Spook Hills in the Lab

Spook hills, also known as antigravity or magnetic hills, are natural places where cars in neutral gear seem to move uphill on a slightly sloping road, seemingly defying the laws of gravity. The phenomenon, found all over the world, has long kept both paranormal believers and skeptics wondering.

Some have suggested as explanation for the strange occurrence that magnetic or gravitational anomalies exist due to mysterious magnetic sources underground or secret military experiments. Magnetic causes can be ruled out easily, though, because effects are visible even on nonmagnetic materials, such as plastic balls or water poured on the ground.

The answer to this mystery is found using a simple tool. When the inclination of several such roads has been measured using spirit levels, the actual slope of the surface has consistently been found to be opposite to the apparent one. To answer the objection that gravitational anomalies would influence the level as well, my good friend and longtime colleague Luigi Garlaschelli, from the University of Pavia in Italy, also took measurements on an Italian spook hill in Montagnaga (Figure 1) from a distance (i.e., away from the stretch of road in question) using a professional surveyor's instrument called a theodolite.

The parallelism between a plumb line hanging within the critical area and another outside of it was first checked by Garlaschelli, then height quotes were taken on graduated yardsticks. The real slope was calculated at about 1 percent of the apparent slope in the opposite direction.

The simpler explanation for spook hills, then, is that they are visual illusions in a natural environment.

The phenomenon can be recreated artificially, with no intervention whatsoever of magnetic, antigravitational, or otherwise mysterious forces.

A Portable Spook Hill Experiment

Recently, Garlaschelli, along with Paola Bressan, a researcher at the Department of Psychology at the University of Padua, and Monica Barracano, also of Padua, published a report on spook hills in *Psychological Science*, the journal of the Association for Psychological Science (previously known as the American Psychological Society).

In the article, they describe four experiments showing that this phenomenon can be reproduced in a laboratory. The researchers find that the phenomenon is due to the visual anchoring of the spooky surface to a gravity-relative eye level whose perceived direction is biased by sloping surroundings.

In the first experiment, for example, they built a tabletop model with three hinged, moveable boards (Figure 2) to investigate the case in which the critical spot is a sloping stretch of road between two other stretches that both run either uphill or downhill as one moves forward from the observation point at one end.

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Because their model was 2.4 meters long, devoid of visible texture, and viewed monocularly through a reduction screen, most depth cues (aerial perspective, texture gradients, and binocular cues such as disparity and convergence) were absent.

Sixty undergraduate students were divided into three groups of twenty subjects each, with each group seeing two or three of the eight different levels of inclination. All subjects were unaware of the actual setup and purpose of the experiment.

In the experiment, the subjects sat in front of the screen one at a time. They were asked to look into a hole and describe what they saw and then assess the slope of the three stretches on a five-point scale that ran from strongly downhill to strongly uphill. Each trial was followed by a break of about one minute, during which the hole was occluded and the model modified.

The results of the experiment showed that slants are generally underestimated. Three stretches with the same slant were seen as horizontal by all subjects, whether they were truly horizontal, downhill, or uphill. A slightly downhill stretch between two strongly downhill inclines was seen as illusorily uphill by sixteen out of twenty subjects and as illusorily horizontal by the other four. This illusory effect explains what occurs at Gravity Hill in Pennsylvania.

However, a slightly uphill stretch between two strongly uphill inclines was seen by all subjects as level, not as downhill as might be expected in light of the previous finding. This result implies that inducing an illusory downhill effect is not nearly as easy as inducing an illusory uphill effect. In a further experiment, Garlaschelli and his team found that steeper inducing slopes are required to suggest an uphill slant.

"After each observer's task was concluded," say Bressan and her colleagues, "we placed a small roll of tape on the misperceived slope, and the tape appeared to move against the law of gravity, producing surprise and, on occasion, reverential fear."

Interested readers can find details on the team's various experiments in the September 2003 (14:5) issue of *Psychological Science*.

Figure 1: At this spook hill in Montagnaga (Italy), the road on the right is misperceived as running uphill.

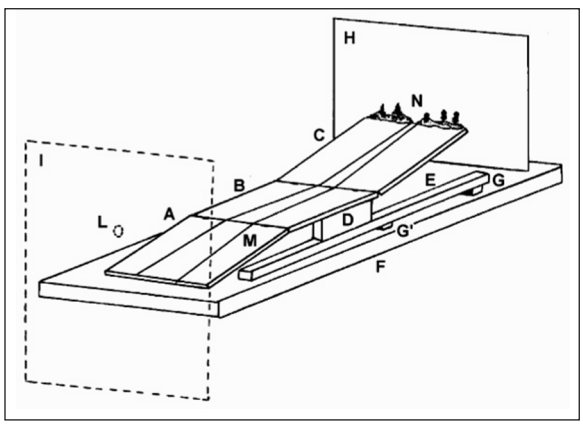

Figure 2: Schematic illustration of the tabletop model used in Experiment 1 (L is where the hole was located and in N there are a few small model trees to add to the realism of the scenery).

Experience the Spooky Effect

"The visual (and psychological) effects obtained in our experiments were in all respects analogous to those experienced on site," the researchers concluded. "The more than twenty natural cases of antigravity hills reported to date are all variations on a single theme. Our study shows that the phenomenon can be recreated artificially, with no intervention whatsoever of magnetic, antigravitational, or otherwise mysterious forces. The spooky effects experienced at these sites are the outcome of a visual illusion due to the inclination of a surface being judged relative to an estimated eye level that is mistakenly regarded as normal to the direction of gravity. Using miniature or even life-size reproductions of our tabletop models, it should now be easy to re-create the fascination of this challenge to gravity in amusement parks and, for twice the benefit, science museums anywhere."

If you'd like to experience a spook hill for yourself, Bressan and colleagues have prepared this list of the best known ones:

United States: Confusion Hill, Idlewild Park, Ligonier, Pennsylvania; Gravity Hill, northwest Baltimore County, Maryland; Gravity Hill, State Route 42, Mooresville, Indiana; Gravity Hill, State Route 96, south of New Paris, Bedford County, Pennsylvania; Gravity Hill, White's Hill, Rennick Road, La Fayette County, Wisconsin; Gravity Road, Ewing Road, Route 208, Franklin Lakes, Washington; Mystery Hill, Highway 321, Blowing Rock, North Carolina; Mystery Spot, Putney Road, Benzie County, Michigan; Spook Hill, North Wales Drive, North Avenue, Lake Wales, Florida; Spook Hill, Gapland Road, Burkittsville, Frederick County, Maryland.

Canada: Gravity Hill, McKee Road, Ledgeview Golf Course, Abbotsford, British Columbia; Magnetic Hill, Neepawa, Manitoba; Magnetic Mountain, Canada Highway, Moncton, New Brunswick.

Europe: Ariccia, Rome, Italy; Electric Brae, A719, Croy Bay, Ayr, Ayeshire, Scotland; Malveira da Serra, Road N247, Lisbon, Portugal; Martina Franca, Taranto, Italy; Montagnaga, Trento, Italy; Mount Penteli, Athens, Greece.

Other countries: Anti-Gravity Hill, Straws Lane Road, Wood-End, Victoria, Australia; Morgan Lewis Hill, St. Andrew, Barbados; Mount Halla, Cheju Do Island, South Korea.

Readers who know of other spook hills are invited to write to us with their locations. □