Basketball training influences shot selection assessment: a multi-attribute decision-making approach[1]

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BASKETBALL TRAINING INFLUENCES SHOT SELECTION ASSESSMENT: A MULTI-ATTRIBUTE DECISION-MAKING APPROACH

KEYWORDS: Decision-making, Basketball, Shoot selection.

ABSTRACT: In spite of the fact that shoot selection is a crucial ingredient of performance in basketball, the judgment and decision making processes involved in it have been largely neglected. In the present work, we explore individuals' strategies to assess the adequateness of shooting (in a simulation laboratory task) in situations varying in the degree of physical defensive pressure, rebound, defensive balance and shooting distance.

Our results showed that the four target dimensions have an impact on participants' judgments. More importantly, training influences the degree to which one of the non-obvious dimensions (defensive balance) is taken into account by participants in order to make their judgments. These results stress the necessity to develop measures of shot selection decisional quality beyond scoring rates.

Shot selection is an essential ingredient of basketball mastery. In spite of this, judgment and decision making processes involved in recognizing good shooting situations have been almost neglected in specialized literature. For example, 'hot-hand' studies have tried to ascertain whether the result of each particular shot depends on the results of the previous shots by the same player (Burns, 2004). Paradoxically, some studies show that the 'hot hand' feeling hampers effectiveness, and scoring rate is, an inverse function of the length of the preceding scoring streak (Bar-Eli, Avugos and Raab, 2006). It could be that shot selection gets less meticulous as the 'had warms up'; unfortunately there are almost no studies addressing this question (see Rao, 2009).

In a similar vein, scoring shapes shot behavior in the same way as reward shapes all goal-directed behavior (Romanowich, Bourret and Vollmer, 2007). Nevertheless, decisional quality of a shot should be assessed, not only on the basis of whether it is followed by scoring. In the case of a missed shot, the consequences of such a miss will depend on the possibility of recovering the ball, and setting the defense (Alarcón, 2008; Alarcón et al, 2010; Alarcón et al, 2011; Gómez-Ruano, Lorenzo, Ortega and Olmedilla, 2007; Perales, Cárdenas, Piñar, Sánchez, and Courel, 2011; Sporis, Sango, Vucetic and Maaina, 2006; Trininic, Dizdar and Luksic, 2002).

In a previous work (Perales et al., 2011), we described shot selection as a learnable decision making process. We neatly demonstrated that defensive pressure is the main cue that players use to decide whether shooting is adequate. Novices did not take into account any other of the cues manipulated in the task (balance, rebound) to make their decisions. However, such cues can be gradually incorporated into decisions if feedback on them is provided during the task. Our intuition is that incorporating

non-obvious cues into decisions is a process that depends on feedback from the game. Given that the consequences of shooting without considering rebound and defensive balance are less obvious (and more delayed) than scoring, their incorporation into decisions will take place more gradually.

The present work can be regarded as a continuation of the abovementioned study. Participants were presented with a computer task in which they had to assess a number of video frames of a field player with the ball in his hands (within a 5x5 situation), each of which was previously characterized by the degree of opposition, rebound, balance, and shooting distance (see Perales et al., 2011, for a precise definition of these dimensions). Their task was to assess the degree to which they thought each situation was adequate to shoot.

Crucially, some participants had taken part in an introductory training course on basketball. In the group of participants who had not received any training, half of them were asked to simply judge the degree to which shooting was adequate. The other half was provided a precise definition of each dimension, before the task commenced, and, in each trial, they were asked to judge, not only the adequateness of shooting, but also the presence of each of those dimensions.

The aim of the study is three-wise: first, to check whether participants weighted the four dimensions differently when they made an adequateness judgment. Second, we also expected trained participants to be able to incorporate the less obviously relevant cues (defensive balance and rebound) into their judgments; in other words, we hypothesize that the observed pattern of dimension weights will show an influence of training. And third, we wanted to make the first step in developing a standard of shot decisional quality that is not exclusively

dependent on scoring. Considering shot selection as a multi-attribute decision, if a specific pattern of dimension weighting is associated to different degrees of expertise, it should be possible to check whether such patterns are influenced by a number of external and idiosyncratic factors (such as the length of previous streaks, attributions of self-efficacy, or mood states). That would entail an important step in establishing an interface between psychological variables and performance.

Method

Participants
First-year students from the degree in Sport Sciences at Granada University took part in this experiment. Trained participants had taken part in the basketball introductory course taught in the first year of the degree. Such a course consists of 4 ECTS credits (approximately 100 hours) of practical and theoretical work. All participants that had any formal training on basketball (previous to the course) were allowed to take part in the study, but were excluded from analyses. The final sample consisted of 103 participants (20.4% female; Mean age 19.47).

Procedure and design
Participants were presented with a computer task designed to randomly display 400 video frames from basketball games. Three experts, entitled as official basketball coaches by the Spanish Basketball Federation, designed the frames. The frames purposely varied in the four target dimensions (defensive pressure, shooting distance, defensive balance, rebound), in such a way that they did not correlate among them.

Each frame was assigned a value for each of the four target dimensions. Frames in which the three experts did not agree to assign a value in each of the dimensions were discarded. All the images were from 5 x 5 games, with the teams dressed in the same two outfits (yellow and blue), taken from a side of the same pitch, and without public or referees. The pictures occupied the left half of a 14'' PC monitor.

The participants were randomly assigned to one of the three conditions. In the *No training/no information* condition, participants were presented with the pictures, one by one, and were just asked to judge the degree to which shooting was adequate in that situation, using a 5-point Likert scale, located on the right of the picture. There was no time limit, and no feedback

was provided upon response. In the *No-training/information* condition participants were instructed on the meaning of the four dimensions. The operational definitions were the same used by the three experts. Additionally, each picture was accompanied by four Likert scales, for the participant to assess the four dimensions. Once the four assessments had been made, the scale for shoot adequateness was activated. Finally, the *Training* condition consisted of the participants who had taken part in the basketball-training course during the first term of the academic year. In all other respects, their task was identical to the one in the No-training/no information condition.

Dependent variables
All shooting adequateness judgments from each participant were collected. In order to assess the degree to which each of the four target dimensions influenced judgments, a multiple linear regression analysis was carried out for each participant, with the objective values of the four dimensions as predictors, and the judgments as the variable to be predicted. Subsequently, we computed the standardized β coefficients for each participant and each dimension. These coefficients can be interpreted as estimates of the four dimensions weights that have on each participant's judgments. We also registered how many of these coefficients were significant. A p value below .05 implied that the dimension under consideration had a significant impact on a specific participant's judgments.

Results

Table 1 displays mean standardized β coefficients for the three conditions and the four dimensions. A two-way *Dimension* (Opposition, Rebound, Balance, distance) x *Group* (No training/no information, No training/information, Training) mixed ANOVA carried out on participants standardized β coefficients yielded a significant effect of Dimension [$F(3, 300) = 1506.016$, $MSE = .011$, $p < .001$]. All differences between cues were significant ($p < .01$; Tukey HSD test).

Neither the effect of Group nor Group x Dimension interaction reached significance, so there was no training effect on this measure [$F(2, 100) = 2.804$, $MSE = 0.015$, $p = .065$, for the main group effect, and $F(6, 300) = 1.723$, $MSE = 0.011$, $p = .115$, for the Dimension x Group interaction.].

Condition	Dimension							
	Opposition		Rebound		Balance		Distance	
No Training-No Information	-.509	(.182)	.041	(.076)	-.050	(.067)	.447	(.148)
No Training-No Information	-.521	(.148)	.033	(.059)	-.030	(.070)	.495	(.137)
Training	-.590	(.103)	.041	(.066)	-.090	(.032)	.464	(.110)
Mean	-.540		.038		-.057		.469	
Confidence Interval (95%)	(-.572	-.511)	(.027	.052)	(-.069	-.044)	(.441	.495)

Table 1. First three rows: mean standardized β (and standard deviation) for each of the four target dimensions in the three experimental groups. Last two rows: Mean standardized β for the 4 dimensions, averaged across conditions (marginal means), and their estimation confidence intervals.

As shown by confidence intervals in the last row of the table, all coefficients were significantly different from zero. That is, even non-obvious cues had a significant impact on judgments. The direction of the influence was the one expected for all dimensions except balance. As shown in the table, the higher the degree of defensive balance, the less adequate to shoot the situation was judged. This paradoxical effect will be discussed in more detail later.

Figure 1 displays the percentage of people whose opposition, rebound, balance, and shooting distance significantly influenced decisions in each of the three groups.
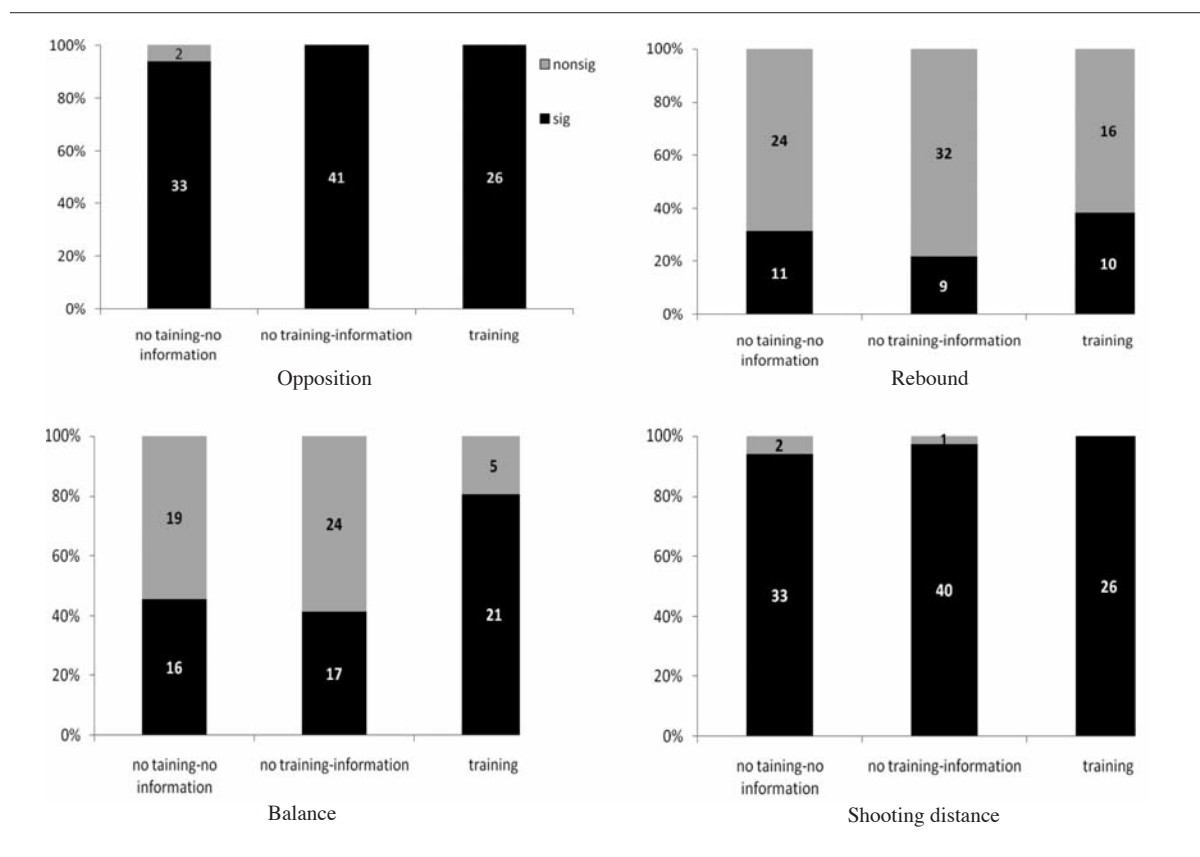

Figure 1. Number (and percentage) of participants who significantly took into account each of the target dimensions (β coefficient's p < .05) in order to make shooting adequateness judgments.

Virtually all participants in the three conditions significantly incorporated opposition and distance into their adequateness judgments, so differences between groups were far from significance [$\chi^2(2) = 3.905$; $p = .142$]. The percentage of participants who incorporated rebound into their shooting adequateness judgments was higher for the Training group than for the other two, although the difference did now reach significance [$\chi^2(2) = 2.193$; $p = .334$]. Importantly, that difference was strongly significant for defensive balance [$\chi^2(2) = 10.984$; $p = .004$]. Specifically, the percentage of participants who incorporated balance into their judgments was almost the double in the trained group than in the other two. That difference was significant both for the comparison between the Training and the No training-information condition [$\chi^2(1) = 12.989$; $p < .002$], and the one between the Training and the No training/no information condition [$\chi^2(1) = 9.406$; $p = .009$], but not for the comparison between the two No training conditions [$\chi^2(1) = 0.139$; $p = .933$]. In other words, Training effects were evident in the percentage of participants who took defensive balance into account when making a shooting adequateness judgment.

Discussion

Results mostly confirm our starting hypotheses. First, non-expert people, independently of training, are more prone to take into account opposition and distance than rebound and balance when judging whether a player is in an adequate situation to shoot. Importantly, however, the impact of the less obvious dimensions is not negligible. A number of participants showed significant impact coefficients for those two dimensions.

And second, training had a significant effect on the subjective importance of one of the two non-obvious cues. Although the effect of training on the number of participants who incorporated rebound into their decisions did not reach significance, such an effect was clearly significant in the case of defensive balance. That effect is not attributable to the mere fact that participants in

the trained group could have more declarative knowledge, or pay more attention to the relevant dimensions. In the condition in which participants were specifically instructed about the meaning of those dimensions, and forced to attend to them during the task (no training-information), the relative impacts of such dimensions was identical to the ones in the other non-trained group (no training/no information).

However, it is important to note that the direction of the influence of defensive balance on judgments is the opposite of the one expected. The higher the degree of balance, the less adequate to shoot was the situation considered. This fact probably implies that defensive balance makes other dimensions emerge. For example, the more players of the attacking team are behind the ball, the defense will be, but that precaution could have deleterious effect on other aspects related to the consequences of shooting. Emergence of dimensions from other dimensions, and interactions among dimensions should be considered in further research.

As noted in the introduction, this work opens up the possibility to identify high-quality decisional patterns in shot selection assessment. In practice, shot selection is assessed on the basis of scoring rates only. However, this fact neglects the delayed effects of shooting. Good shooters should be, not only those whose scoring rates are high, but also those who take into account what happens when they miss.

INFLUENCIAS DE LA FORMACIÓN EN BALONCESTO SOBRE LA EVALUACIÓN EN LA SELECCIÓN DE TIRO: UN ENFOQUE MULTI-ATRIBUTO EN LA TOMA DE DECISIONES

PALABRAS CLAVE: Toma de decisiones, Baloncesto, Selección de tiro.

RESUMEN: A pesar del hecho de que la selección de tiro es un ingrediente crucial del rendimiento en baloncesto, el juicio y la toma de decisiones que participan en él han sido ampliamente descuidado. En el presente trabajo, analizamos las estrategias de los individuos para evaluar la adecuación de tiro (en una tarea de laboratorio de simulación) en situaciones que varían en el grado de bienestar físico presión defensiva, rebote, balance defensivo y la distancia de lanzamiento. Los resultados mostraron que las cuatro dimensiones de destino tenían un impacto en los juicios de los participantes. Más importante aún, la formación influye en el grado en que una de las dimensiones no evidentes (balance defensivo) es tomado en cuenta por los participantes para hacer sus juicios. Estos resultados subrayan la necesidad de desarrollar medidas de calidad de disparo selección de decisión más allá de las tasas de puntuación.

INFLUÊNCIAS DA FORMAÇÃO EM BASQUETEBOL SOBRE A AVALIAÇÃO DA SELECÇÃO DE LANÇAMENTO: ENFOQUE MULTI-ATRIBUTO NA TOMADA DE DECISÃO

PALAVRAS-CHAVE: Tomada de decisão, Basquetebol, Seleção de lançamento.

RESUMO: Apesar do facto de que a seleção do lançamento tiro é um ingrediente crucial no rendimento no basquetebol, o julgamento e a tomada de decisão envolvidos têm sido largamente negligenciados. Neste trabalho, analisamos as estratégias dos indivíduos para avaliar a adequação do lançamento (numa tarefa de simulação em laboratório) em situações que variam no grau de bem-estar físico, pressão defensiva, ressalto, equilíbrio defensivo e distância de lançamento. Os resultados mostraram que as quatro dimensões de destino tiveram um impacto sobre os julgamentos dos participantes. Mais importante ainda, a formação influencia o grau em que uma das dimensões não evidentes (equilíbrio defensivo) é tida em conta pelos participantes para fazer os seus julgamentos. Estes resultados reforçam, para além das taxas de pontuação, a necessidade de desenvolver medidas de qualidade de lançamento e de tomada de decisão.

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