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## **Decision Field Theory Explain Individual Risk-Taking Behavior And Simulation Data In Sports**

<sup>1,2</sup>**Markus Raab & <sup>1</sup>Joe Johnson**

<sup>1</sup>*Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development, Berlin;* <sup>2</sup>*Institute for Movement Science and Sports, University of Flensburg, Germany*

One very well known individual difference in sports is the distinction of action and state orientation. The state/action orientation is commonly used in sports, for instance, in describing behavior of basketball players under stress situations. An action orientation is attributed to players if they concentrate on a specific goal and take risks, whereas a state orientation is attributed to players if they have non-task-relevant cognitions and reduce the risk-taking behavior by considering more situative considerations and future consequences of their behavior. Research using this distinction for tactical decisions concluded that this personality trait results in different decision times and choice distributions. For example, action-oriented players shoot more to the basket and score more under competition instructions. Other research reveals that state-oriented players have longer decision times, at least in soccer. Thus, in the basketball task of the current study, we predict that action-oriented players will prefer to shoot at the basket whereas state-oriented players will prefer to pass to a teammate who will make the play (hereafter, the playmaker), *ceteris paribus*.

We will attempt to dissect the individual decision-making process into four possible components that could be responsible for these behavioral differences. First, action-oriented players may use different cues or focus their attention on task-relevant over task-irrelevant information (Beckmann, 1994). Second, action-oriented players may have a higher preference for shooting from the onset of the decision task (Raab, 2002). Third, action-oriented players may not need as much information to respond in a given situation—that is, they may have a lower threshold for acting (Kuhl, 1986). The fourth explanation we explore is that action-oriented players consider the current task an approach task (here, a forced choice between two beneficial outcomes) whereas state-oriented players define it as an avoidance situation (here, a forced choice between aversive outcomes).

Because one or any combination of the above possibilities can explain differences in individual choices, we have to consider these parameters independently to understand which, if any, may have predictive value. Furthermore, because competing explanations may make similar predictions regarding choice probabilities, it would be helpful to derive predictions for response time, as well. One framework that allows us to derive both choice and time predictions, while incorporating the possible influences identified above, is Decision Field Theory (DFT, Busemeyer & Townsend, 1993). In essence, DFT assumes that at each moment during a task, attention focuses on a particular feature (e.g., probability of losing the ball) of the choice alternatives (e.g., shoot, pass). Each alternative is then assessed depending on its relative

advantage on the focal feature, and this assessment is added to an initial preference for the alternative. Greater initial preference would tend to increase the choice probability for an alternative, but not always. For example, if one has an initial preference for passing, but the probability of losing the ball is high due to tenacious defense, the preference for passing will be reduced whenever attention is on losing the ball. As attention shifts between different features over time, the preference for each option continues to shift accordingly. The more important a feature is—such as increased importance of keeping possession near the end of a close game—the more likely it is to receive attention at each moment. Also, the magnitude of the preference at each moment can fluctuate, depending on the approach-avoidance assessment. For example, if a player with the ball thrives on being in the situation (approach), the preference will build to a greater degree, and thus more quickly. Once enough information has been accumulated to favor an alternative, this deliberation process ends and the favored option is chosen. If a player requires more information to make a decision, then the response time and choice probabilities may change as well.

Decision field theory (DFT) was applied to a basketball task in which participants had four options displayed on video that varied in the degree of associated risk. The 27 males and 26 females were all novices in basketball (no club experience) but all received an introductory course in basketball before the experiment.

This situation is a standard training skill in which the center player and the post player change their positions while the perimeter players (playmaker and wings) pass the ball around to set up the play. All situations are attack situations, shown to players from the perspective of the attacking team from a camera angle of the right wing player. The situational rotation of a center in basketball at time  $t$ , when the right wing player possesses the ball, defines when and how the post and center players change their positions. The right wing player's options are to shoot at the basket, to pass to the post, to pass to the center, and to pass to the playmaker. The risk for these options was manipulated by the distance between each passing option and the associated defender. Shooting to the basket is defined as risky because, on average, a defense player is rather close to the shooting attacker. Passing to the playmaker is non-risky because, on average, no defense player is close to the playmaker. Passing to the center or the post player are considered risk neutral (defined by the distance between the opposing defense players and the post or center player, respectively). This definition is justified because the average distance between these two options and their associated defenders is between those for the playmaker and the wing (shooting) player. The term risk neutral was also used because of the function of these passes, because neither pass results in a restart of the situation (like the pass to the playmaker) or a potential score (like the shoot to the basket). From the perspective of the individual decision maker, it can now be argued that shooting at the basket is a risk-taking procedure especially when the situation shows little distance between oneself and the nearest defensive player. The situation definition and the distance manipulation between attackers and defenders have been used before in a study of decision making under time pressure (Raab, 2002).

To assess the state- and action-orientation of players, we used the standardized “Questionnaire for Assessing Prospective Action Orientation and State Orientation in Success, Failure, and Planning Situations” (German questionnaire for assessing “HAndlungsKontrolle bei Erfolg, Misserfolg, Planung,” hereafter HAKEMP, Kuhl, 1990). The HAKEMP inventory contains 36 items in German measuring action- and state-orientation. The questionnaire has been analyzed for good reliability, discriminative validity, and construct validity.

The players were instructed to make a tactical decision about the development of the attack from the point the right wing player catches the ball. In addition, in an attempt to control for speed-accuracy effects caused by our instructions, we balanced the instructions by emphasizing the importance of both. In addition, players were informed that the scenes differed in the risk to shoot or to pass to specific teammates, but they should decide what they think is the appropriate decision in each presented scene. The procedure of balancing decision accuracy and decision time

enables us to evaluate the assumption of faster deliberation time for action-oriented players compared to state-oriented players. The players were to make their decision and activate with their foot one of four electronic mats on the floor in front of them, as quickly as possible. Each mat was associated with one of the four possible decisions: shoot to the basket, pass to the post, pass to the center, or pass back to the playmaker. The decision and the time between stoppage of the scene and electronic mat activation in milliseconds were recorded by specifically-designed software. Personal data—age, gender, and sports experience—were initially collected for all players. Afterwards, players were tested individually on the main task. The order of the scenes was randomized. After the test all players completed an inventory including the HAKEMP questionnaire.

The results of the experiment show that action-orientated players shoot faster and more often to the basket and state-orientated players prefer to pass to a playmaker more often (Figure 1), but an individual analysis reveals that the mean of the group does not represent the individual behavior appropriately. The participants were classified by scores on the HAKEMP questionnaire as action-orientated or state-orientated decision makers. Using these survey results to preset model parameters, four simulations were run to evaluate whether behavioral differences depend on differential focus of attention, different initial preferences, different threshold values, or an approach-avoidance interpretation of the task. The simulations varying the parameter representing initial task preferences was most successful in predicting decision choices and decision time. Furthermore, an analysis of particular individuals reveals important interactions not captured by the “standard” aggregate statistical analysis.

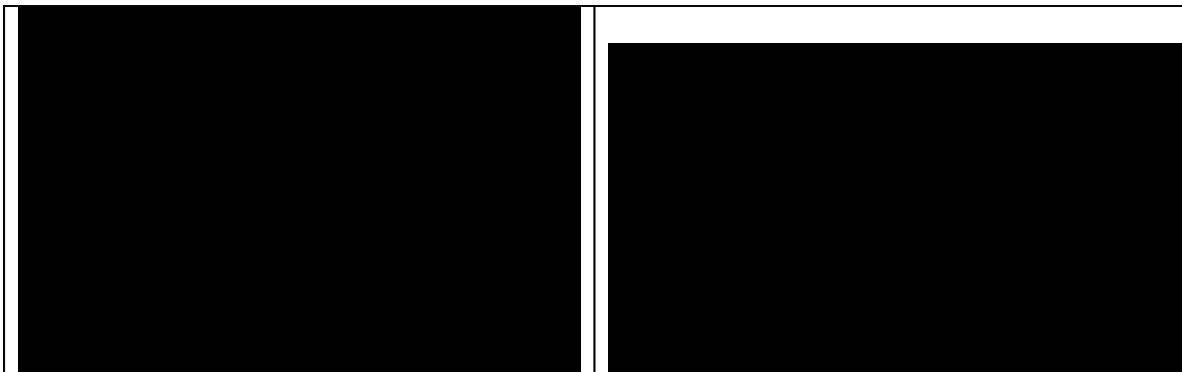


Figure 1. left: Number of decisions for high-risk (shoot to Basket) and low-risk (pass to Playmaker) responses for action-oriented (Action) and state-oriented (State) players in the basketball task. Lines on the bars represent standard errors. Right: Decision time for high-risk (shoot to Basket) and low-risk (pass to Playmaker) responses for action-oriented (Action) and state-oriented (State) players in the basketball task. Lines on the bars represent standard errors.

Simulations with the DFT framework revealed that risk taking in basketball shooting behavior can be explained by differential perception of the initial value of risky/safe options, which is correlated with different levels of action orientation (Raab & Johnson, submitted). In conclusion, the benefits of simulations in the DFT framework to predict choices and times for risk and non-risk illustrate a novel perspective in understanding individual decision making in sports.

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