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SLOPE ILLUSION (MAGNETIC HILL) IN RADAN

Abstract: The slope illusion (Magnetic Hill) in Radan, Serbia was investigated and compared with some slope illusion places in the world. The slope illusion generally occurs at a gentle slope flanked by steep slopes. The role of a sag or crest is discussed.

Key words: slope illusion, magnetic hill, Radan mountain, sag and crest

1. WHAT IS THE SLOPE ILLUSION?

The "slope illusion" refers to the anomalous phenomenon that an ascent appears to be a descent (Figure 1a) or a descent appears to be an ascent (Figure 1b). The place where the illusion is observed is sometimes called "Magnetic Hill"[1] because it appears as if cars were pulled by magnetic power to move uphill. There are many places in the world that are known to show the slope illusion. According to Bressan, Garlaschelli and Barracano (2003), there are at least ten places in the United States, three in Canada, six in Europe, one in Australia, one in Barbados, and one in South Korea. Ninio (1998) mentioned two places in France. In Japan, more than ten places are known and some of them were investigated by the author and colleagues (Imai, 1984; Kitaoka, 2013; Kitaoka and Newton Press, 2007; Tsuinashi, 2008; Tsuinashi and Kitaoka, 2012). Such places are also called "Anti-Gravity Hills", "Gravity Hills", "Spook Hills", "Confusion Hill", "Mystery Spot", "Electric Brae", etc. (Bressan et al., 2003), or "Mystery Zone", "Mystery Slope", "Ghost Slope", "Backward-flowing water", etc. (Tsuinashi and Kitaoka, 2012).

2. BRESSAN ET AL.'S (2003) EXPERIMENTAL STUDY

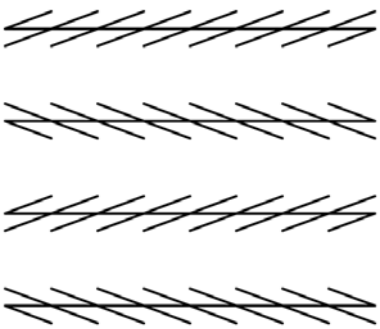
By investigating the slope illusion experimentally, Bressan et al. (2003) made the following three observations. First, slopes were underestimated or appeared to be horizontal when their slants were small. Second, perceived slope was an inverse function of

Fig. 1a
Fig. 1b

An example of the slope illusion. (a) The nearer slope appears to be a descent though it is a gentle ascent (2%). Actually, the bus is running up on a steep ascent (9%). (b) When seen from an upper place, the farther slope appears to be an ascent though it is a gentle descent (2%). This place is named "Mystery zone," which is located in a toll road connecting to the top of Mt. Yashima, one of the sightseeing spots in Takamatsu City, Japan.

the height of the visible horizon. They suggested that mountains make observers misperceive the level of the horizon and produce the slope illusion. Third, perceived slope was affected by connecting or flanking slopes: when accompanied by descents, horizontal stretches were perceived as ascents, and when accompanied by ascents, horizontal stretches were perceived as descents. This finding or "slant contrast" has a resemblance to the Zöllner illusion that lines intersected by oblique line segments appears to tilt in the direction that the acute angle of intersection appears to be larger than it is (Kitaoka, 2007; Oyama, 1960; Robinson, 1972/1988; Zöllner, 1860) (Figure 2).

Fig. 2

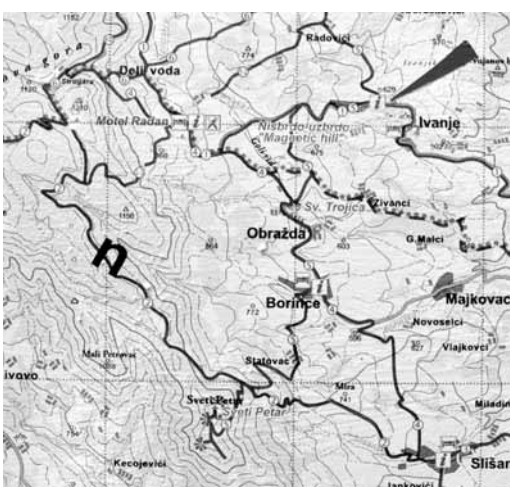


The Zöllner illusion. Four horizontal lines appear to tilt alternately and do not appear to be parallel to each other. The uppermost and third lines appear to tilt clockwise whereas the second and lowermost ones appear to tilt counterclockwise.

3. THE SLOPE ILLUSION IN RADAN

The present article is aimed to add a Balkan instance to the list because Bressan et al.'s (2003) collection lack instances from Eastern Europe. The Balkan slope illusion is located in Radan, Serbia (Figure 3). It is named "Uzbrdna Nizbrdica" (Magnetic Hill). Figure 4 shows the site with a view of Radan's mountains, in which an ascent appears to be a descent when observed from a lower place. When observers see the same slope from an upper place, it appears to be an ascent though it is a descent (Figure 5).

Fig. 3



The site of the Balkan slope illusion ("Magnetic hill"). It is located in Ivanje. This image is a photo of the signboard map that stands at the point "i".

Fig. 4a

Fig. 4b

The slope illusion (Magnetic hill) in Radan, Serbia. (a) The stretch before the curve appears to be a descent though it is actually a gentle ascent. The left peak of mountains seems to be Mt. Sveti Petar. (b) The point just before the curve appears to be lowest though this road is entirely an ascent.

A detailed report on this illusion site was previously published in 2010 as an Internet article written in Serbian (Bubnjević, 2010). With the help of Serbian people, the author (Japanese) who studies visual illusion heard about this site and visited it in August, 2014 when the 37th European Conference on Visual Perception was held in Belgrade.

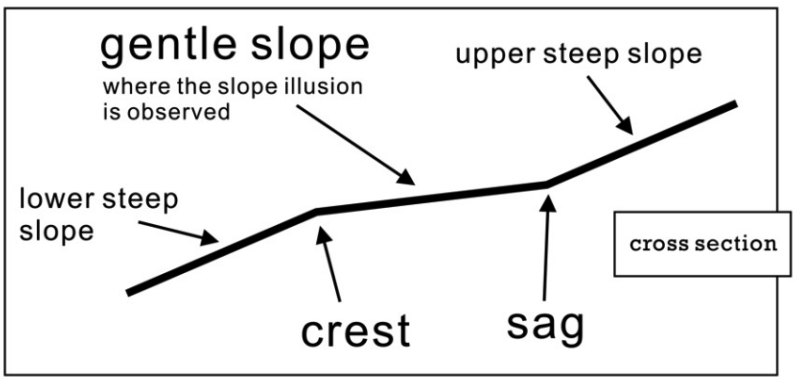
This site consists of three consecutive slopes: a gentle slope and two steep slopes of the same orientation that sandwich the gentle one (Figure 6a). The gentle slope is at a 35 min (1%) incline according to Bubnjević (2010)[2] and displays the slope illusion, though no data are avaialble about the steep slopes. The same layout is observed in "Mystery zone" in Japan that is shown in Figure 1.

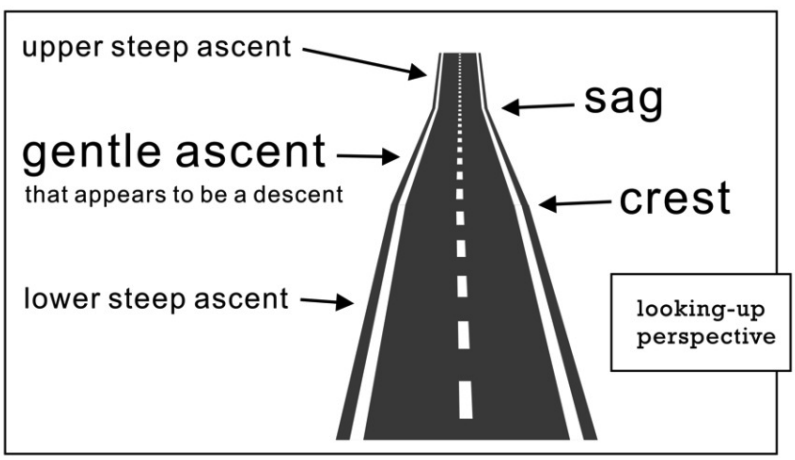
Fig. 5a

Fig. 5b

The slope illusion in Radan when looked down. (a) The slope appears to be an ascent though it is actually a gentle descent. (b) A water bottle is rolling away because this slope is actually a descent.

The point where the gentle slope and one of the steep slopes meet is called "sag" or "crest" according to whether it is concave or convex, respectively (Tsuinashi, 2008; Tsuinashi and Kitaoka, 2012) (Figure 6a). Figure 6b shows a schematic perspective of this site seen from a lower place. It corresponds to the photographs shown in Figure 4, but they do not show the lower steep slope or the crest. This means that the gentle ascent and the upper steep one, which render a sag, are sufficient for the slope illusion that an ascent appears to be a descent. Conversely, Figure 6c shows a schematic perspective of this site seen from an upper place. It corresponds to the photographs shown in Figure 5, but they do not show the upper steep slope or the sag. This means that the gentle descent and the lower steep descent, which render a crest, are sufficient for the slope illusion that a descent appears to be an ascent.





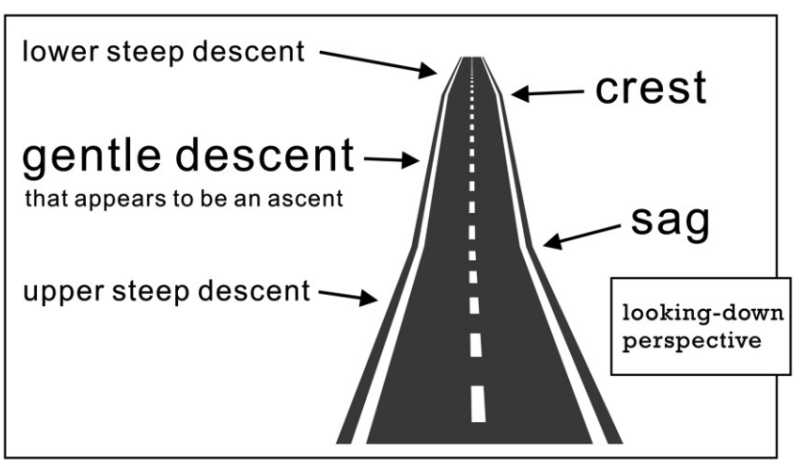


Fig. 6a
Fig. 6b
Fig. 6c

A schematic cross section of this site. It consists of a gentle slope sandwiched by steep slopes of the same orientation. The point where the gentle slope and one of the steeper slopes meet is called “sag” or “crest” according to whether it is concave or convex, respectively. (b) A schematic perspectives of this site seen from a lower place. This view corresponds to Figure 1a and Figure 4. (c) A schematic perspectives of this site seen from an upper place. This view corresponds to Figure 1b and Figure 5.

Fig. 7a

Fig. 7b

(a) The slope illusion in Yashima, Japan, the same place as Figure 1b. The farther slope is a gentle descent but appears to be an ascent. (b) The slope illusion in Tsunan, Japan. This slope is a gentle descent but appears to be an ascent. For both images, mountains are visible in the background.

4. A NEW EXPLANATION OF THE SLOPE ILLUSION

The first claim of Bressan et al. (2003) was that slopes appear to be underestimated when they are nearly horizontal. This claim was not confirmed, but it might be because the gentle slope was slanted much enough (1%). Moreover, the third claim that perceived slope was affected by connecting or flanking slopes, was confirmed.

However, the second claim that perceived slope is an inverse function of the height of the visible horizon, remains questionable. It is true that Figure 4a agrees with this claim because mountains might make observers raise the perceived level of the horizon,

Fig. 8a

Fig. 8b

The slope illusion in Tanegashima, Japan. (a) This slope is a gentle descent but appears to be an ascent. In this place the horizon is visible. (b) Converging lines of the roadsides meet under the horizon, which confirms that this slope is really a descent.

but Figure 4b disagrees with it because it does not show mountains or any cue for the horizon. One may assume that Figure 5 makes observers lower the perceived level of the horizon and the gentle descent appears to be an ascent. This assumption is not acceptable because the slope illusion that a gentle descent appears to be an ascent can be observed when mountains are visible in the background (Figure 7) or even when the horizon is seen (Figure 8).

Instead, I propose a new, simple explanation, in which a sag and crest are the most important cues. It is assumed that the slope illusion should occur depending on the condition whether a gentle slope is located before a sag or crest. Specifically, a gentle ascent located before a sag tends to appear to be a descent (Figures 1a and 4), whereas a gentle descent located before a crest tends to appear to be an ascent (Figures 1b, 5, 7 and 8). This idea can explain the slope illusion parsimoniously.

5. HISTORICAL VIEW OF THE SLOPE ILLUSION

The slope illusion is mostly reported in the countryside, not in towns, probably because abundant horizontal cues prevents the illusion in towns. The same holds true for this Balkan slope illusion. However, this does not mean that the slope illusion is a classic illusion. Historically speaking, the slope illusion is not so old as e.g. the moon illusion that the moon above the horizontal appears to be larger than the moon at the zenith though they are the same size (Ross and Plug, 2002). On the contrary, the slope illusion should be regarded as a modern illusion because it requires straight, paved roads of constant width that are located in the countryside.

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[1] "Due to the slopes and grades localized at the foot of Lutes Mountain, Magnetic Hill creates the illusion that automobiles and other objects, including running water, apparently travel uphill" (Canada's Historic Places, 2004).

[2] This measurement was conducted by Dr. Milovan Šuvakov, president of the Society for Promotion and Popularisation of Science (DPPN), research associate professor at Institute of Physics Belgrade and seminar organizer in Petnica Science Center.

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