Alice and Bob each rotated their polarizers in opposite directions, as they did in Experiment IV, they could each send this pair of twins on their Path 2. They would thus not record this double change as a mismatch.

Because of such double changes, when Alice and Bob compare their data streams in Experiment IV, the mismatch rate will likely be *less* than the 5% error rate Alice alone would cause *plus* the 5% error rate that Bob alone would cause. In Experiment IV the mismatch rate they will see is likely *less* than 10%. In a statistically large sample it *cannot* be greater.

That's it! We've derived a Bell inequality:

> **The mismatch rate when both polarizers are rotated by Θ (in opposite directions) is equal to, or less than, twice the mismatch rate for the rotation by Θ of a single polarizer.**

Since space is the same in all directions, a rotation of the two polarizers in opposite directions by Θ is equivalent to a rotation of only one by 2Θ. Thus rotating a single polarizer in one experiment by Θ and in a second experiment, by 2Θ can demonstrate the same inequality. The Bell inequality would then state: A rotation by 2Θ cannot produce more mismatches than twice those for a rotation by Θ.

Here's an intentionally ridiculous story to emphasize that the *only* assumptions in our derivation of a Bell inequality were reality and separability. Instead of talking of stick-like fotons and oval polarizers, we could have said that each foton is steered by a little "foton pilot" and that a polarizer is just a traffic sign indicating an "orientation" with an arrow. The foton pilot carries a travel document instructing him to steer his "foton" on Path 1 or Path 2 depending on the traffic sign. The hidden variable is now the physically real instruction printed on the pilot's travel document. His sister, piloting the foton's twin, follows her identical instructions at the traffic sign she encounters with no regard for the behavior of her brother. This model yields the same Bell inequality. Only reality and separability need be assumed.

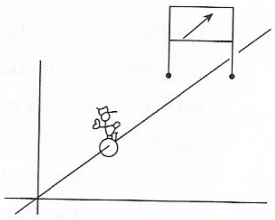

Figure 13.6 The photon pilot