, 2013) by encoding positions based on offensive/defensive side of the match and answering questions about the side they were not paying attention to. Results revealed that this was most promising for the offensive possessions (Gorman, 2018). As Didierjean and Marmèche (2005) found that experts also more often falsely recognized new configurations during basketball game scenarios. This shows that experts tend and try to encode the visual information available into likely next state of the game.

As Furley (2010) found, inattentional blindness or IB (where the performer misses an opportunity because the attentions is somewhere else) also plays a factor in decision making. In the experiment the participants got distracted by a simple instruction (researcher mentioning that the respective defender was too close to the participant with the ball, triggering an if-then reaction mostly seen in basketball, by player responding to dribbling the ball), moving their focus of their attention to and in the process miss an open teammate who by way of instruction did not receive the ball.

Selecting the relevant cues from visual input on their perceptual chunking, provide a quicker context to said cues and lastly have a quicker coupling between perception-action is what separates the experts from the recreational players. Part of this is explained by Correia (2010) by combining General Tau theory (Lee, 2009) that combines interpersonal distance and relative velocity plus the time to fulfill a gap as the variables that could be used as control parameters. If the player sees and can anticipate how fast his teammates is moving, he can anticipate the moment the teammate would arrive at said location and therefore decide to pass or not to pass and at what velocity and angle based on spatial-temporal information observed.

Previous research by Gorman (2015) has shown that using complex and dynamic actions or sequences as images is mostly influenced by the constraints of number of total players and the disparity of attackers versus defenders. While increasing the number of active players displayed, experts tend to decrease the time spent fixated on one point and increase the number of fixations. This leads to a wider range of different display features for a longer time. However, while training this, Oppici et al. (2017) mentioned that it is not yet know if the long-term exposure task constraints lead to better processing of environmental information.

So, if experts perform better than novices, it is measurable and trainable, and therefore, identifiable. This research aims to provide a baseline test for testing decision making in basketball. As concluded in previous meta-analysis by Johnston et al. (2018), talent identification is mostly focused on physical profiling and not on perceptual skills. The idea to create a baseline measure for decision making accuracy and measured by time can provide a valuable tool in talent identification processes, as decision making is not impaired by early growth spurts or maturation.

2. RESEARCH METHODOLOGY AND ORGANISATION

2.1. Research object, strategy, logic and nature

Research was designed to create a new video-based decision-making tool with the aim to help coaches in the talent identification process in basketball. The research strategy was divided in four main stages:

Stage 1. The research started by assessing previous literature about talent identification in basketball. This led to conclusion that the research on decision making within talent identification did not have a valid and reliable video-based tool yet.

Stage 2. A video-based tool was then developed with purpose to create a baseline tool. Specifically, in cooperation with professor we chose which videos to use based of quality of the video and the clearness that this indeed was the decision-making moment.

Stage 3. Test execution.

Stage 4. Assessment of validity, reliability, and differences between age categories. Through a network of coaches, the test was spread with instructions in different languages (Dutch, English and Lithuanian). Due to Covid-19 pandemic this was exclusively online, with the idea that participants from the safety of their own home could perform the test. Test was designed to be completed between 8/12 minutes with the idea that again due to Covid-19 pandemic people spend more time on their computer and since the test was performed by youth players the time spent in front of a screen needed to be limited. All data was gathered between January and April 2021.

Nature of the research was a quantitative analysis with a descriptive design. The importance of the test was to test answer's accuracy on predicting decision of professional player and time spent on deciding for validity and reliability purposes of creating a new tool that can be used by coaches to identify talent in decision making.

2.2. Contingent of research subjects

Because prior research by Bennet et al (2019) with a large sample size group in soccer proved ineffective while using an Ipad for the video test and testing a wide spectrum of ages, a larger scale basketball test was designed to be made at home on a PC with a larger screen. To be able to compare age groups that play at various levels, players from different countries and backgrounds were approached through the network of the researcher.

There was a total of 326 participants in the first video test. Ages of the participants ranged from 6 years old to 50 years old. For a clear comparison, only the participants aged twelve to eighteen were include while older than 18 years old participants were excluded. Participants who did not answer all the questions in the test were excluded. After exclusion 191 participants were included in the study.

Participants were grouped according to age into three groups:

- U12/14 – 12 – 14 years old (n=61)
- U15/16 – 15 – 16 years old (n=101)
- U17/18 – 17 – 18 years old (n=31)

Skill groups were assessed in three levels:

- Professional level – included players in any paid professional league.
- High level – included players who performed in the highest level of age group in domestic competition.
- Low level - included players below the highest group of domestic competition.

We also grouped participants within the age group according to their skill level for comparison purposes.

Twenty-two of the first-time participants were asked to complete the same test after four weeks for the test reliability analysis.

2.3. Research methods and organization

The Lithuanian Sports University approved the study with protocol No. SMTEK-67 (2020-12-21) for the use of a questionnaire combined with the use of videos to investigate decision making in basketball, with the purpose of creating a new tool for talent identification in an ethical, holistic way in accordance with the Helsinki declaration. All participants and their parental guardians signed an informed consent.

Online questionnaire to identify age, gender, country of playing, level of play, number of years played combined with 5 test video questions with instructions. Level of play indicated either highest domestic youth league according to age, or lower domestic youth league, or professional level. 20 Videos of basketball situations were gathered from 7 different basketball games in Eurocup, World cup, ACB from various teams. Videos were cut using Dartfish (Dartfish 10, release 2017, Switzerland), edited in Nacsport and Klipdraw (release 2015, Aligfra Digital Canarias, S.L.) and put into online questionnaire software Limesurvey (Germany 2003), and distributed across the internet through social media

(Facebook) and email. Videos were shown with five seconds of basketball 5 on 5 games, with the video pausing at the decisive moment the person with the ball in their hands at that time decided to dribble, pass or shoot. Because of the nature of 5 versus 5 basketball, decisions included passes to either 4 active teammates, or a shot or drive to the basket. After being acquainted with the first five test videos, participants were asked to watch 15 more videos with the instruction to give the answer they would perform had they been on the court to make that decision as quickly as possible.

The answers were recorded and coded into correct answers if the participant choose the same solution as the professional player on the screen chose for statistical analysis. To exclude emotions and to prevent a stressful situation, players did not see if they answered correctly. Questions were timed and scores were kept per participant for statistical analysis. Time was recorded but not displayed to participants to prevent rushing.

Participants performed the test from home, on their laptop or computer to ensure that the video would be clear to see, as the test was not designed for mobile phone use. At the end of the test, participants were asked if they wanted to participate in the retest. Participants who did volunteer got asked again after 4 weeks to retake the same test, but with the same 15 timed questions randomized in order. This to prevent players from experiencing the exact same test as four weeks prior.

2.4. Methods of statistical analysis

Descriptive statistics were calculated and particularly mean, minimum, maximum, and standard deviation. Number of correct answers and average time spent to complete the test were considered as the dependent variables, while age categories and group levels the independent variables. Normality of each variable was analyzed by Shapiro-Wilko test showing non-normally distributed variables. Therefore, the Kruskal-Wallis test was used between different age and level groups and within age group according to level were compared. In case of significant differences were found, post hoc analysis was performed by mean rank test Mann-Whitney U using a Bonferroni correction. Moreover, the association between correct answers and average time was analyzed using Spearman's correlation. Significance was set at $p < 0.05$. For reliability analysis of the test considering the number of correct answers and the time spent to answer, the intra-class correlation (ICC) was adopted. Acceptable values for ICC values were set at equal or above 0.70 according to Baumgartner & Chung (2001). Additionally, reliability was assessed using the Coefficient of Variation (CV) which was interpreted as 5% being reliable as made standard by Hopkins (2000). All analyses were completed in SPSS version 23 (IBM, 2018).

3. RESULTS

3.1. Comparison of number of correct answers and average time spent per question in different age groups

Firstly, average correct answers in different age groups were compared (Table 1). Average amount of correct answers in the U12/14 group was 8.7±1,91, while in the U15/16 it was 9.65±2.05. Participants in the age group U15/16 chose significantly more correct answers than the participants in the age group U12/14 (p=0.023). Also, the age group U17/18 outperformed the U13/14 group significantly (p=0.05) with average amount of correct answers of 9.87±2,10. The oldest group (U17/18) did not significantly answer better than the middle group of U15/16 (p=1.00).

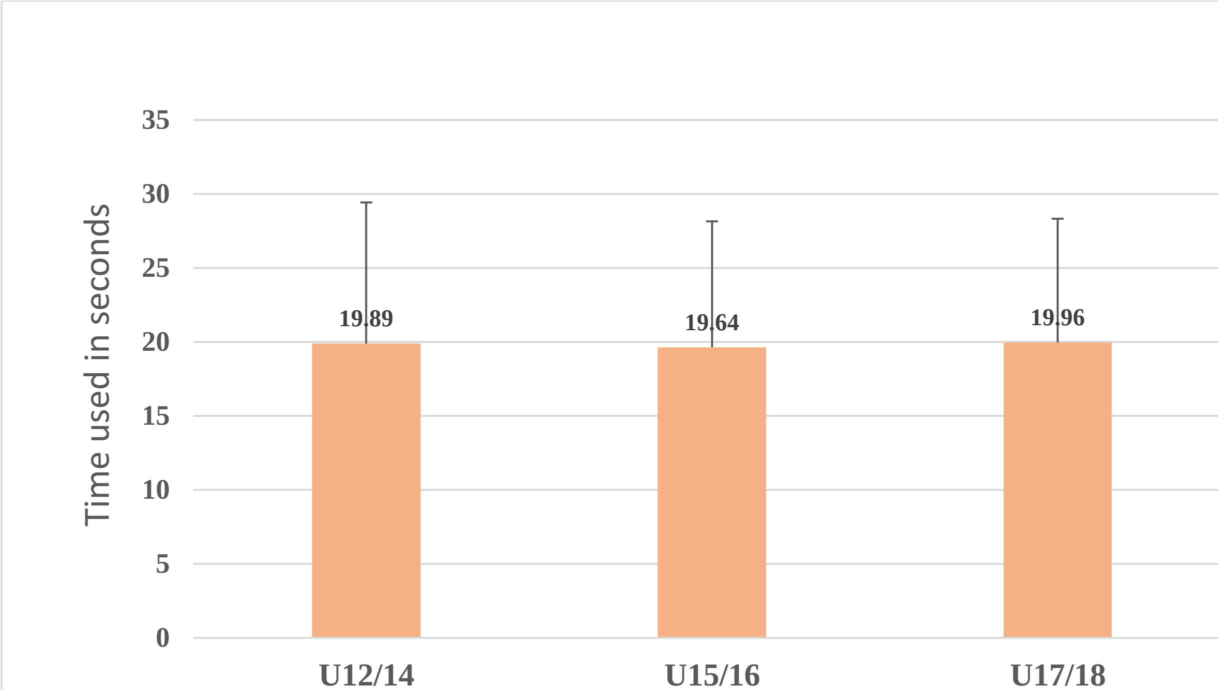
Table 1. Number of correct answers in different age groups

Age group	N	Average Rank	Z	P	Adjusted Significance
U12/14	61	69,04	-2,657	**0.008**	**0.02**
U15/16	101	89,02			
U12/14	61	41,83	-2,389	**0.017**	**0.05**
U17/18	31	55,69			
U15/16	101	65,69	-0,443	0.653	1.00
U17/18	31	69,13			

After comparing the times spent per question there was almost no differences between age groups (Graph 2). No significant findings were discovered in time analysis when comparing between age groups.

On average, the youngest group (U13/14) used 19.89 ±9.61 s per question to answer. This was similar than U14/15 group, who on average responded within 19.64±8.55 s.

Even slower were the U17/18 participants, who with 19,96±8,50 s performed the slowest when grouped according to age.



Graph 2. Differences in time to answer between the investigated age groups.

3.2. Comparison of number of correct answers and average time spent per question in different skill level groups.

The combined groups of all ages regarded on skill level did not produce any significant results (Table 2). Both high and professional skill groups did score higher than low skill group on average amount of correct answers and with less deviation, but the differences were insignificant.

Table 2. The difference in number of correct answers between different skill level groups

Skill group	N	Average Rank	Z	P
Low	32	75,38	-0,439	0,661
High	124	79,31		
Low	32	32,75	-0,866	0,386
Professional	37	36,95		
High	124	80,03	-0,482	0,630
Professional	37	84,24		

The skill group analysis showed that the average amount of correct answers in the lower group was 8,61±2,14, with less time used on average per question when compared to the higher-level group, with average amount of answers 9,55±2,04 while answering at the slower pace (Graph 3). The increases in either number of answers correctly answered, or time spent proved insignificant. The professionals, with 9,72±1,92 correct answers took less time than the higher-level group but more than the lower-level group per question. However, they did not significantly outperform either the low- or high-level group.

Spearman's correlation between time used and correct answers proved non-significant (r=-,112; p=0,12). This means that the longer time the participants took did not reflect a higher number of correct answers.

Graph 3. Differences in time to answer between the investigated skill levels groups.

3.3. Comparison of number of correct answers and time spent per question within age group according to skill level.

The within group analysis (Table 3) demonstrated that the only significant result was found comparing the number of correct answers within the U17/18 age group between the high and pro level (p=0,047).

Other comparisons within group proved various but insignificant data. This proves that this test is suited to distinguish the level of participants and can identify individuals of that age that shows promise to make decisions at a professional level.

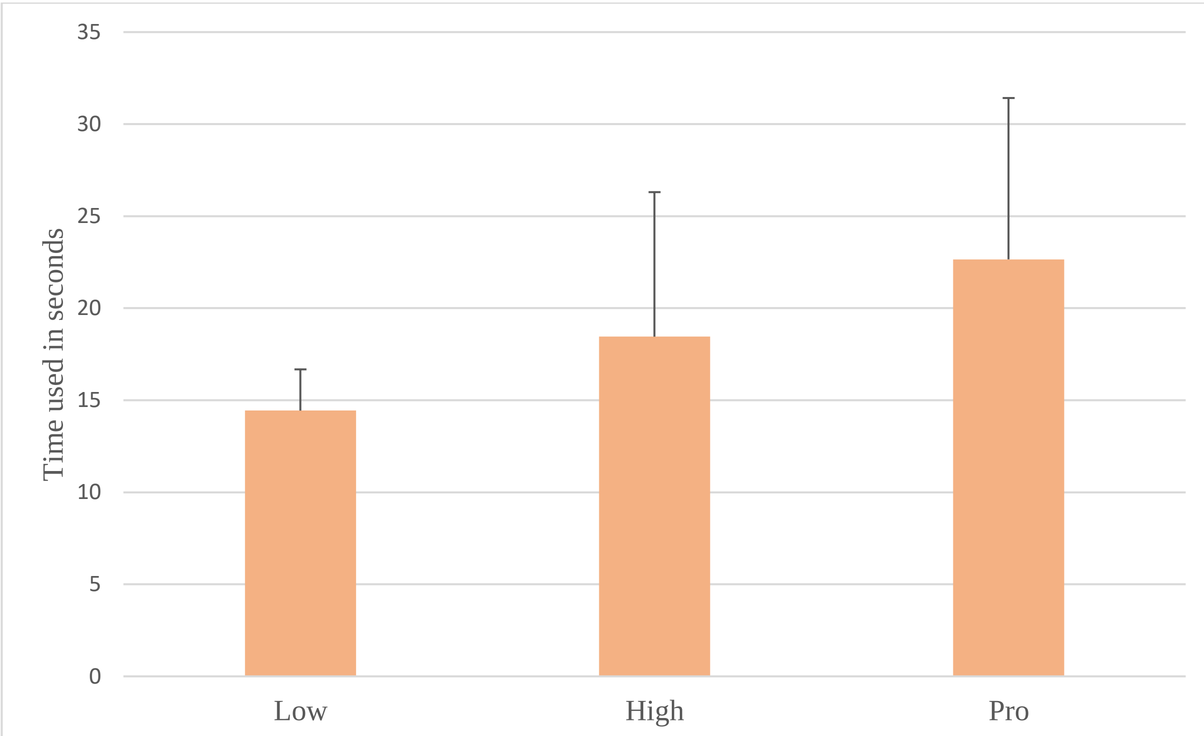
Table 3. The distribution of correct answers between different skill level players within age groups

Age groups and skill levels	N	Average rank	Z	P
Within Group U12/14	61			
Low	17	30,76	-0,064	0,949
High	44	31,09		
Within Group U15/16	101			
Low	11	35,73	-0,673	0,501
High	68	40,69		
Within Group U15/16	101			
Low	11	14,14	-1,228	0,233
Pro	22	18,43		
Within Group U15/16	101			
High	68	44,45	-0,680	0,496
Pro	22	48,75		
Within Group U17/18	31			
Low	4	5,50	-1,508	0,170
High	12	9,50		
Within Group U17/18	31			
Low	4	12,63	-1,078	0,307
Pro	15	9,30		
Within Group U17/18	31			
High	12	17,38	-2,005	**0,047**
Pro	15	11,30		

Time analysis of different skill level players within age groups revealed that the higher-level participants did not perform significantly quicker than the lower-level participants in the U13/14 age group (P=0,949). Actually, lower-level players took on average more time of 19,01±7,7 S per question while higher level - 20,22±10,11 S.

In case of U15/16 age group the professional were much quicker (17,44±4,8 s) in answering the questions than the high (20,2±9,17 s) and low (20,59±9,2 s) level players but the differences were not significant (P=0.817).

The situation was different in the U17/18 age group where the professional players took longer to answer the questions than high- or low-level players (Graph 4). Noteworthy is that the comparison of low level versus professional 17/18-year-olds provided a close to significant value of p=0.062 while the high to professional provided p=0.167 and the low versus high provided p=0.446.



Graph 4. Differences in time to answer between different skill level players in the U17/18 group.

3.5. Reliability analysis of the test

The reliability analysis of our test was done with 22 participants who took the test a second time. The ICC Average Measures of correct answers showed 0.809 with bounds of 0.547 and 0.920. The ICC Average Measures of time used is 0.897 with bounds of 0.752 and 0.957. These values correspond with Baumgartner & Chung (2001) acceptable value if they equal or are above 0.70.

From 22 valid participants the CV of answers correct was on average: 0.082, with largest CV being 0.28 and smallest 0.00 with a median of 0.07 The CV of time used was on average: 0.1, with largest CV being 0.31 and smallest 0.01 and median of 0.075.

4. CONSIDERATIONS

Twenty video clips of basketball matches were selected at the decisive moment before a pass or shot or drive to the basket. This to simulate the decision-making aspect. Moments of games where the action was a decision but lead to another action before a shot were excluded, only moments that lead to a shot or score were included. The selection of moments is up for debate, different coaches with different philosophies might reason that a decision might have been made before or after the video stopped at a specific frame.

The test was not designed perfectly, as a part of the time used by participants was not making decisions, but after they had made their decision, they had to use the mouse clicking on the corresponding answer to their decision. So, while using the computer, effectively measuring executive control, instead of directly measuring the decision speed, as high-tech equipment was not available due to budget restrictions. However, since the test did measure accuracy of decisions based on visual input, as well as quickness of response, one could argue that the only non-representational part of the research was the use of the mouse and the delay in timing it causes. Since all participants had five videos to get acquainted with the model, we hoped to reduce this bias to a minimum.

Another discussion point is age, because some videos showed tactical situations that rule wise by the world basketball association (FIBA) are not allowed in younger age categories such as screens or zone defense, and the participants ranged from 12/18. This shows that the test might not be valid for identifying talents in the younger age groups simply because they have not been exposed in training to these types of situations. However, following the reasoning that pattern recognition and spatial awareness is a talent in and of itself, players could analyze what they saw on the screen based on the position of the 5 offensive and 5 defensive players, and draw anticipatory conclusions from that.

In the end, the test does test reaction speed and pattern recognition, which is what it was designed for. Also: professional players and coaches spent a lot of time studying tape, pregame scouting sessions can take up to 30 minutes, players receive individual game tape of their direct opponent, as well as the opponents most used patterns and tactics. The faster players recognize these patterns, the better the in-game performance is. The video part is of course not as optimal as on court training would have been, but it is quite similar to what professional players experience on a day-to-day basis, although for different purposes.

The results demonstrate that older players performed better than younger players. From the average answers in different age groups (8.7±1.91 for U12/14, 9.65±2.05 for U15/16 and 9.87±2.10 for U17/18) we can provide a baseline indicator to compare future results within the research of decision-making talent identification using videos since to our knowledge there have not been done any other successful similar research in basketball. This baseline indicator can be used to show that a player is displaying above average decision-making skills by having more correct answers than would be suspected because of age.

The results show that the U17/18 age group skill comparison between high level and pro level players the pro level players answered significantly better than their high-level peers (P=0.04). This is similar to what Rösch et al. (2021) found that the external validity of a video-based test with virtual reality was applicable to discriminate between high level players in youth basketball, which links to our findings of being able to distinguish between high level and pro level players in the U17/18 categories. This is promising for further use as a possible inclusion in future testing batteries.

Since ages and skills were compared both in number of answers and time used, there is a lot of potential for comparisons with others who might use this setup or a similar design. Also, since average time spend is given, coaches could see if someone is answering fast compared to peers, albeit that the purpose and credibility of these time findings have not been proven.

Professional players choose more correct answers than low level by 1,11 and high-level players by 0,17, while high level players by 0,94 than low level players, but the differences were not significant. So, we cannot concisely say that higher playing participants were making better decisions, although the average amount of correct answers and smaller SD would suggest so. This is in line with Silva, Conte & Clemente (2020), who found in a systematic review, that video interventions for decision making do not have a clear or defined benefit yet. This shows that the pro level and high-level players were on average are more correct than their lower-level peers. The only significant discrimination within age groups was found in 17/18 years in the high/pro comparison, meaning that the test can safely distinguish between high level and pro level 17/18 years old players.

Time spent on the test differed between different groups of level and age but did not reach significance. Actually, professional players took longer to finish the test by 0,57 seconds than low lever players and by 0,49 seconds than high level players, therefore showing that even more experience in the court can lead to slower albeit correct decision making. The time differences in the age group were quite small (U17/18 group were slower than U15/16 by 0,32 seconds and just by 0,07 seconds than U12/14) and insignificant. This may be explained by lesser interest in the test in younger kids or quicker reaction time while using technology to make decisions. Further testing with bigger different age groups should be able to distinguish if similar testing is useful to find out talents not just in correctness of decision making but in quickness.

The hypothesis that the newly created video-based tool for talent identification was reliable of our research can be confirmed, because the ICC for correct was 0,09 which is considered very good and the ICC for time used was 0,897 which is considered excellent. Other part if hypothesis about test validity is rejected in all the skill level comparisons except for U17/18 high level/pro level participants. For time, the hypothesis that higher level players or older players would perform the test statistically faster was rejected.

It is hard to draw conclusions, since not many similar investigations were made specifically in basketball for talent identification using video tests. There are multiple tests done on if improved decision making can be achieved with video simulations and or virtual reality.

The insignificance could be caused by sample size, since we grouped participants. It could be that not according to chronical age but with measuring biological age more interesting results could be found, since the more chronologically older participants scored better than their younger counterparts. In this research only the chronological age was factored.

CONCLUSIONS

1. Test can be used to discriminate between age groups on number of correct answers but not on time used.
2. Test cannot be used to discriminate between skill groups on number of correct answers and on time used.
3. Test can be used to discriminate within the age group U17/18 on number of correct answers but not on time used.
4. Our created video-based test for decision-making talent identification is reliable.

SUGGESTIONS

1. We encourage to further investigate the phenomenon of talent identification in basketball through video-based decision-making tests as it could be a valuable part to add to already existing testing batteries.
2. For future research it could be worthwhile finding out the reliability of test with less or more video questions.
3. For optimal design we would suggest a program or tool that if a mouse click is required, the click immediately opens the next question or phase, since this is where a grey area arises due to the nature of the website used.
4. Further research can be used for more advanced positions, where the decision to make is not the leading decision but a decision leading up to an advantageous position or include virtual reality tools.
5. Future tests should be designed to be rather quick, short (around 7-12 minutes) and should be fun especially if testing youth players and kids.

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