moving toward you at 80 percent of the speed of light were to throw a ball to you at 70 percent of the speed of light, you would observe the ball moving toward you at about 96 percent of the speed of light rather than the 150 percent of the speed of light predicted by classical theory. In this case, the difference between the velocities predicted by each theory cannot be ignored, and the relativistic addition of velocities must be used.

In this last example, it is significant that classical addition predicts a speed greater than the speed of light ($1.5c$), while the relativistic addition predicts a speed less than the speed of light ($0.96c$). In fact, no matter how close the speeds involved are to the speed of light, the relativistic equation yields a result less than the speed of light, as seen in **Table 1.**

How does Einstein's equation cover the second case, in which the bicyclist shines a beam of light toward you? Einstein's equation predicts that any object traveling at the speed of light ($u' = c$) will appear to travel at the speed of light ($u = c$) for an observer in any reference frame:

$$u = \frac{v + u'}{1 + (vu'/c^2)} = \frac{v + c}{1 + (vc/c^2)} = \frac{v + c}{1 + (v/c)} = \frac{v + c}{(c + v)/c} = c$$

This corresponds with our earlier statement that the bicyclist measures the beam of light traveling at the same speed that you do, 3.0×10^8 m/s, even though you have a different reference frame than the bicyclist does. This occurs regardless of how fast the bicycle is moving because v (the bicycle's speed) cancels from the equation. Thus, Einstein's relativistic equation successfully covers both cases. So, Einstein's equation is a more general case of the classical equation, which is simply the limiting case.

Table 1 Classical and Relativistic Addition of Velocities

c = 299 792 458 m/s		Classical addition	Relativistic addition
Speed between frames (v)	Speed measured in A (u')	Speed measured in B (u)	Speed measured in B (u)
25 m/s	15 m/s	40 m/s	40 m/s
100 000 m/s	100 000 m/s	200 000 m/s	200 000 m/s
50% of c	50% of c	299 792 458 m/s	239 833 966 m/s
90% of c	90% of c	539 626 424 m/s	298 136 146 m/s
99.99% of c	99.99% of c	599 524 958 m/s	299 792 457 m/s