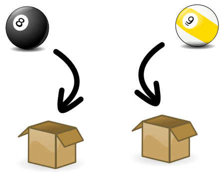
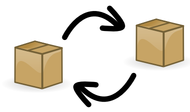
1 Nonlocality of billiard balls

Put an eight-ball and a nine-ball into indistinguishable boxes:



Close the boxes and mix them up, so no one can tell whether a box contains an eight-ball or a nine-ball:



Move the two closed boxes to opposite ends of the table:

Open the box on the left and observe the billiard ball that is in it. For argument's sake, let us suppose it is a nine-ball:

(The same arguments apply if it is an eight-ball, if one swaps eight-balls and nine-balls in all the statements from here on.)

When we open the box on the right and observe its billiard ball, will that ball be an eight-ball or a nine-ball? Seeking an answer to this question, let us follow the lead of John Bell.[1] In accord with Bell, do not allow the observation of a nine-ball on the left exert an influence the type of the ball on the right; this is

[1] J.S. Bell, *Bertlmann's socks and the nature of reality*, **http://cds.cern.ch/record/142461/files/198009299.pdf**, p. 13.

the requirement of *local causality* or *no action at a distance*. In parallel to Bell’s argument, represent *local causality* by considering the probability the ball on the right is a nine-ball as *unconditional* on the observation that the ball on the left is a nine-ball (Bell’s equations (10) and (11)). Therefore, because there is one eight-ball and one nine-ball, both equally likely to have ended up in the box on the right, the probability the ball on the right *also* is a nine-ball equals ½. In other words, about half the time that we observe a nine-ball (*or* an eight-ball) on the left, we should also observe a nine-ball on the right, like so:

However, it turns out experimentally, *if* one first observes a nine-ball on the left, one later, *always*, observes an eight-ball on the right, like so:[2]

By *reductio ad absurdum*, the assumption of *local causality* must be rejected. Ergo: observing a nine-ball on the left must exert a *causally nonlocal* influence on the ball to the right, *causing* it always to be an eight-ball. In the behavior of billiard balls, as in quantum mechanics and by equivalent reasoning, there is ‘a spooky kind of action at a distance’[3].

2 The correct solution

Given the conditions that there are just an eight-ball and a nine-ball, and that the nine-ball has been removed from consideration by being obversed on the left,

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[2] Try it yourself if you doubt me.

[3] Albert Einstein, quoted in E.T. Jaynes, *Clearing up mysteries – the original goal*, **http://bayes.wustl.edu/etj/articles/cmystery.pdf**, p. 10.

then the *conditional probability* that the ball on the right is a nine-ball equals 0. The *conditional probability* that it is an eight-ball equals 1. These numbers correspond to what actually is observed.

Bell's equations (10) and (11) are fallacious. It is mathematically naive – that is, 'innumerate' – to represent *local causality* by using unconditional probabilities instead of conditional ones. In common parlance, to do so is 'confusion of correlation with causation'.

It is astonishing to see a dominant claim in physics founded on an instance of simple innumeracy, perhaps buttressed by the weight of mere authority. Do *not* take my word for it. I urge people to see the fallacy for themselves – and, in so doing, to develop firmer trust in their own ability to reason.

3 Correct solution of the epidemiology thought experiment

To be written.

4 Correct solution of the problem of Bertlmann's socks

To be written.