



TEN REASONS WHY BASKETBALL IS NEUROLOGY

Robert P. Friedland, MD

In view of the prominence of Kentucky basketball teams I thought that it would be valuable to point out the neurological basis of all basketball skills.

1. The force needed to throw the ball depends on assessment of the weight of the ball and the motor resources available. The brain evaluates the ball's weight and through the activities of the pyramidal and extrapyramidal motor systems calculates the coordinated action of the legs, trunk, arms, hands and fingers necessary to send the ball in the desired direction.
2. The force of gravity acts consistently on the ball throughout its path. The brain calculates this unconsciously to determine how high to throw the ball in order for it to end up in the basket. This process involves procedural memory: the memory for action, and not events.
3. The player determines the likelihood of the shot being blocked and adjusts both the height of the shot and the force applied to the ball, in regard to the height of the opponent and the expected height of his or her outstretched arms at the point the shot is released. This is a complex perceptual, attentional and judgemental task.
4. The position of the player on the court is constantly monitored by the player using all signals available (not only the position of the basket.) The basket may not be visible to the player who is dribbling with his back to the basket, but the markings on the court (the three-point line, sidelines and half court line) are all permanent and never changing in regard to the position of the basket. So an experienced player can calculate the position of the basket in regard to these lines through unconscious processes involving simple geometry [most likely completed by the right parietal lobe]. Thus the player who turns and shoots does not need to have a good look at the basket before the ball is released.
5. The player needs to focus attention on the task at hand. Thus a player who devotes his attention entirely to the task of dribbling is likely to have the ball stolen. He or she must have divided attention: paying attention to the balance of body weight, the time left on the shot clock, the instructions from the coach, the position of teammates as well as opponents, and the flow of the game. Focusing attention also requires the ability to not pay attention to other factors, which are distracting. A player shooting a free throw concentrates on the weight of the ball, the feeling of the ball in her hands and the elasticity and strength present in her legs, and may or may not be able to ignore the distraction provided by fans screaming and standing up behind the basket, attempting to divert attention from the shot itself. This process of division of attention is been attributed in large part to the frontal lobes. Focusing of attention is supported by brainstem projection systems and the entire cerebral cortex (e.g., visual cortex for seeing and auditory cortex for hearing).
6. The player must remember what is happening, and what the coach's plan for the game is for that moment. This may involve knowing that a certain defender does not defend well when challenged from the left, or that he is likely to foul in certain situations. Players must recall how many fouls they've gotten and that an additional foul would make them leave the game. Memory is a vital function of the medial temporal lobes.
7. Emotion is an integral feature of basketball and must be controlled. A player can be disturbed by having a foul called when, in his opinion, he is innocent. In order to hold back anger and emotional outburst (which can result in ejection or a technical foul), the player must be able to inhibit emotional expression. This is an interaction of the frontal lobes and the amygdala, an important nucleus in the anterior medial temporal lobe.
8. Basketball players are constantly falling: every time they jump they fall to the floor, and we hope they land safely on their feet. They do not usually crash to the floor because of the ability of the semicircular canals and otolith organs in the inner ear to calculate precisely the position of the body in regard to the center of the earth and make appropriate adjustments.
9. When we move our heads our eye position is adjusted with feedback from the inner ears, to allow the brain to interpret the visual world without being confounded by the motion of the head. This problem is apparent when we see a movie filmed from a camera perched on someone's shoulders: the image appears to be jumping and is often impossible to watch. Our inner ears instruct the eye muscles, with the help of complex brainstem interactions, how to move in a way that produces a stable image of the world. Without these systems basketball would be impossible!
10. Joy: the reason people play and watch basketball is because it is fun. The capacity for fun is shared by many mammals that enjoy play (including, of course, dogs, cats and nonhuman primates). This capacity for joy with play cannot be localized in the brain and is undoubtedly an interaction between the frontal, parietal, temporal and occipital lobes and memory, emotion and the basic reward systems of nervous functioning, which are many millions of years old.

What about the rest of us who enjoy watching basketball? Certainly we derive pleasure from the intensity of the final moments of the game, when our attention is perfectly focused on the contest – the focusing of attention is a clear path to joy. In addition, basketball provides a sense of membership, of belonging to a tribe, which is as ancient a human motivation as can be found! **LM**

Note: Dr. Friedland is a professor and Rudd Chair at the University of Louisville School of Medicine, Department of Neurology.