The Magnetic Hill

How do visual illusions distort perception and influence action?

There is a place in New Brunswick, Canada, to which people travel to be fooled. They call it a magnetic hill. People drive to a certain location on a country road, put their car in neutral, and watch in amazement as it begins to roll *up* the hill. Or, at least, that is what seems to happen. The hill is not magnetic, of course, and the car does not actually go uphill. But the feeling of rolling uphill is there just the same.

We depend on vision to interpret the world around us, using perceptual skills learned over a lifetime of experiences and interactions with our environment. But, our visual perception can sometimes be fooled, and researchers find this very exciting because it leads to fascinating insights regarding how we think and act. The magnetic hill is one of many types of visual illusions—examples of how perception can lead us to mistaken conclusions about reality. An important lesson about the magnetic hill illusion is that what we see often overshadows what we feel.

There are scores of visual illusions, and scientists have been studying them for many years. One of the better known and most often studied of these is called the Müller-Lyer illusion, which is illustrated in figure 1.1. Compare the two lines in the figure. The line between the tails (i.e., > and <) in the figure on the left looks longer than the line in the figure on the right. In reality, the lines are identical in length; the orientation of the inward- and outward-pointing tails, in relation to the line, creates the illusion that the lines are unequal. Your perception of reality has been fooled, not unlike what happens at the magnetic hill.

Visual illusions can lead us not only to see things that are not real, but also to feel things that are not real, such as what occurs in the size–weight illusion. You can readily experience this illusion by filling two containers, one smaller than the other, with equal amounts of mass (e.g., sand). Then, ask a

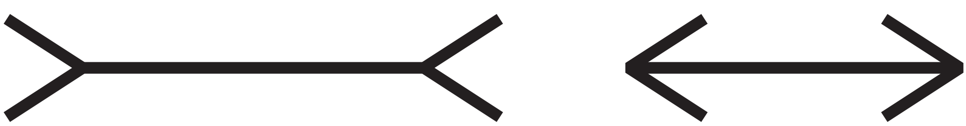

Figure 1.1 Two figures showing the Müller-Lyer illusion. The horizontal line on the left appears longer to most people than the line on the right. However, they are the same length.

friend to lift both containers, one at a time, and tell you which one is heavier. After lifting each of the containers, most people perceive that the smaller container is heavier than the larger container. Of course, you know this is wrong because you filled them with equal amounts of sand.

The key to experiencing the illusion depends on seeing the difference in the size of the containers. After many years of experiencing objects of different sizes, we have come to the general conclusion that bigger objects are heavier than smaller objects. The visual difference between the sizes of the two containers has set up, or biased, our motor system to expect something that we have previously experienced to be true. When we pick up the two containers (which are identical in mass), the expectation is that the larger one *should be* heavier than the smaller one. When this fails to be confirmed (because they actually weigh the same), most people conclude that something unexpected is occurring and therefore they perceive, incorrectly, that the smaller object must weigh more than the larger object.

The size–weight illusion is strongest when we allow our visual system to bias our expectations. However, the work of neuroscientist Randy Flanagan and others suggests that the size–weight illusion remains strong even after subjects are told, quite explicitly, that the smaller and larger objects weigh exactly the same. And more surprising, their research revealed that the perceptual illusion remained as strong after 20 lifts of the two equally weighted objects: repeatedly lifting the two objects fails to bring perception any closer to the truth. However, there is one special finding to note about their research: the hands quickly adjusted to the illusion by changing their grip. Initially, the subjects were using a stronger grip force with the smaller

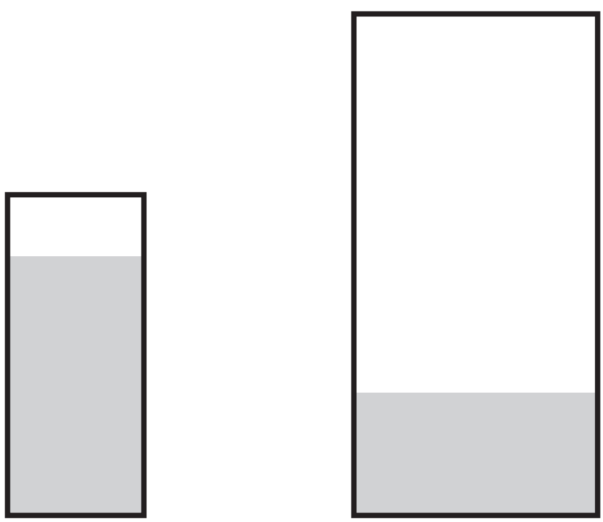

Figure 1.2 The size–weight illusion. Which of these two containers is heavier? When filled with equal amounts of mass (e.g., sand) so that they weigh exactly the same, the smaller container will feel heavier than the larger container.

object than they used with the larger object, consistent with what the visual system "told" the hand to do. However, after just a few trials, the subjects were using equivalent grip forces to lift the two containers. In other words, the motor system adjusted quickly to the reality that the objects were equal in weight even though the subjects' perception continued to be fooled by the visual illusion.

The size–weight illusion tells us something very interesting about the interaction of our visual, motor, and cognitive systems. One suggestion is that we tend to believe our eyes more than our limbs. But perhaps what is more interesting about visual illusions is that our conscious perception of reality can be tricked more easily than our actions.

These illusions reveal that vision dominates what we see and feel, distorting our sense of reality. So, what about our other senses, such as hearing—does vision bias what we hear as well? Researchers who study the McGurk effect suggest so. Initially investigated by Harry McGurk and his colleague John MacDonald, subjects in their study viewed close-up films of a woman's head as she uttered a single-syllable word. The movements of her lips clearly showed her saying the syllable "ga," but the vocal track that the subject heard was the syllable "ba." Indeed, people who watched the film without the soundtrack reported that they saw "ga," and people who listened to the auditory track without watching the video reported that they heard "ba." So, did the subjects report "ga" or "ba" when the soundtrack and video were played simultaneously? As it turns out, most people reported hearing neither of those two syllables. Instead, they reported that the woman had said "da"—an incorrect hybrid perception of what was seen and heard.

The McGurk effect is a nice illustration of the fact that our perception of reality actually results from a combination of inputs from our senses. When one of those senses gets fooled, especially when it involves vision, our combined perception is likely to be fooled as well. And the strength of these illusions indicates that our visual system will continue to fool us for a period of time after we experience reality. The magnetic hill just happens to be one of those perceptual illusions that nature provides to keep us on our toes.

Self-Directed Learning Activities

1. Define *illusion* in your own words.
2. Describe a real-life experience in which you encountered a visual illusion. What was the reality, and what were you fooled into believing?
3. Find a research article in the literature in which the effect of an illusion on visual perception is contrasted with the effect on movement accuracy. Were the effects on perception and action similar or different?
4. Design a research experiment that explores the role of actions in a different type of visual illusion (e.g., the Titchener illusion or the Ponzo illusion—for some examples, see Schmidt & Lee, 2011, figure 5.2).

NOTES

- There are a number of online videos demonstrating the McGurk effect. This one is a particularly good illustration:

  www.tinyurl.com/mcgurkeffectyoutube

SUGGESTED READINGS

Flanagan, J.R., & Beltzner, M.A. (2000). Independence of perceptual and sensorimotor predictions in the size–weight illusion. *Nature Neuroscience, 3,* 737-741.

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