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Do Basketball Players Rely on Previous Observations of Opponents or Decide Based on On-going Interaction?

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abstract

This study investigates prior observation of an opponent's performance as a task constraint on decision-making of basketball players. Participants will watch a 1vs1-basketball scenario under two conditions differing in the ball-carrier's trajectory. Condition A is defined by distribution of offensive moves equally to the right and left. In condition B, offensive moves will be biased to one side. Thereafter, participants will perform as defenders against the observed opponent with pseudo-random distribution of offensive moves. All trials will be video recorded and players' displacements tracked. It is expected that participants will show initially biased displacements by the previous observation, but will adjust their behaviour to the situational dynamics.

Keywords: Ecological dynamics, basketball, bias

In general, when studying cognition, the term "bias" refers to a phenomenon that leads to perception, judgment or memory that (1) differs from real-world stimuli it should represent, (2) occurs in a systematic fashion, and (3) appears involuntarily (Pohl, 2004). As suggested by normative theories of cognition in the study of decision-making, "biases" refer to judgments and decisions that systematically deviate from the norms of a given framework such as logic, probability theory, or decision theory, and thus rational behaviour (Over, 2004).

As a result of this normative/descriptive distinction, many frameworks have been formulated to study decision-making, most notably perhaps, the heuristics and biases approach in the 1970s, that gradually made its way into social sciences (Gilovich, Griffin, & Kahneman, 2002) and

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sports science (Gilovich, 1984). As a precursor of this, the cognitive approach to decision-making in sports dates back to the 1980s (Straub & Williams, 1984), as research began focusing on memory, attention and problem solving in sports situations (Ripoll, Kerlirzin, Stein, & Reine, 1995; Tenenbaum & Bar-Eli, 1993). Tenenbaum and Bar-Eli (1993) were among the first researchers to investigate possible disturbances and distortions in competitive decision-making (Bar-Eli, Plessner & Raab, 2011), implicating Bayes' theorem as a normative model for coping with inefficient decision processes, an approach solidified in their later research (Tenenbaum, Eklund, & Kamata, 2011). Since the first sport-related bias study by Gilovich, Vallone, and Tversky (1985), many others have followed, finding ample evidence of biases from a cognitive perspective with respect to perception, categorization, memory and information integration in individuals involved in diverse sports to various extents (from athletes, to judges, to management; Plessner & Haar, 2006).

Classical models of motor behaviour following a cognitive approach do not account, however, for real-life scenarios in sport in which movement serves the purpose of information gathering or "moving via perceiving to deciding" (Gibson, 1986, as cited in Hossner, 2009, p. 26). In order to incorporate this, an alternative theoretical framework has been proposed by Gibson (1986), with a main focus on the reciprocal character of perception-action; the two infer one another, and constitute an undividable pair (Hossner, 2009).

The ecological approach (Gibson, 1986) emphasises the emergent nature of adaptive behaviour, which arises from the interplay between the environment, the agent, and the task itself, considering that all these factors impose constraints on the occurring behaviour (Warren, 2006). The individual-environment entity, constitutes an "ecosystem" (Araújo, Davids, & Hristovski, 2006), that can be best understood via a dynamical systems' approach. The study of dynamical systems coupled with the theoretical framework of ecological psychology, formed the ecological dynamics framework that aims to understand how agents behave in complex systems, such as sports (Araújo, Davids, Chow, Passos, & Raab, 2009). According to ecological dynamics, in order to best understand an individual's decision-making process, one must analyse the "ecosystem" it is performed in, and take into account that it is emergent by nature due to the interaction of an array of constraints (Araújo et al., 2006).

Given this perspective, ecological dynamics of decision-making have profound implications for skill acquisition and performance, as it considers sport to be a dynamic, fluid environment (Araújo et al., 2009). Expertise can be defined by a functional relationship between an individual and her or his respective environment, as a measure of how well an agent can satisfy constraints imposed on them by complex environments, tasks and by their own individual constraints (intention, motivation etc.; Araújo & Davids, 2011). In order to gain a better understanding of decision-making in a complex system while taking into consideration the "ecosystem" as a whole, one must adhere to the Brunswikian idea of a representative task design, to ensure generalisability (Araújo et. al., 2006). Araújo and Davids (2011) explain representative task as the organisation of an experiment so that the constraints embody the behavioural context that the results are projected to apply.

The present research is being carried out in accordance with the theoretical framework of ecological dynamics. As previously explained, this approach considers both environmental and task characteristics as key constraints that shape decision-making in sport, as well as individual characteristics and players and opponents that can influence performance (Davids, Button, & Bennett, 2008). Essentially, it views the players, their surroundings and their task as a unitary system, rather than independent of each other. In this case, the environment refers to the 1 vs. 1 basketball scenario and the task refers to the goal of defending the basketball hoop and, by doing so, preventing the attacker from scoring. With this in mind, the present study examined the effects of observing a biased game

interaction between two players. It is expected that participants will show initially biased displacements by the previous observation, but will adjust their behaviour to the situational dynamics.

Method

Participants

About 26 participants will be gathered in each country (Ireland, Hungary and the USA), from either University teams or clubs (depending on accessibility). Participants are expected to have four or more years of structured practice and more than one year of competitive experience. Dependent upon availability of teams in the countries being tested, participants will be either male or female college players.

The nature of the experiment implies that the original ball-carrier attacker and defender act as confederates, whereas the participant (who originally observes the confederates), when playing, acts as central defender (defender marking the ball-carrier) and is naïve. The participant will thus play the central attacker (confederate) and will be then invited to act as confederate to the next naïve participant. Some participants may be invited to play as confederates to more than one central defender (naïve).

Prior to testing, subjects must give informed consent to participate in the experiment and will also fill in a demographic questionnaire, which we have devised.

Experimental Task

The task designed consists of a 1 vs. 1 basketball situation (Figure 1) performed on a half of the full basketball court (28 m in length by 15 m in width measured from the inner edge of the boundary line; International Basketball Federation, 2012). The goal of the attacker will be to score. Conversely, the goal of the defender will be to prevent the latter from scoring and recover ball possession.

At the beginning of the experimental task confederates will form a 1 vs. 1 basketball situation as depicted in Figure 1. The confederates will be instructed to perform a rehearsed scenario in order to provide a simulation of game-based situation in which participants will be invited to take part. Each participant will participate in every unique game-based situation based on the designated scenario.

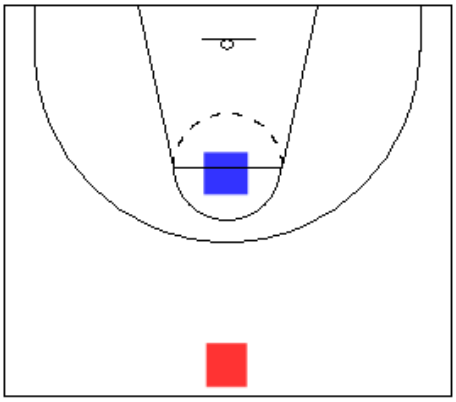

Figure 1. Schematic representation of the 1 vs. 1 task. Red square illustrates the attacker, and the blue square the defender.

The task consists of a 1 vs. 1 basketball situation performed within one half of the full basketball court. The goal for the attacker (confederate) will be to score. Conversely the goal for the defender (participant) will be to prevent the attacker from scoring and recover ball possession.

The experimental task comprises two stages:

(1) Two confederates will demonstrate a naturalistic 1 vs. 1 basketball scenario. The confederates will be instructed to perform a rehearsed scenario in order to provide a simulation of game-based situation. The participant will observe the two confederates perform 12 trials from the side-line. (Given the dearth of literature relating to the number of trials necessary to create a bias, 12 trials were decided upon so as not to tire the participant

excessively and to ensure they maintain their attention on the task.) They will be informed that when the 12 trials are completed they will play opposite the attacker. While observing the original trials, the participant is asked to keep score of the attacker. The purpose is to draw the participant's attention to the attacker's performance, and therefore putatively biasing him/her towards his/her frequent trajectories. There are two possible conditions the participant can observe. (i) Condition A - equal distribution of offensive moves pseudo-randomly to right and left sides (6 trials to the left and 6 trials to the right). This pseudo-random ordering of attacks will be pre-designed with half of the participants encountering a set of trials that begin on the left and the other encountering a set of trials that begin on the right. (ii) Condition B - offensive moves are biased to one side (9 trials to the left and 3 trials to the right).

(2) After the observation, the participant will take the place of the central defender (opposite the attacker they kept score on) for 12 trials (with an equal distribution of offensive moves). The player will be asked to behave as if they are in a game. In total, 12 trials will be observed and each participant will perform 12 trials.

Data Collection

Prior to the experiment, each participant will fill out a questionnaire, detailing their age, gender, basketball experience (years), and whether they are left or right handed. All participant trials will be recorded with three digital video cameras (frequency = 25 Hz) located above and laterally to the area in the basketball hall where the performance of the task occurs. Cameras' zooming rate will be fixed in order to simplify the motion image processing with TACTO 7.0 software (see Duarte et al., 2010, for software details). The use of this software, together with the application of Direct Linear Transformations method (DLT) using MATLAB 7.0, allows us to obtain the x and y coordinates (2D positional data) of participants' displacement.

Data Analysis

With the positional data we will compute the following variables that will be considered dependent variables: (i) trajectory (indicating the residual standard deviation to a straight line adjusted to the attacker's trajectory), (ii) angles of deception (the angle formed between a vector parallel to the side-line – defining the initial trajectory of the attacker – and a vector defined by the change in displacement direction result of attacker heading/dribbling to the side defined by the experimenter), (iii) symmetry-breaking (the attacker breaks the symmetry of the attacker-defender-basket system, if he manages to get closer to the basket. We will also analyse the distance of the participants to the basket over time, the participants' speed, and the outcome (score or no score).The manipulated conditions: A) in which the participant firstly observes the attacker he/she is going to face keeping the ball and running to both sides equally; B) in which the participant firstly observes the attacker he/she is going to face keeping the ball and running mostly to one side.

Practical

Research group members that are to run the experiment reside in three different countries: Ireland, Hungary and the USA. All written materials were translated to Hungarian in order to accommodate participants there.

Through this research process the research group has been communicating via email and Skype, and sharing the data (e.g. videos) via Dropbox to a folder with restricted access to the group members.

Apart from minor difficulties with regards to resources, primarily in acquiring recording devices, it has been more challenging than originally envisaged to find both basketball teams willing to participate and courts in which to run the experiment. Basketball courts generally charge rental fees beyond project resources. To account for this,

project members negotiated with their university sports centres to allow them use the facilities for free. A Communications and Media Department at one college supported acquisition of tools (recording devices) and permission to film on college property. The USA member has addressed one professional and large amount of amateur local college clubs in the USA, however none of them has committed to the participation in the study due to low incentives. This difficulty in acquiring participants led to the experimental design changing from a 3 vs. 3 basketball scenario to a 1 vs. 1 scenario.

Current status of project

On top of completed translations of the questions into Hungarian, ethical approval was received in the involved countries, except for the USA.

The first pilot was carried out in Ireland, which highlighted many practical concerns of the experiment. Firstly, a viewing gallery is necessary to provide an important vantage point for filming the entire field area of the experiment. Secondly, the need for a third camera emerged to be a conspicuous additional help for analysis of obtained trace data. Also, it became clear that an "assistant" would be necessary to operate the cameras (start/stop procedures) as they are set up in a viewing gallery above the hall. Thirdly, the experimenters need to determine a signal to herald the beginning or end of a trial to allow for synchronisation of the three sets of video footage. Some of these concerns have since been resolved as more appropriate basketball halls have been found and permission to use them has been agreed. Similarly, usage of a third recording device has also been arranged.

Further experimental sessions are planned in Ireland, Hungary and USA.

Prospective discussion

We expect that participants will base their decision-making on previous observations of the behaviour of the opposing player, but they will then adjust their behaviour to the dynamics of the situation. For example, it is expected that participants will move to the right after observing the attacker moving mostly to that side. In other words, they will be biased by previous observations. However, we expect the participant to subsequently adjust their behaviour to the dynamics of the situation as the task continues. Thus, the participants' behaviour will be responsive to the behaviours of other players in the task as opposed to continuing to follow the 'learned rules' from their observations.

We hope that this study will shed light on the understanding of decision-making dynamics in representative situations of sport. We also hope to demonstrate that players' behaviours are adaptive and can be influenced by the manipulation of task constraints.

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