Visual illusion from running

Sir — We have observed a striking visual illusion. When walking on solid ground after more than 10 minutes of fast jogging or running on a treadmill exercise machine, people experience a sensation, lasting 2–3 minutes, of apparently moving at a markedly accelerated pace, as when walking on the passenger-transporting devices (travelators) often found in airports.

We and 14 other subjects (total age range 23–73 years), seven of whom were naïve to the expected effect, reported the sensation of accelerated self-motion in comparing their experiences when walking in stationary surroundings before and immediately after treadmill running. In separate experiments, subjects were instructed to maintain a constant ‘visual speed’ while repeatedly walking a 5-metre course, and were seen to accelerate their pace as the illusion gradually vanished with successive laps (see figure).

We made the following additional observations. First, the effect is strongest after treadmill running with eyes open; we also observed a weak effect after treadmill running while blindfolded, running outdoors, or exercising on a stationary bicycle. Second, occluding peripheral visual information during treadmill running by looking through a restrictive visor reduces the strength of the effect. Third, we observed the illusion when moving forwards, backwards or sideways only after movement on the treadmill in the corresponding manner. Fourth, running with the treadmill close to a textured wall on one side leads to a stronger effect when walking next to a wall on the same side compared with the other side. Fifth, long-term experience of exercise on treadmills reduces the strength of the effect. Sixth, there is no reduction in strength after running with head and elbows stabilized on a shelf mounted above the treadmill. Seventh, active movement is necessary to observe the effect — subjects report no effect when pushed on a wheelchair instead of walking. And finally, the effect is most compelling when walking on the treadmill itself after it has stopped.

We think the first four observations have been reported. In one study, blindfolded subjects who had jogged for 60 seconds on a treadmill inadvertently advanced when asked to jog in place, still blindfolded, on solid ground. In the other study, subjects walked for 8 minutes on a treadmill which itself was pulled along by a tractor at different speeds; they were then shown a target and asked to walk to it blindfolded on solid ground. When the tractor speed was lower than the treadmill-walking speed, the subjects overshot the target, and when it was higher they undershot it. In these experiments, subjects made biased movement in atypical self-motion situations without any visual input during the test period. Our illusion shows that disturbing the normal relation between self-induced motion and the expected sensory input leads subjects to experience altered motion and misjudge its extent even in normal locomotion with eyes always open.

We believe that all these phenomena are related to those Helmholtz explained as unconscious inference, and involve recalibration of the mechanisms estimating associations between sensory messages. Changes in these associations are often of vital importance, for they signal changes in the causal net within which we live. One way to detect them sensitively would be to adjust the representational variables continuously, so that they are decorrelated; in the illusion described here, this achieves the same end for variables representing self-motion inputs from two or more sensory modalities as automatic gain control does for a single sensory variable (for example, in light adaptation). Adaptation after-effects, including those discussed here, would then be the outcome of adjustments made during a period of novel sensory experience.

A. Peha*  
H. B. Barlow  
Physiological Laboratory, University of Cambridge, Downing Street, Cambridge CB2 3EG, UK


* Also at: Visual Development Unit, University College, Gower Street, London WC1E 6BT, UK.