The science of swing

James Anderson’s ability to swing the ball could decide the fourth Test at Headingley. His success will depend on manipulating aerodynamics and creating subtle pressure imbalances on either side of the ball, by positioning the seam so it acts as a rudder. Contrary to cricketing lore, however, the weather will not be a factor: science suggests that none of the three types of swing are affected by cloud cover or humidity, although pitch conditions and wind can make a difference.

Normal swing

The grip
Bowler holds ball next to seam, with part of shiny side towards batsman, and points seam in direction he wants the ball to swing. For an outswinger, the seam points towards slip, for an inswinger towards fine leg.

1. Ball swings in the direction in which the seam is pointing.
2. As air flows around the ball, it is disrupted on the side with the seam, causing turbulence.
3. Turbulent air breaks away from the ball later, reducing pressure on that side.

70mph optimum speed
Swing difficult to achieve above 80mph

Reverse swing

The grip
Bowler holds ball next to seam, with part of rough side towards batsman, and points seam in the opposite direction to the way he wants the ball to swing. For an outswinger, the seam points towards fine leg, for an inswinger towards fine leg.

1. Ball swings away from the direction in which the seam is pointing.
2. Rough surface of ball creates initial turbulence on both sides of the ball.
3. As turbulent air hits the seam, turbulence is disrupted and weakened.
4. Weakened turbulent air breaks away from the ball earlier, raising pressure compared with the other side.

90mph optimum speed
Roughened balls will reverse at lower speed

Contrast swing

The grip
Bowler holds seam vertically, with shiny side facing the way he wants the ball to swing. For an outswinger, the seam is pointing towards fine leg, for an inswinger towards fine leg.

1. Ball swings in the direction of the rough side.
2. Air moves smoothly over smooth side, but rough side creates turbulence.
3. Turbulent air breaks away from the ball later, reducing pressure on rough side.
4. Weakened turbulent air breaks away from the ball earlier, raising pressure compared with the other side.

At high speed

1. The grip
Bowler holds seam vertically, with shiny side facing the way he wants the ball to swing.

At low speed

1. The grip
Bowler holds ball next to seam, with part of rough side towards batsman, and points seam in the opposite direction to the way he wants the ball to swing. For an outswinger, the seam points towards slip, for an inswinger towards fine leg.

1. Ball swings away from the direction in which the seam is pointing.
2. Rough surface of ball creates initial turbulence on both sides of the ball.
3. As turbulent air hits the seam, turbulence is disrupted and weakened.
4. Weakened turbulent air breaks away from the ball earlier, raising pressure compared with the other side.

80mph optimum speed
Ball still swings if seam is less prominent

Sultans of swing

Waqar Younis
Richard Hadlee
Bob Massie
George Hirst
Zaheer Khan

Weather report
• Experiments show that, contrary to popular cricketing belief, cloud cover and humidity seem to have no effect on swing
• Prevailing winds can disrupt turbulence patterns on the ball, promoting swing in particular grounds or from a particular bowling end

Pitch report
• Grassys wicket: can protect shiny side of ball, assisting conventional swing
• Abrasive wicket: can scuff up ball, creating rougher rough side and promoting reverse-swing
• Very hard wicket: can depress seam, making conventional or reverse swing impossible. Contrast swing may still be effective

Worries for 2020

Projecting the conditions for the fourth Test at Headingley, according to prediction models, indicates that in the absence of an onshore breeze, three types of swing will be affected by weather, but pitch conditions and wind will not: so it will be impossible to make a choice between conventional, reverse and contrast swing. The choice will depend on the weather conditions.