Tusi or Not Tusi

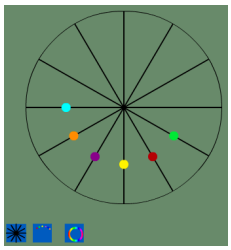
Arthur Shapiro and Alex Rose-Henig
Department of Psychology, American University

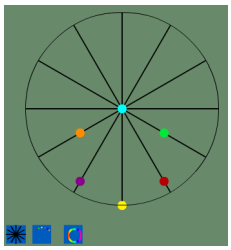
The title of this entry takes its name from Nasir al-Din Tusi, a 13th-century Persian astronomer. Tusi showed how to create a straight line from circular motion.

The principle is illustrated in the figure to the left. If circle with diameter A rotates on the inner boundary of a circle with diameter 2A, then a point on the circumference of the inner circle traces a straight line. The figure is from a Tusi manuscript in the Vatican collection (also posted on Wikipedia). (http://www.ibiblio.org/expo/vatican.exhibit/exhibit/d-mathematics/Greek_astro.html)

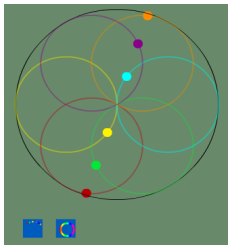
Here we explore local motion versus global motion with two different constructions:

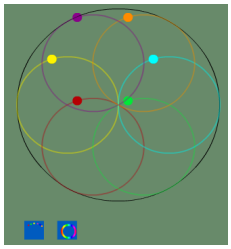
Tusi Motion: motion from elements that travel in linear paths, and
Not Tusi Motion: motion from elements that travel in circular paths.



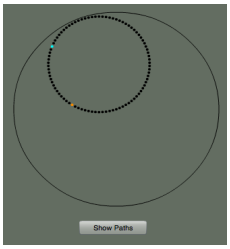


Tusi Motion: In the two figures to the left, each colored dot moves on a straight path along the radial lines—like the point on the circumference of the circle in the manuscript illustration above. Changing the relative phase of the colored dots makes the global percept appear as radiating lines or as a spinning circle.





Not Tusi Motion: In the two figures to the left, each colored dot moves on a circular path—very different from the motion Tusi described. Changing the relative phase of the dots makes the global percept appear as lines spinning around the circle or as a circle that moves around inside the outer circle, but – unlike Tusi motion – the inner circle does not spin.



Tusi or Not Tusi: The motion from Tusi and Not Tusi can be made to overlap. In the figure to the left, all the dots are black except for two. The blue dot follows a straight path (as in the Tusi motion demonstration); the orange dot follows a circular path (as in the Not Tusi motion demonstration). When an observer attends to the blue dot, the inner circle appears to spin as it moves inside the outer circle, and when an observer attends to the orange dot, the inner circle does not appear to spin as it moves inside the outer circle.

Purpose, and why these effects are interesting: These effects show how the perception of the same local paths can be interpreted as different global structures. Our perception, therefore, depends upon the statistical relationship between motion elements, not just upon the motion of the individual elements. In the final example (Tusi or Not Tusi), we show how attention can switch between two different global percepts even though both types of motion are present.