Problems in the Laboratory

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Overview

- Problems in the laboratory: the things that can go wrong in designing and conducting experiments.
- It's a specific kind of problems – those that put the validity of results in question.
- Laboratory can be any place where you conduct empirical research.

- Observation
- Selection of subjects and stimuli
- Subject-experimenter effects
- Concluding remarks

Observation

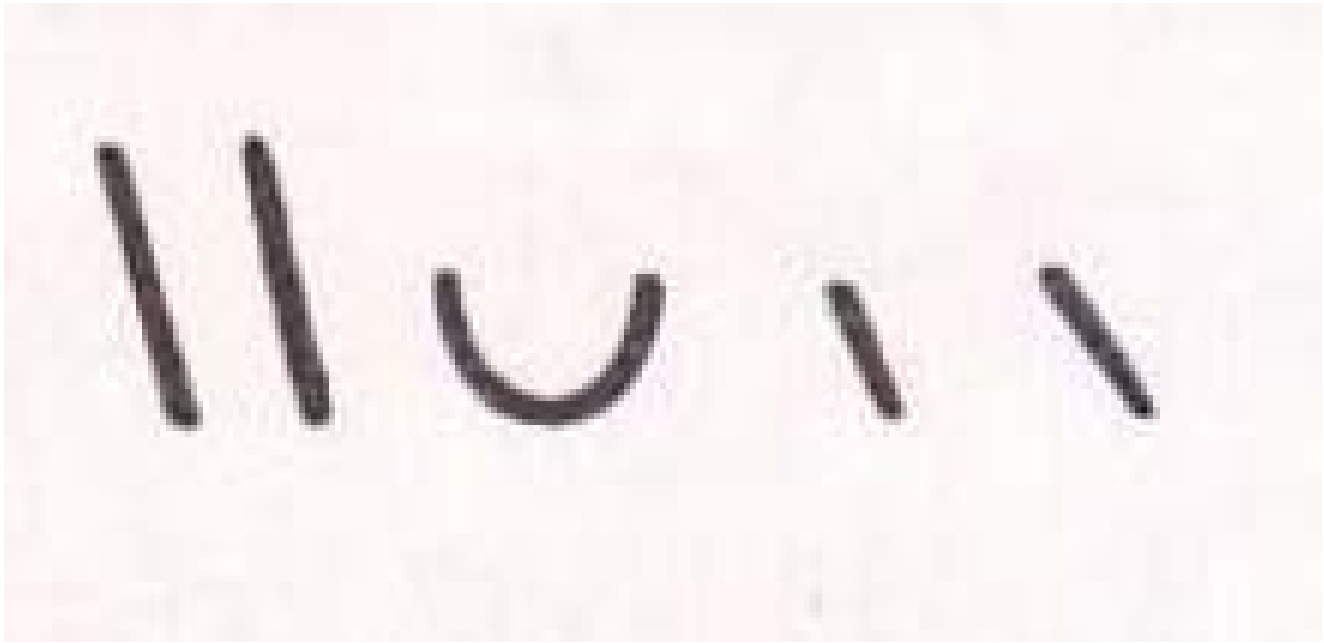
How can we be sure that what we see is what is really happening?

Sometimes we are laughing about those silly people who thought that the Sun turned around Earth.

We are not in a much better position with respect to many things and people may laugh about us only a few hundred years from now.

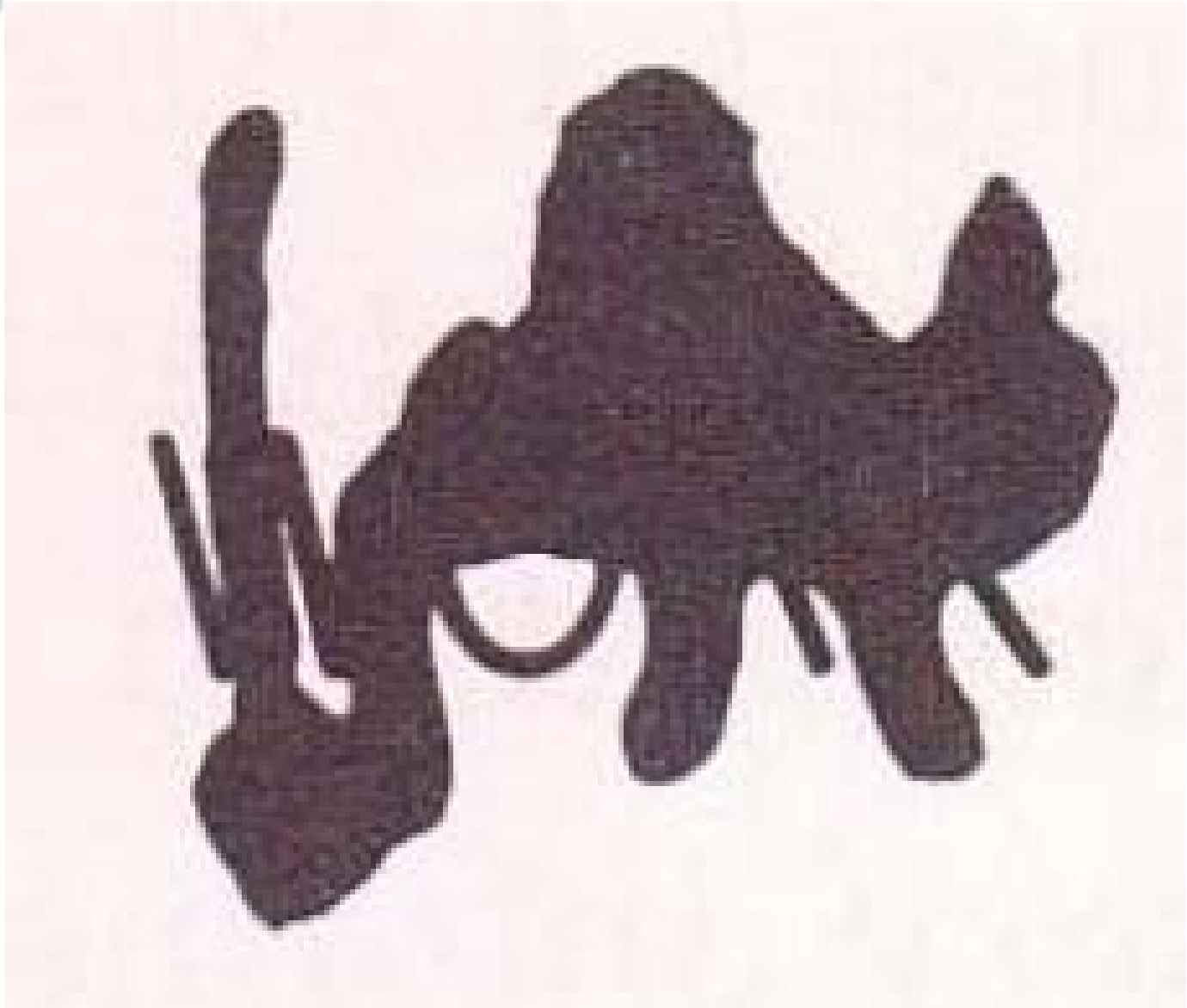
Senses: Vision

Vision



What is this?

Vision

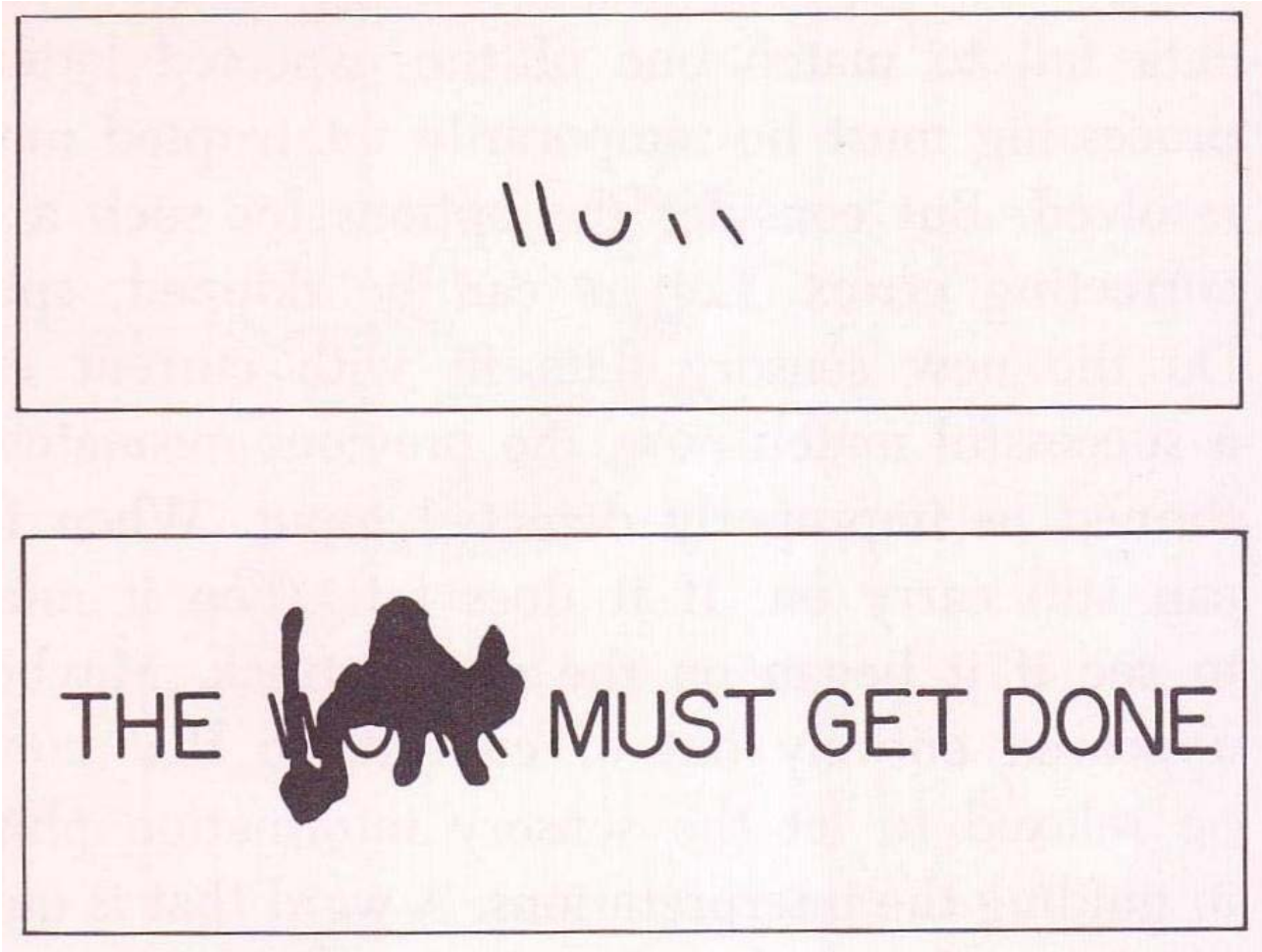


And now?

Vision

And now?

Vision



It's the same set of signals plus „noise"

Vision seems to be processed at a higher level of cognition

Vision (interactions)

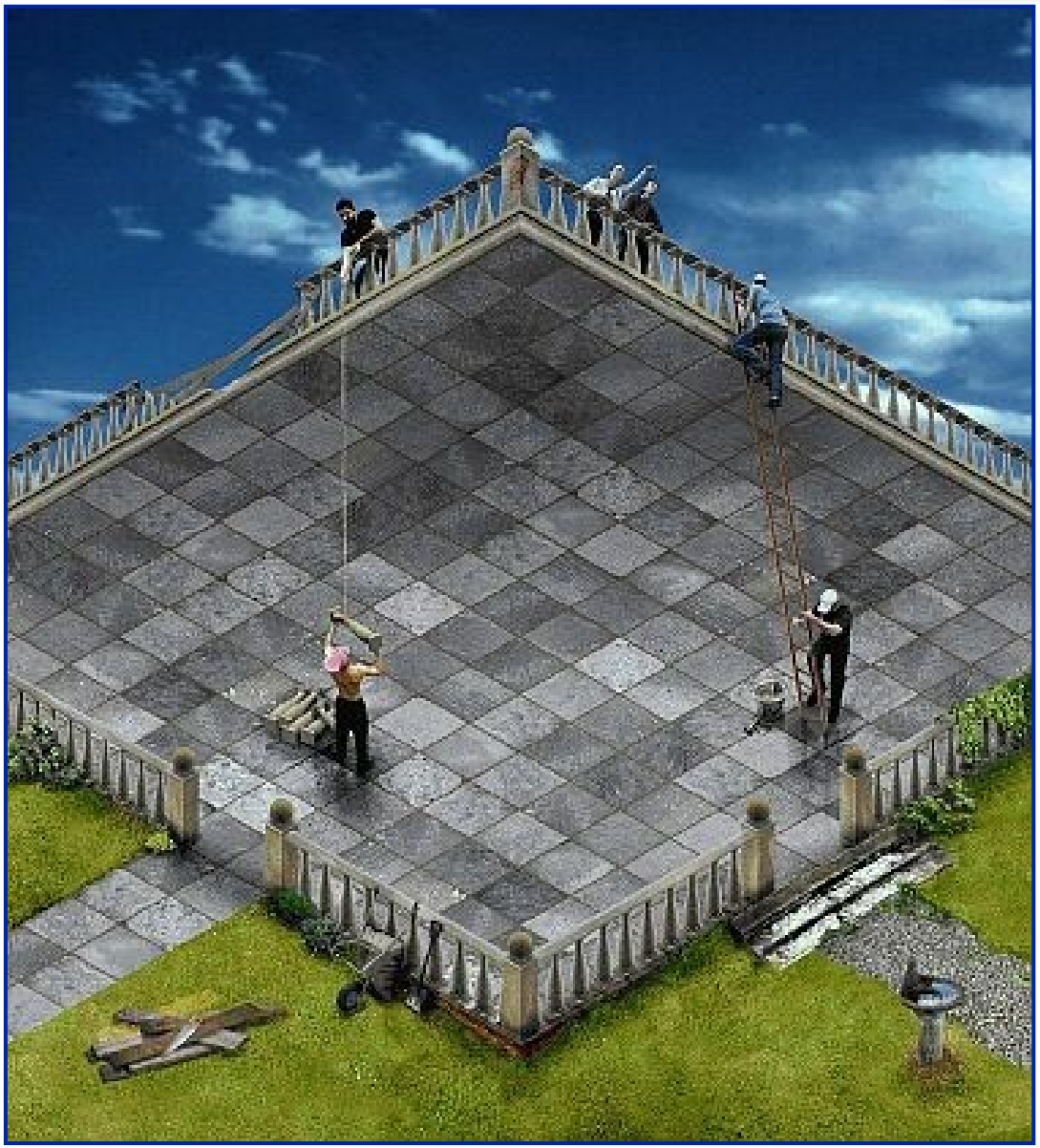
Look at the following words and say their color and not the words themselves.

YELLOW	GREEN
BLACK	RED
BLUE	PURPLE
ORANGE	BLACK
GREEN	BLUE

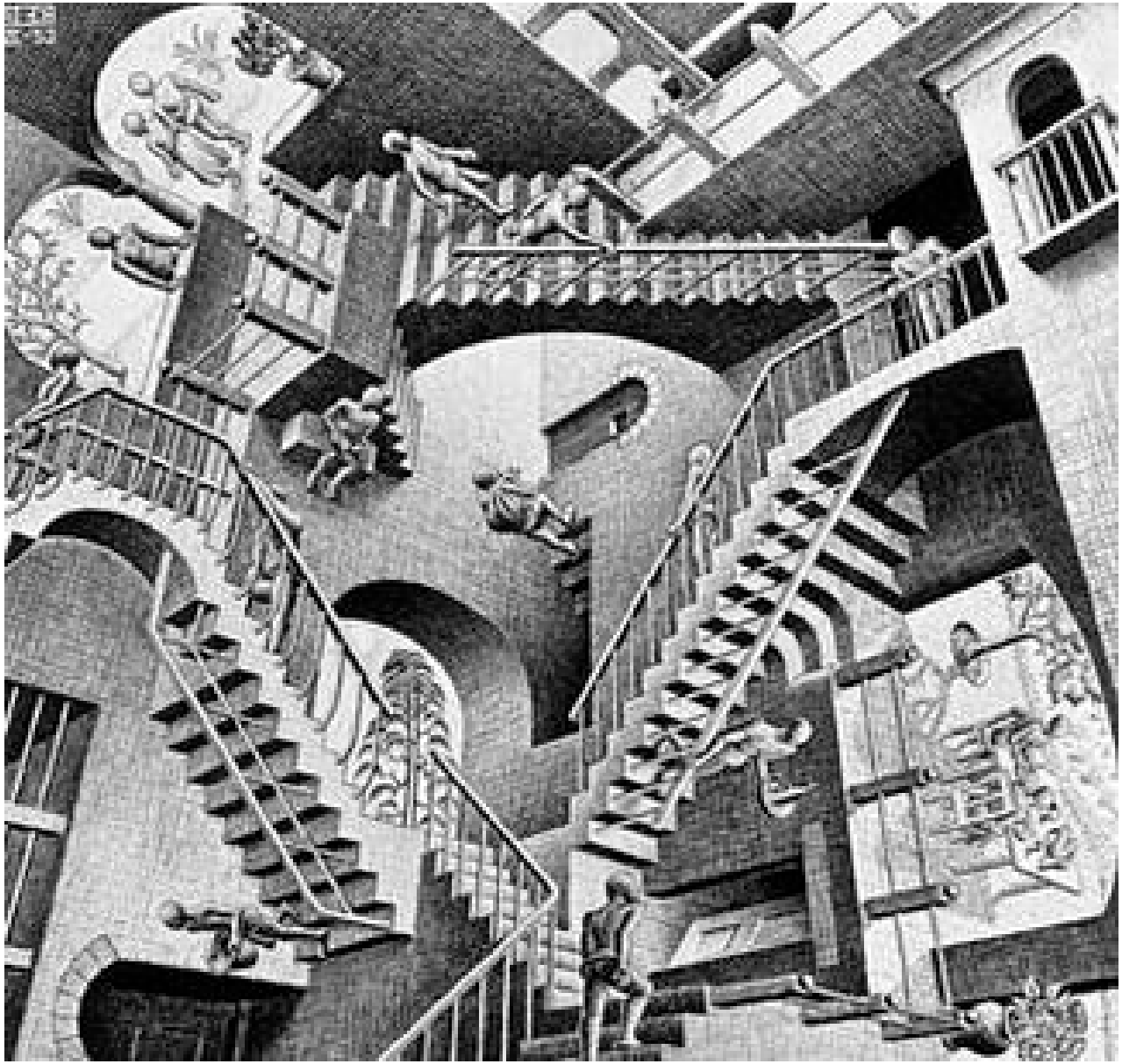
A part of our brain tries to process the colors while its another part insists on reading the words.

Perception:
Can you really trust yourself?

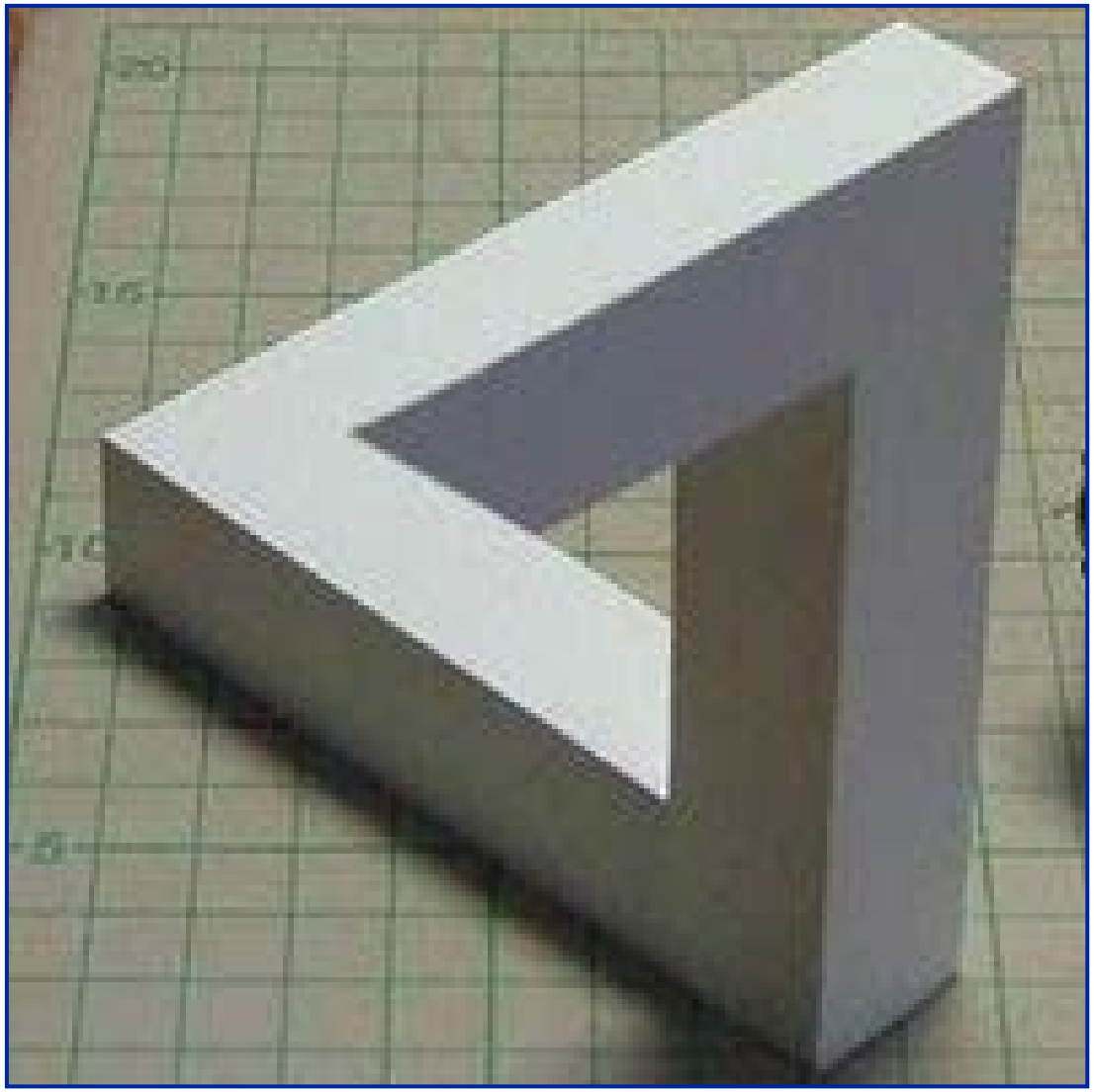
Illusions



Illusions



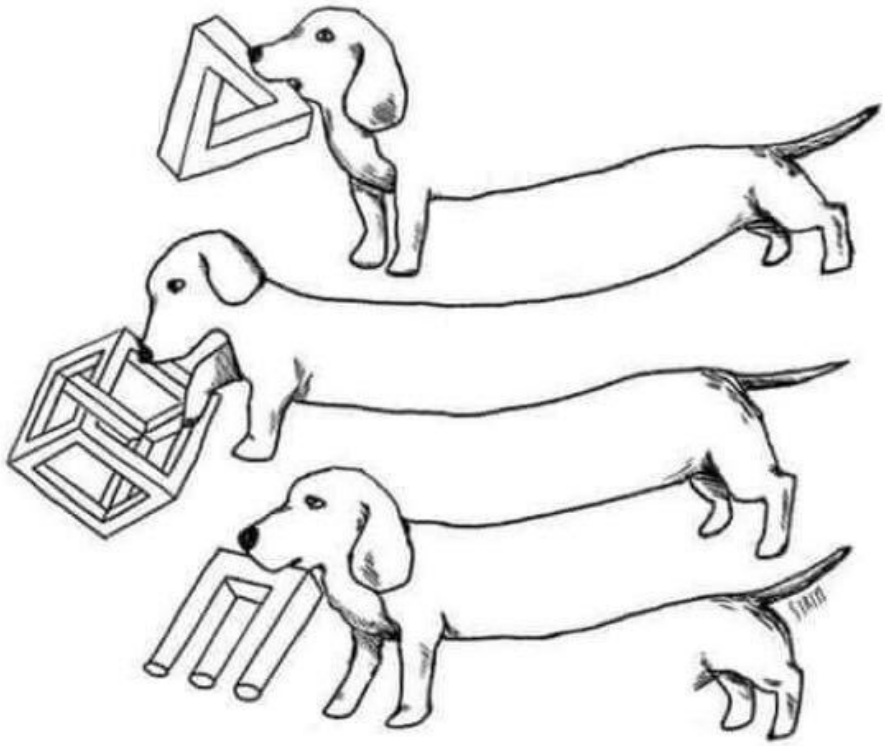
Illusions



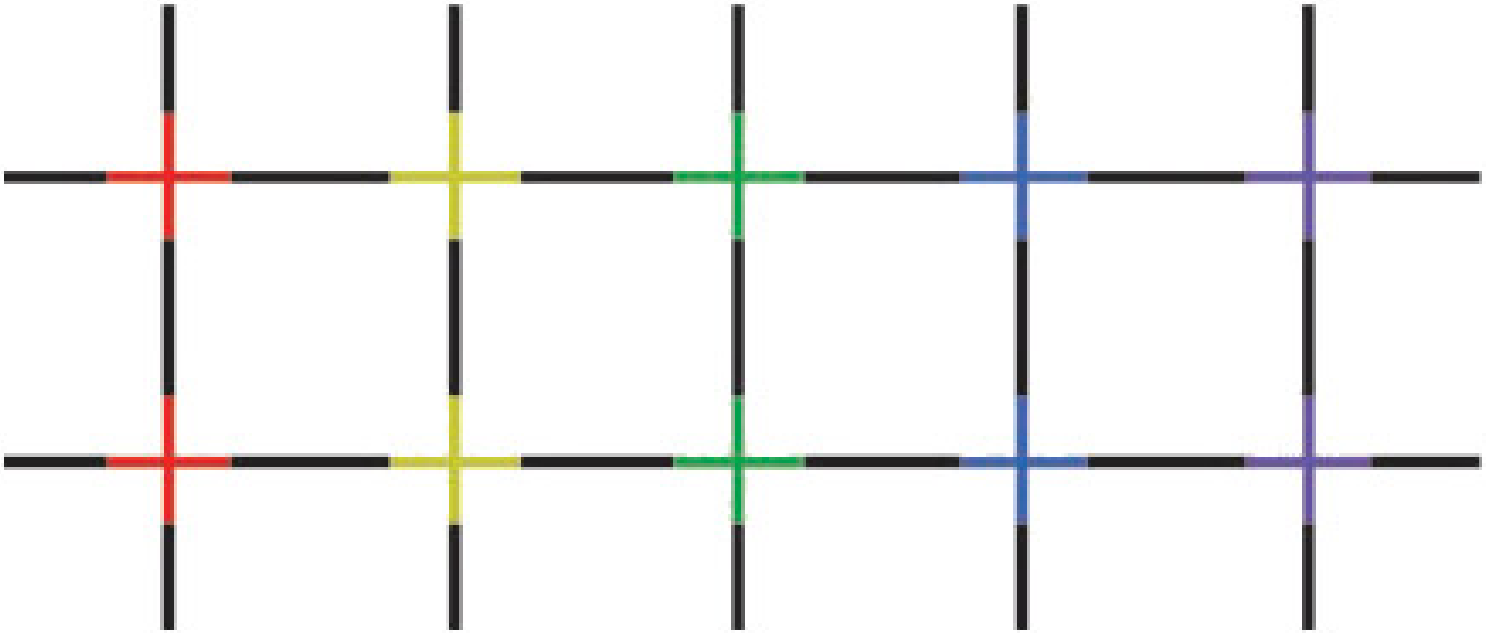
Illusions

Impossible figures, such as the famous Penrose triangle, depict 3-D objects that defy the laws of nature. Each corner of the triangle looks plausible on its own, so the brain accepts the object as a whole even though it cannot physically exist. Or can it? Artist Brian McKay created a giant version of the impossible triangle in Perth, Australia, in collaboration with architect Ahmad Abas. The illusion works only when the sculpture is photographed from one particular vantage point.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

Illusions

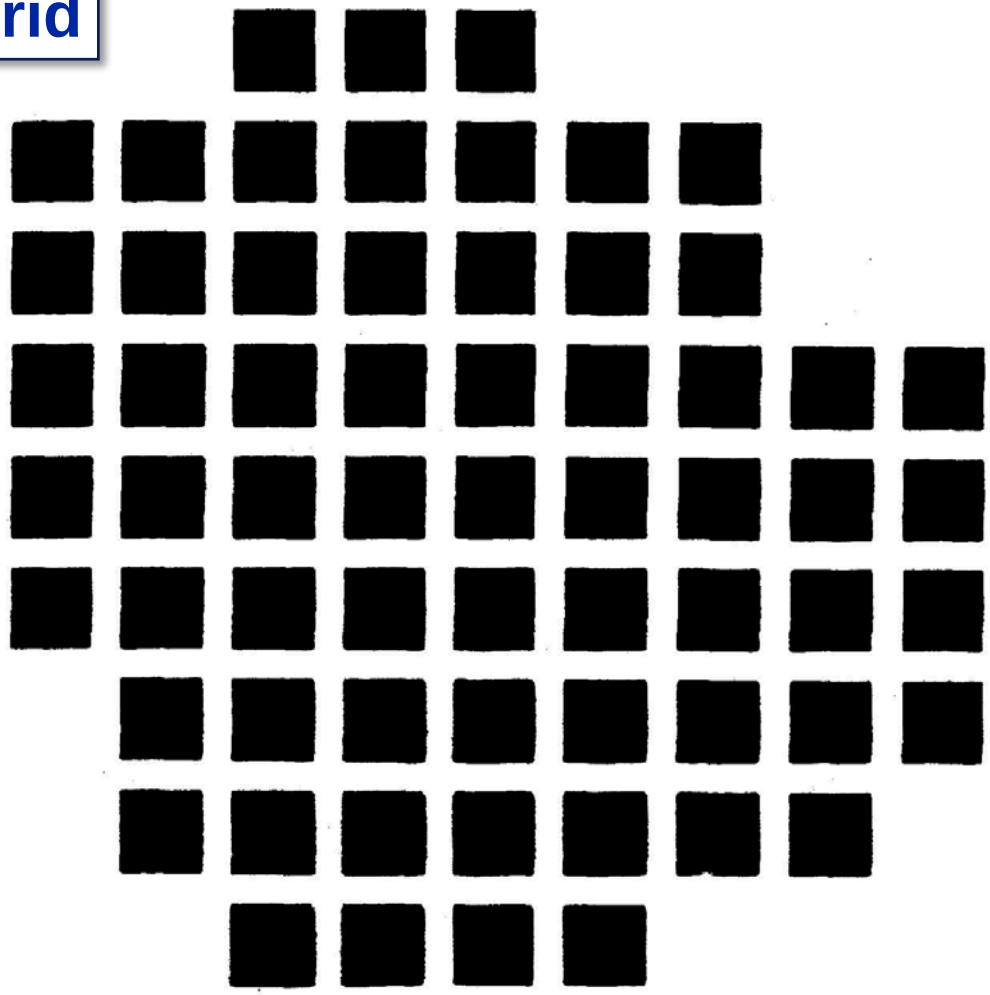


Illusions



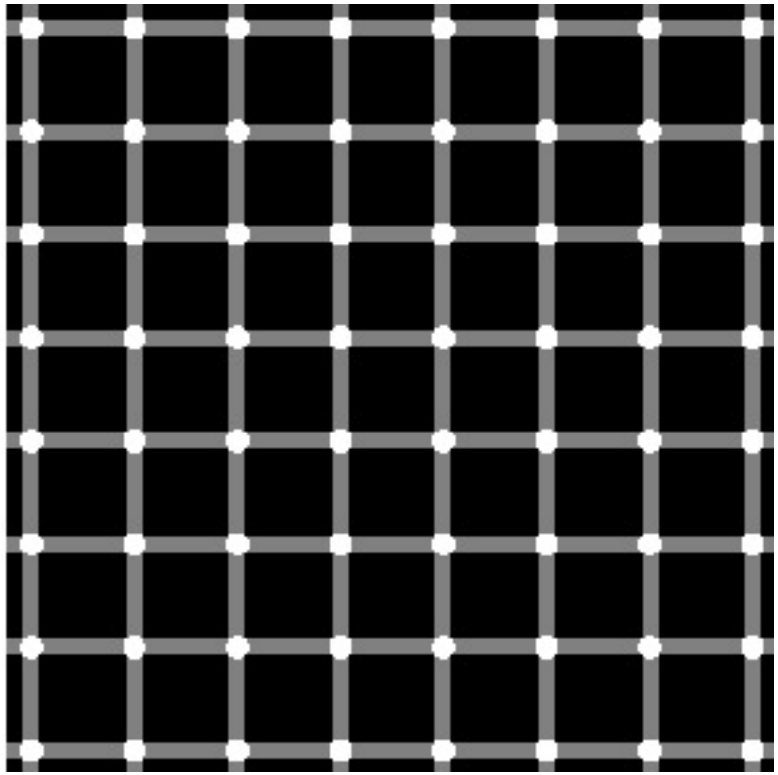
Sometimes we see colors where they do not physically exist. In this illusion, the colors of the small crosses appear to diffuse into the empty spaces surrounding each intersection. This effect is known as neon color spreading, because it resembles the glare from a neon light. It was reported in 1971 by Dario Varin of the University of Milan in Italy and independently rediscovered a few years later by Harrie van Tuijl of the University of Nijmegen in the Netherlands, but its neural causes are still unknown.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

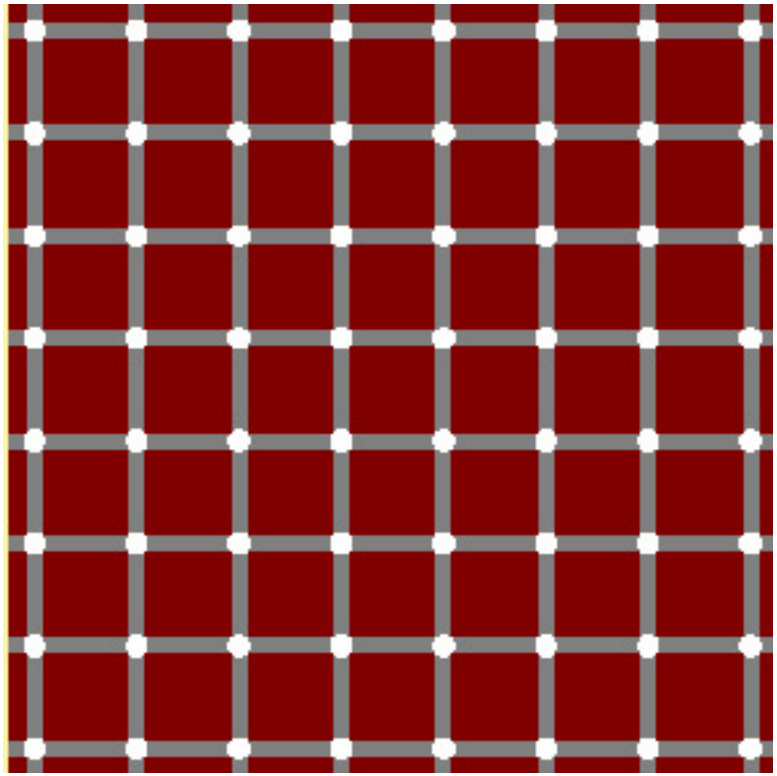
Herring grid



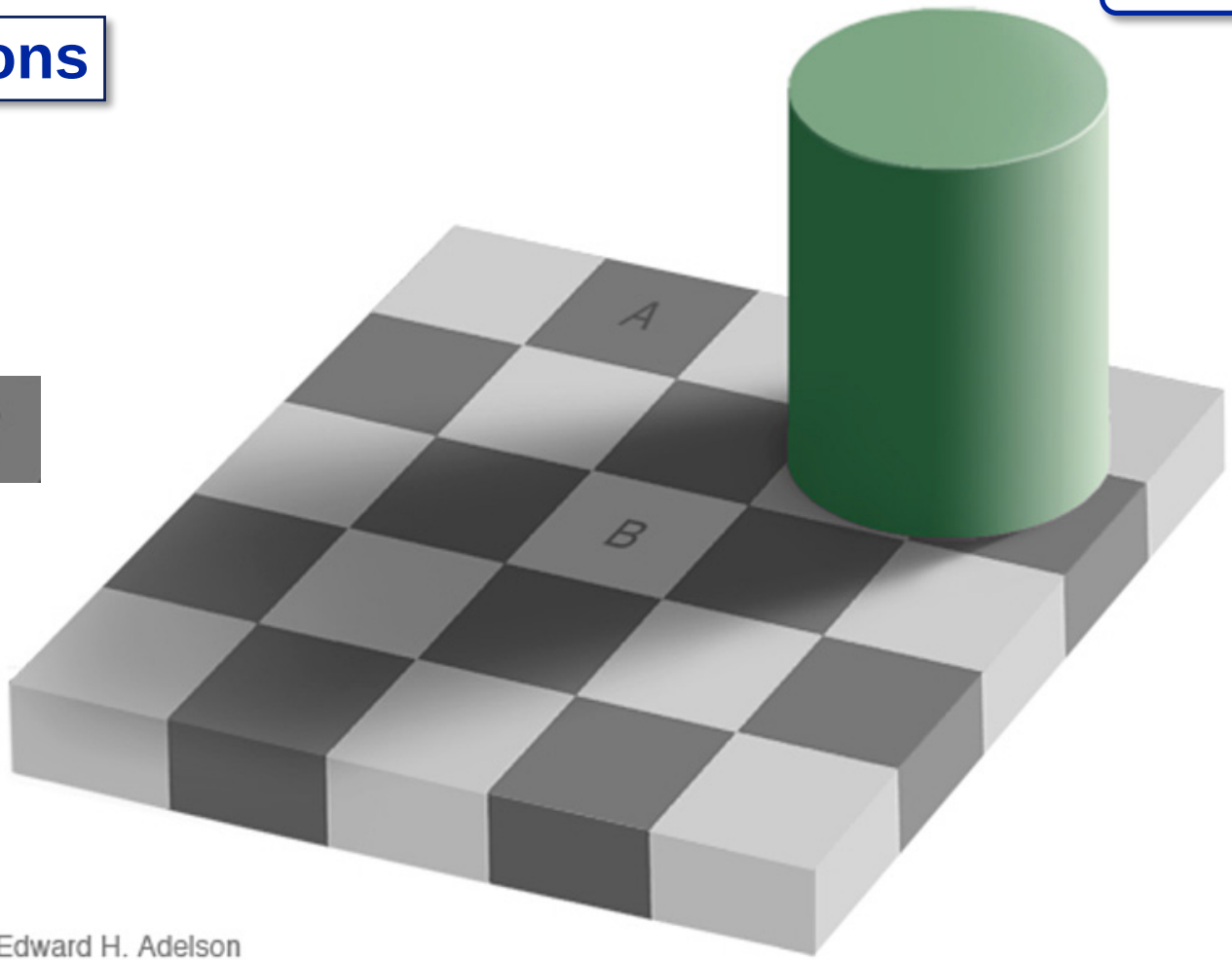
The Hering grid: Gray spots appear at each intersection, except the one you are looking at. FIGURE 1-38

Herring grid (other versions)





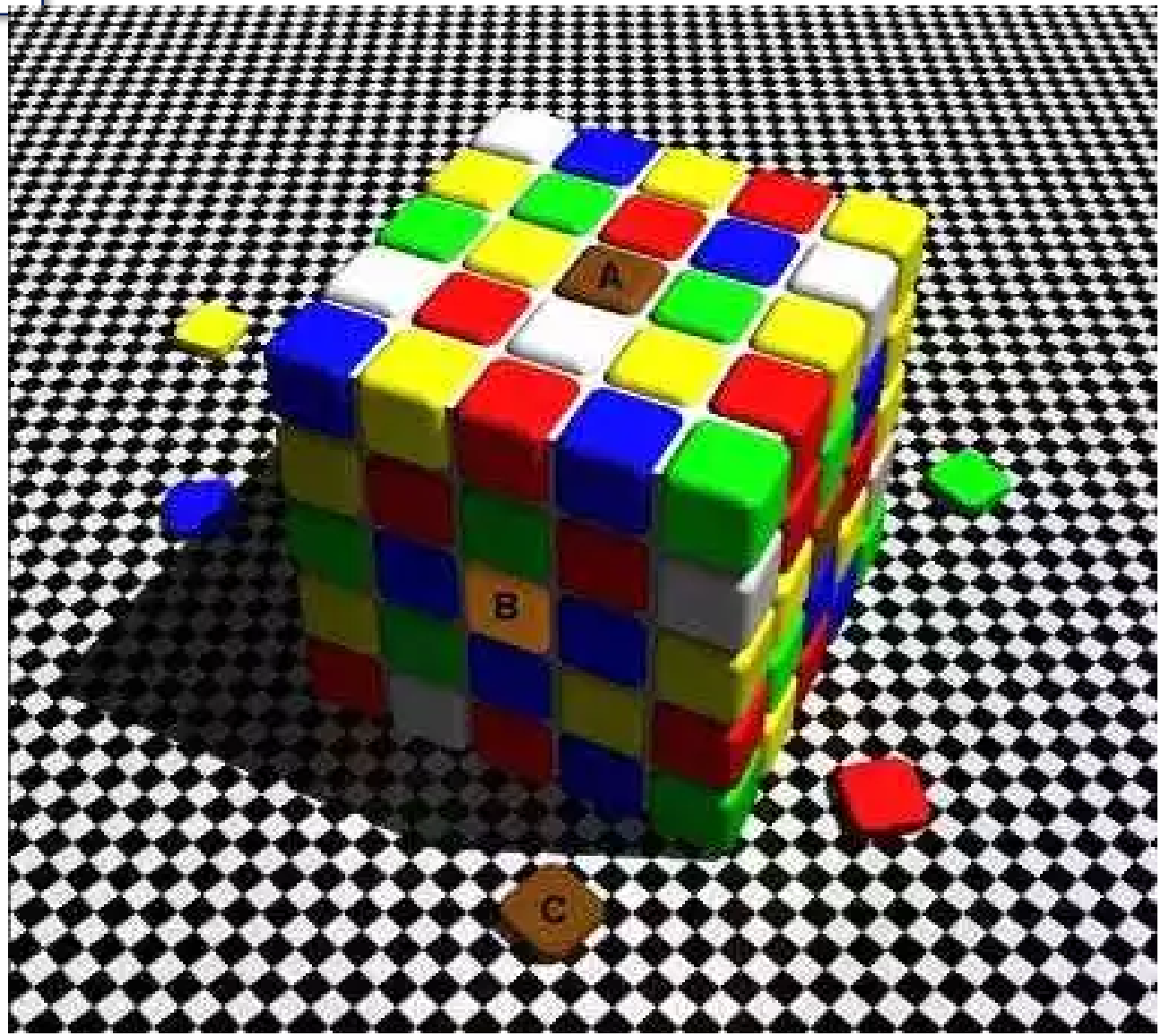
Illusions



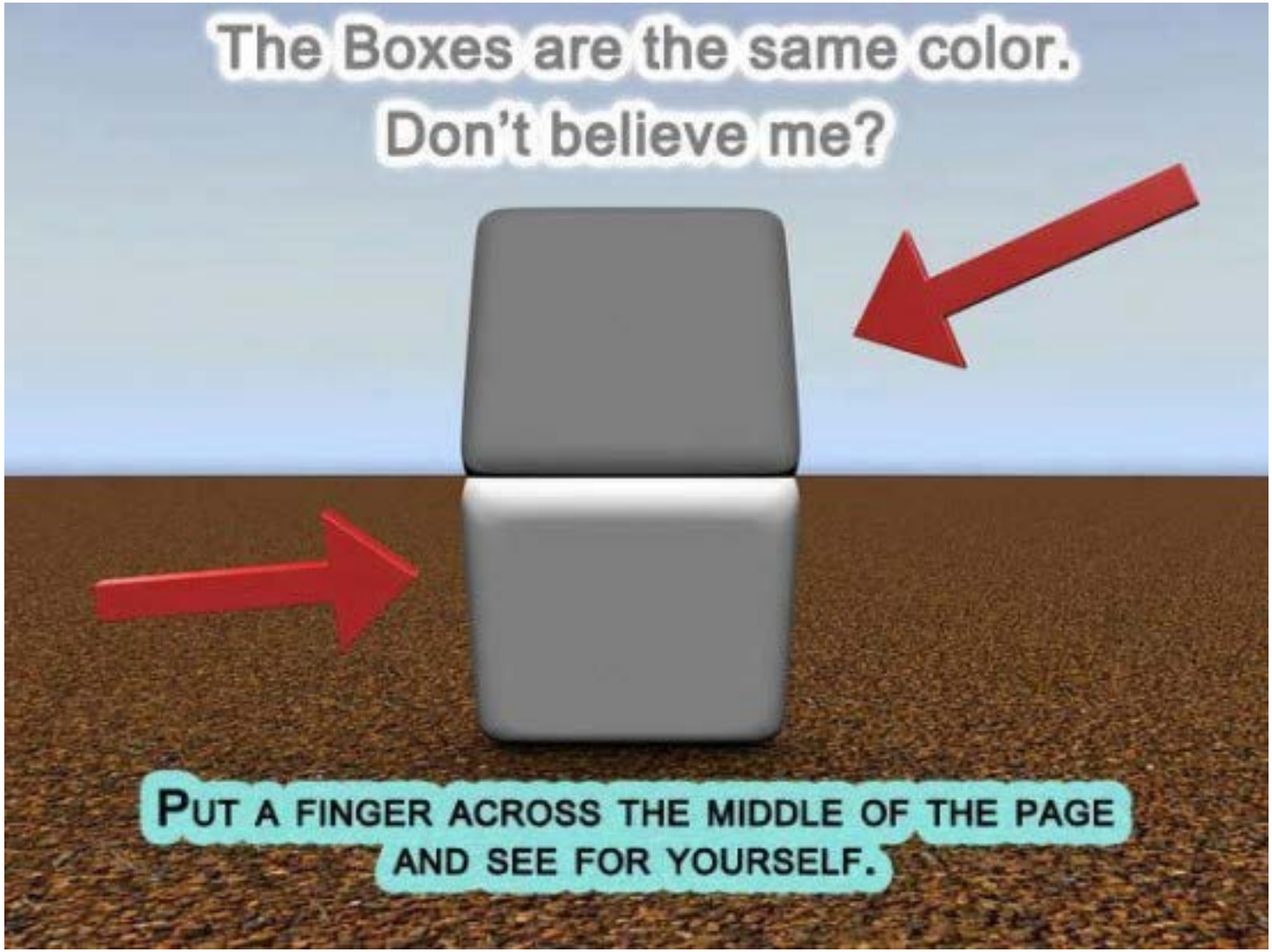
Edward H. Adelson

Brightness and color can have powerful effects on perception. In this illusion created by vision scientist Edward H. Adelson of the Massachusetts Institute of Technology, squares *A* and *B* are the same shade of gray. (If you don't believe it, print out this page, cut out the two squares and place them side by side.) Our brain does not perceive the true brightness and color of each square but instead determines the brightness and color of *A* and *B* by comparison with the squares surrounding them.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

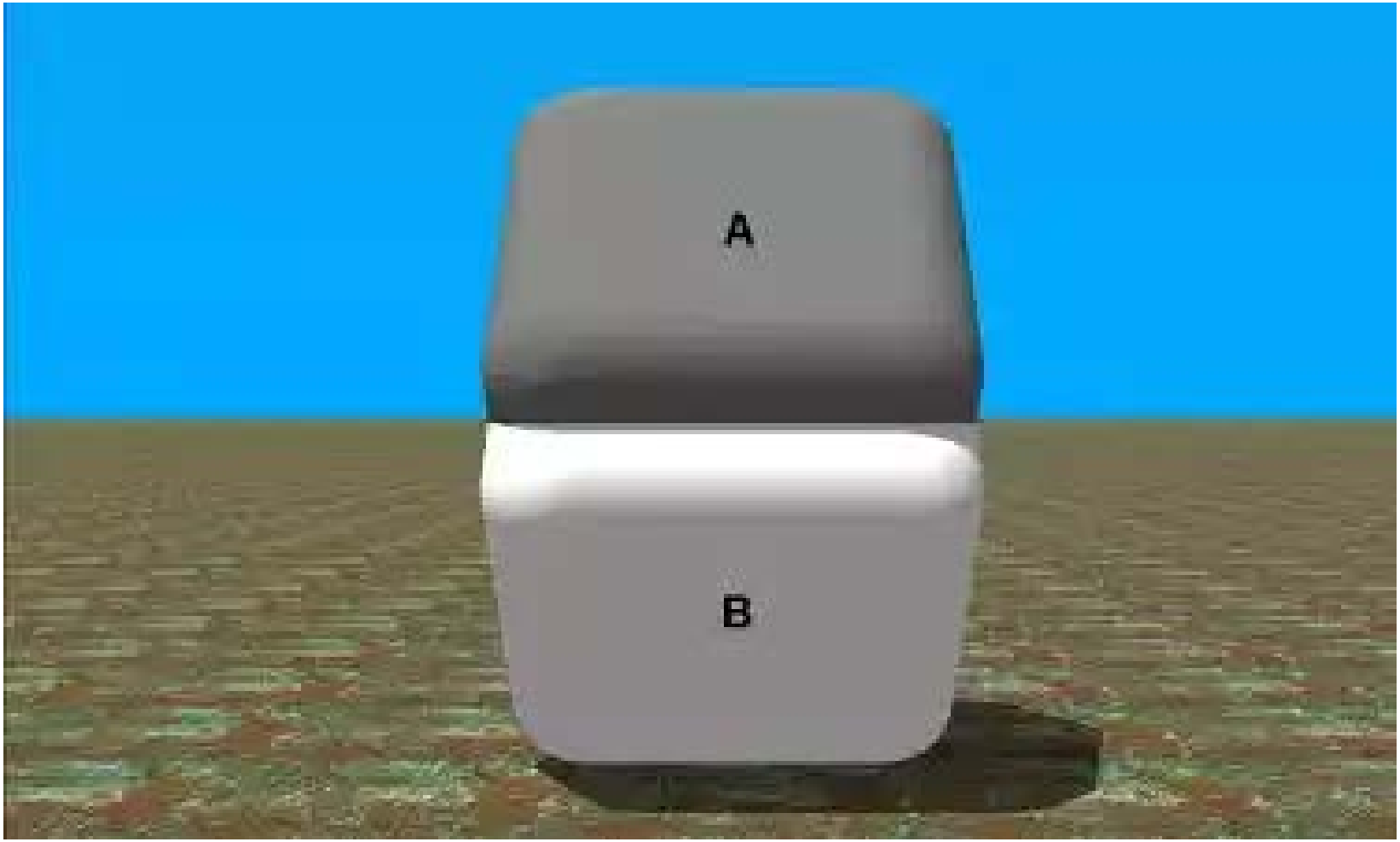
Illusions



Illusions


The Boxes are the same color.
Don't believe me?
PUT A FINGER ACROSS THE MIDDLE OF THE PAGE
AND SEE FOR YOURSELF.

Illusions

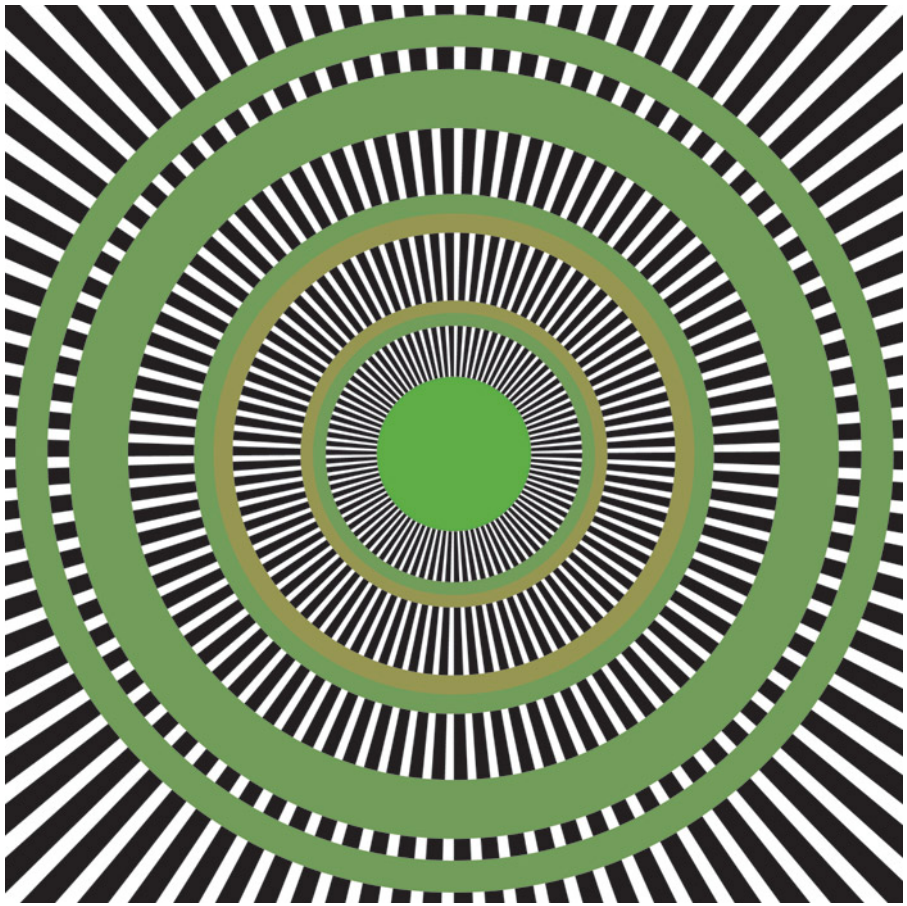


Illusions

Some people see the dress as blue and black, and some as gold and white

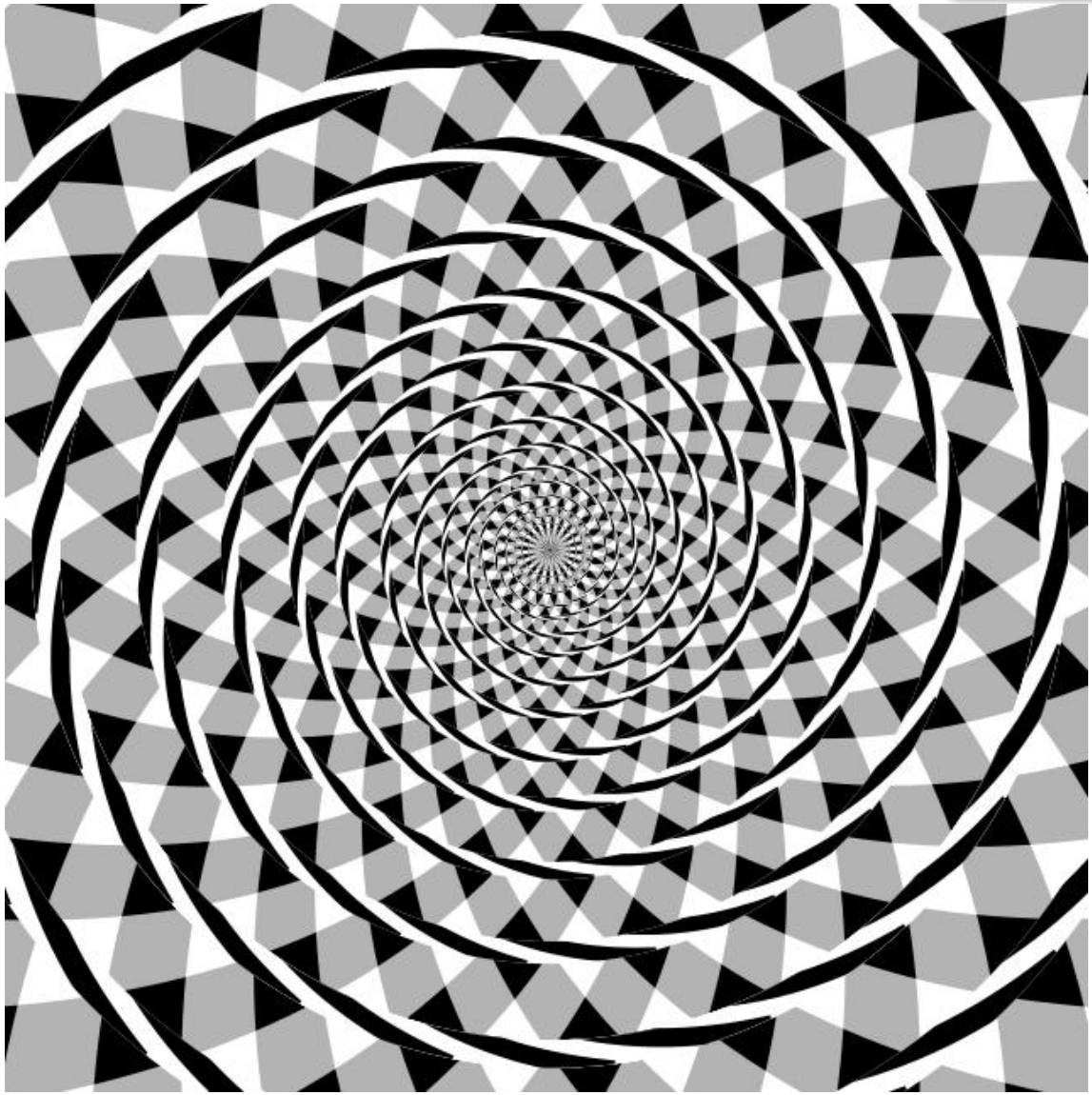
https://www.theguardian.com/technology/blog/2015/feb/27/science-thedress-colour-illusion-the-dress-blue-black-gold-white

Illusions



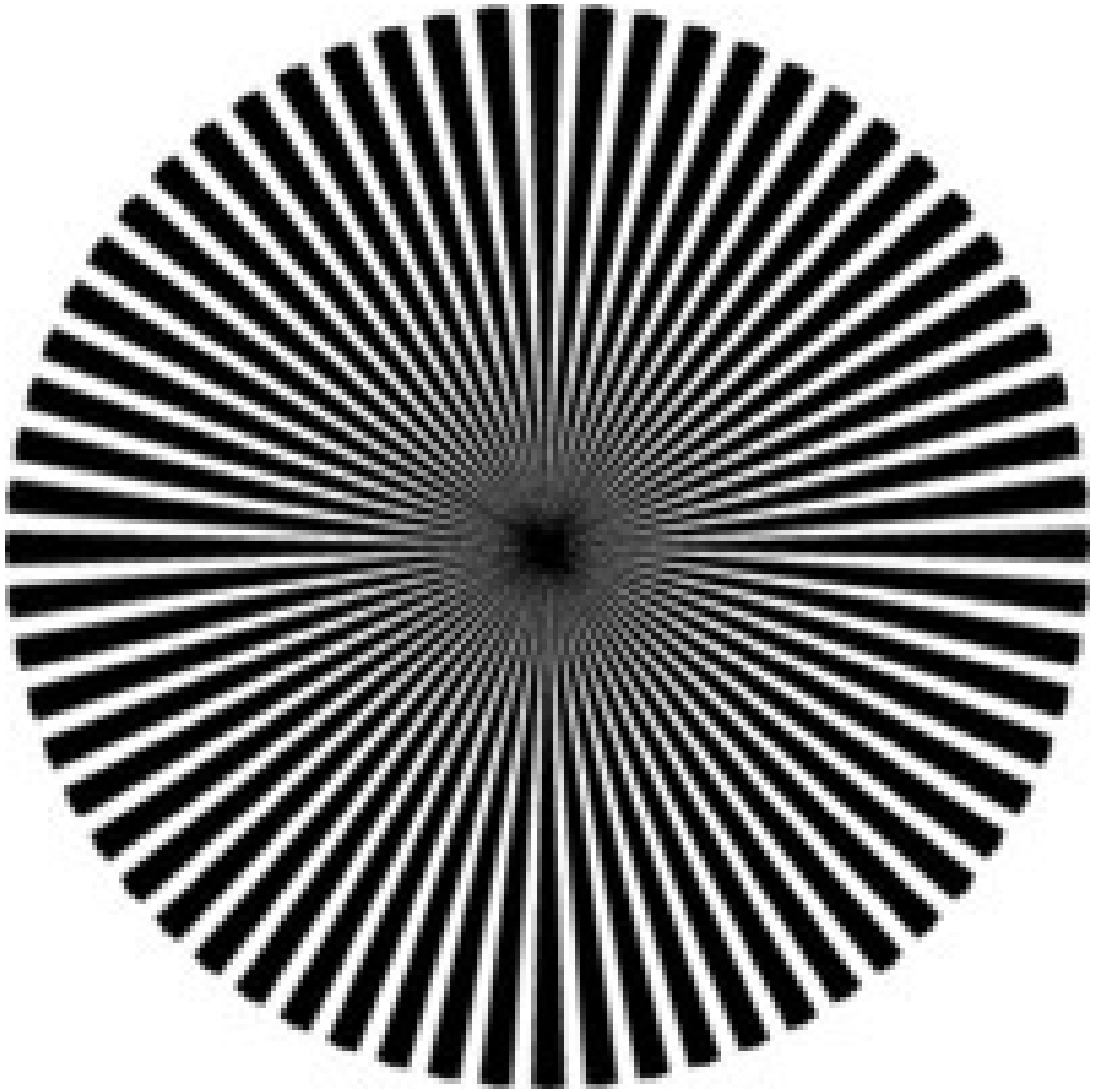
Art as Visual Research: Kinetic Illusions in Op Art
With the birth of the op art movement in the 1960s, illusions became a recognized art form. The most striking examples of op art are kinetic illusions in which stationary patterns create the perception of motion. In this reinterpretation of French op artist Isia Léviant's famous Enigma by neuroscientist and engineer Jorge Otero-Millan of the Barrow Neurological Institute in Phoenix, the concentric green rings appear to fill with rapid illusory motion, as if millions of tiny and barely visible cars were driving hell-bent for leather around a track. Small, involuntary eye movements, called microsaccades, are responsible for this illusion.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

Illusions



Is this a spiral or concentric circles?

Illusions



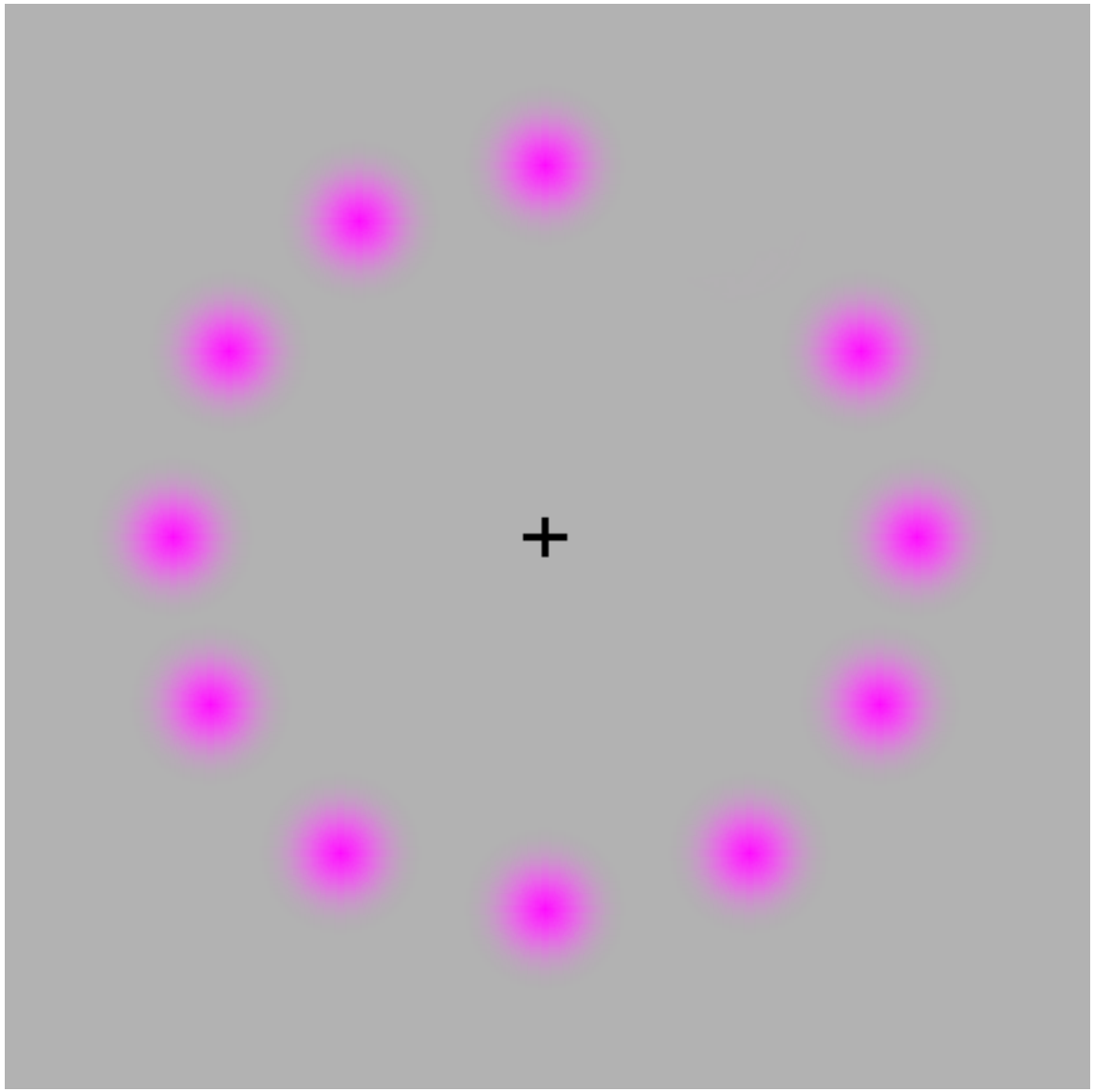
Illusions

If your eyes follow the movement of the rotating pink dot, the dots will remain only one color, pink.

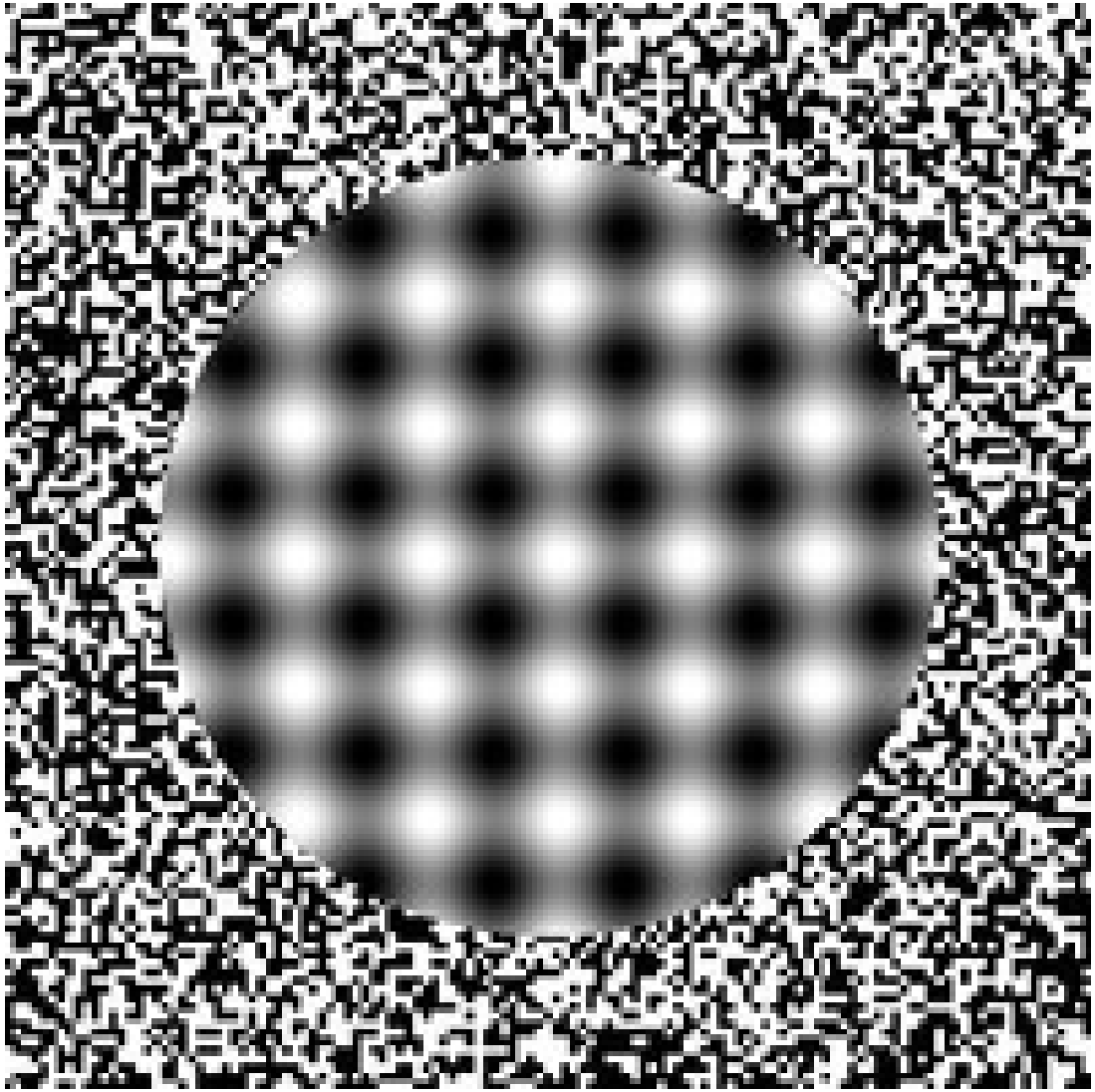
However if you stare at the black "+" in the center, the moving dot turns to green.

Now, concentrate on the black "+" in the center of the picture. After a short period, all the pink dots will slowly disappear, and you will only see only a single green dot rotating.

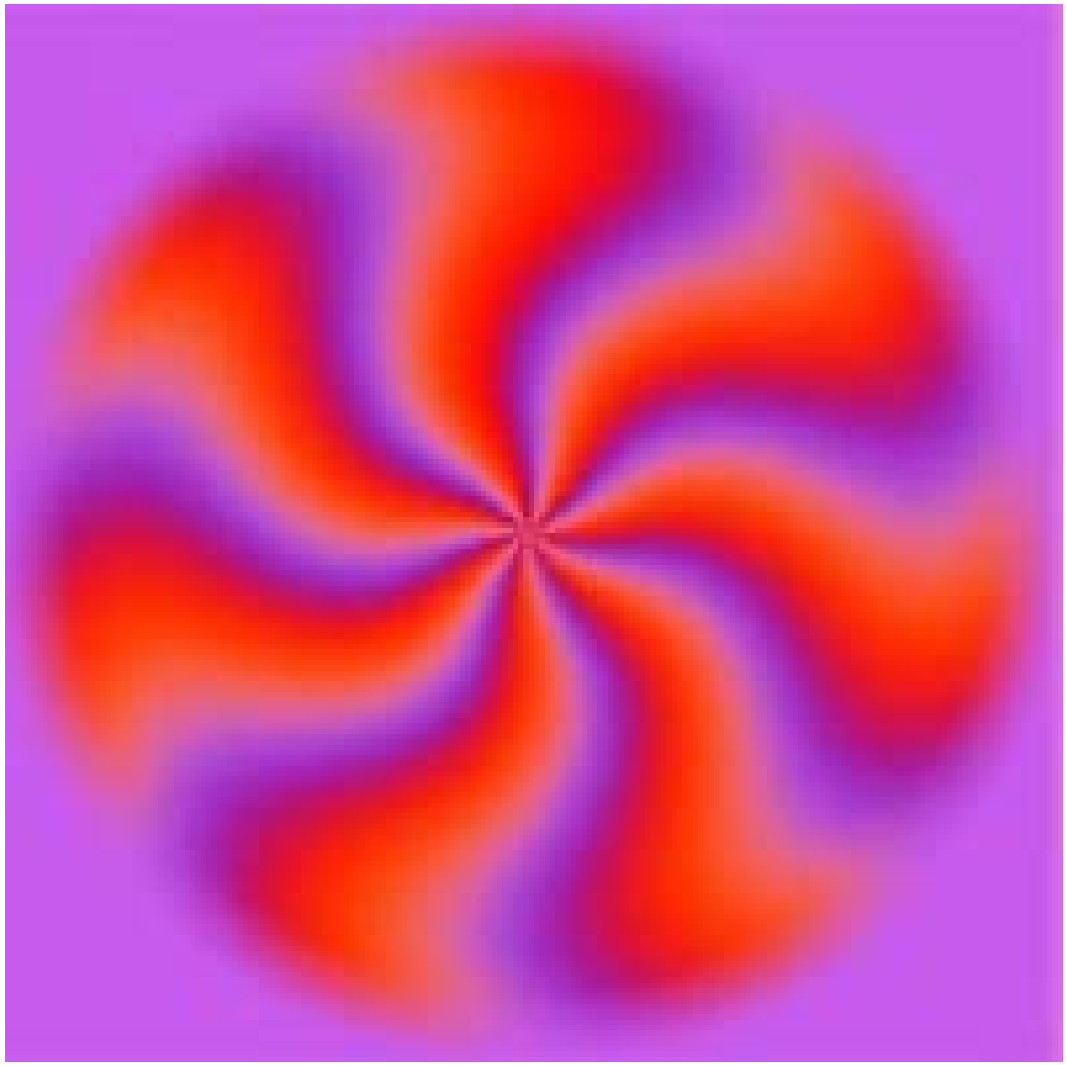
It's amazing how our brain works. There really is no green dot, and the pink ones really don't disappear. This should be proof enough, we don't always see what we think we see.



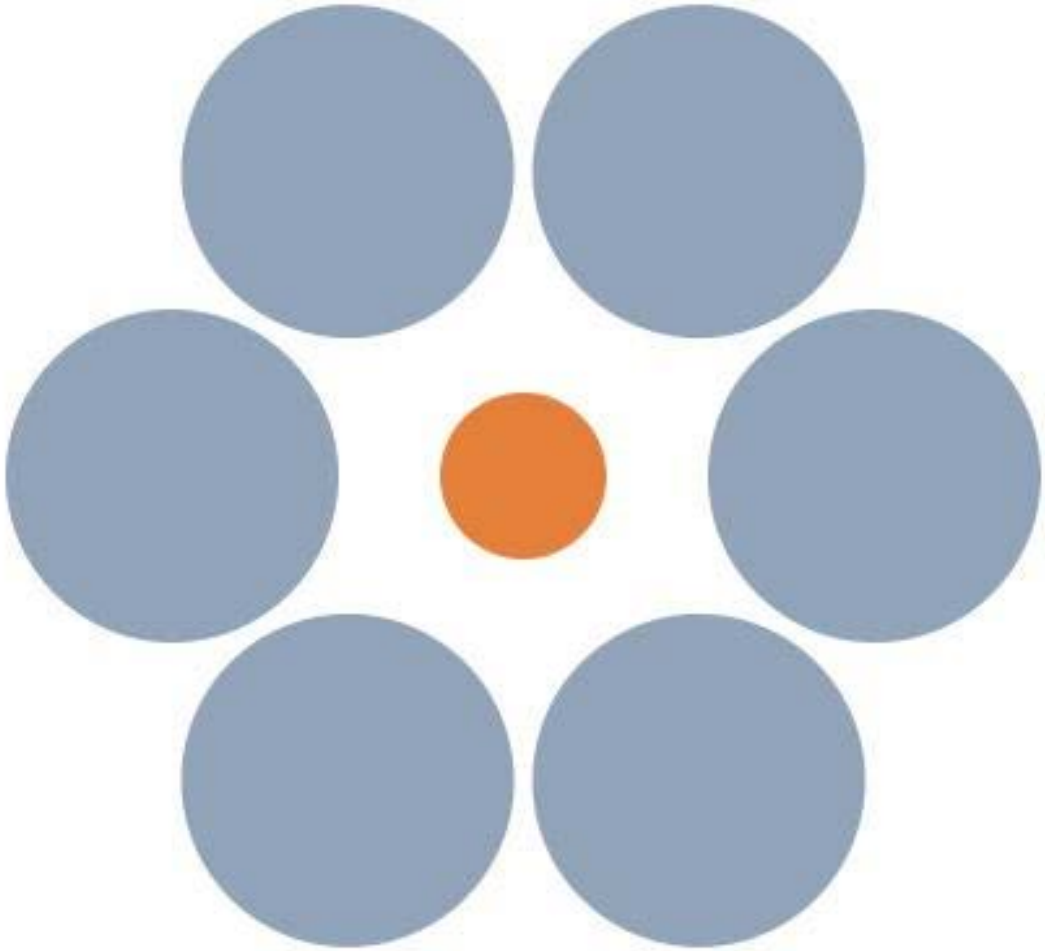
Illusions



Illusions

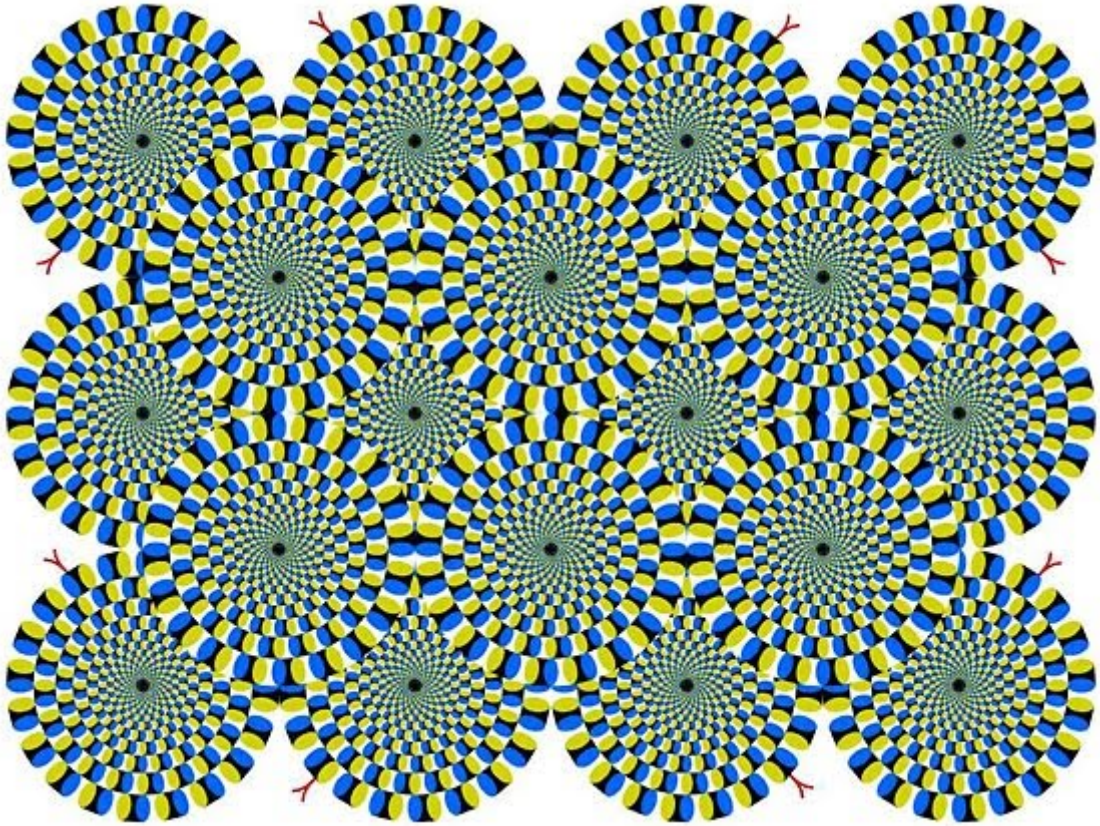


Illusions



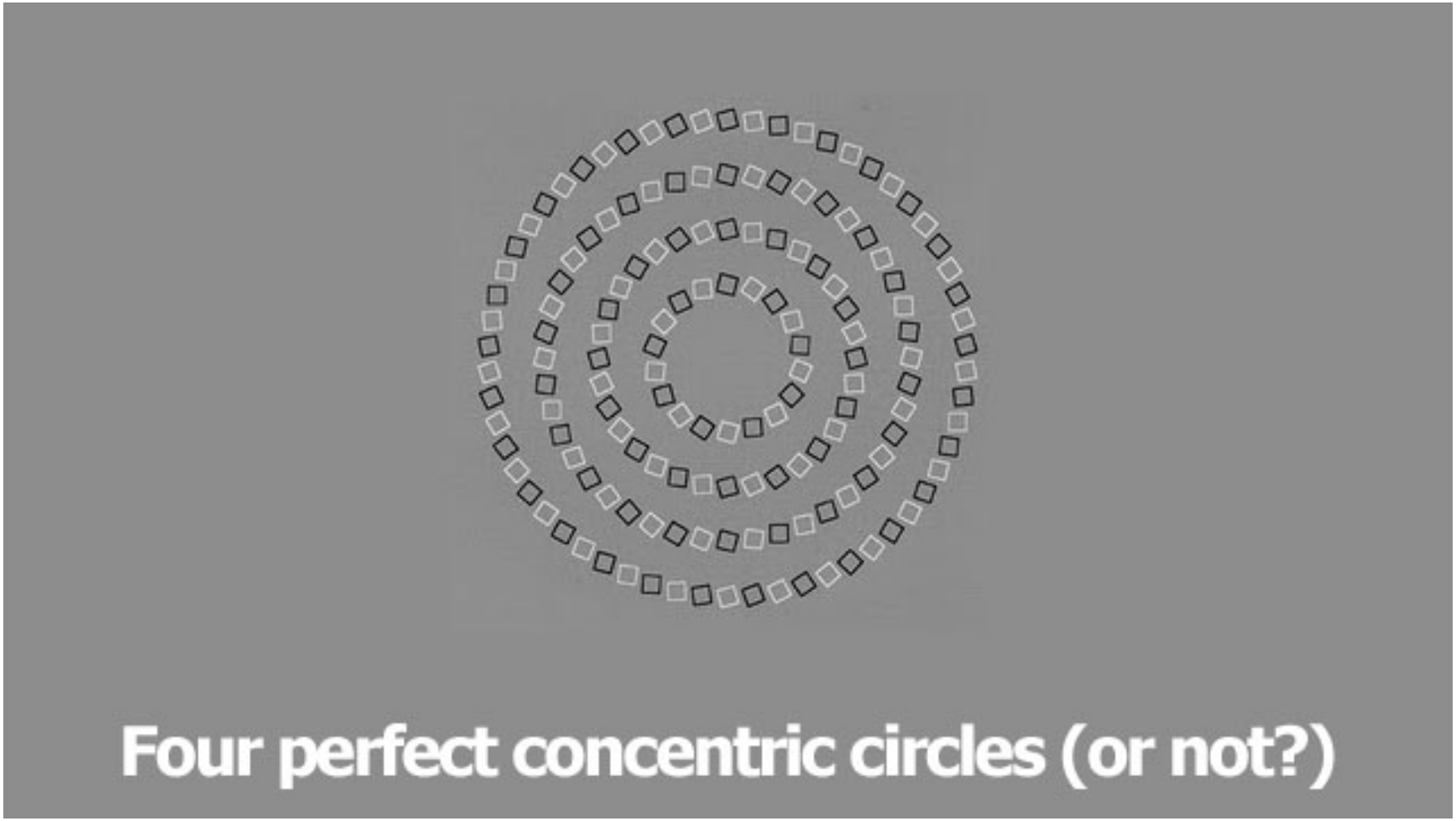
Which orange circle is bigger?

Illusions

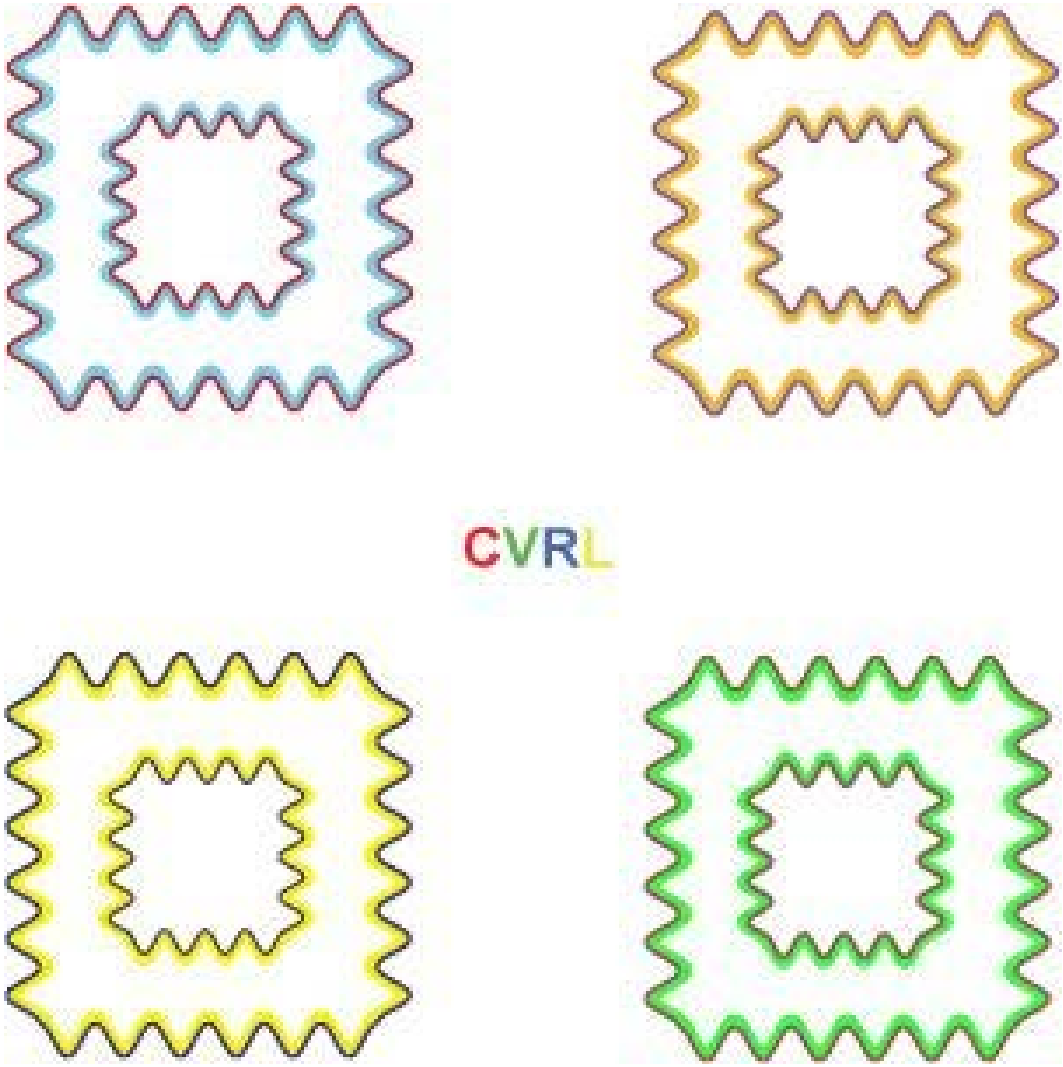


http://humancustomer.blogspot.com/2011/05/perception.html

Illusions

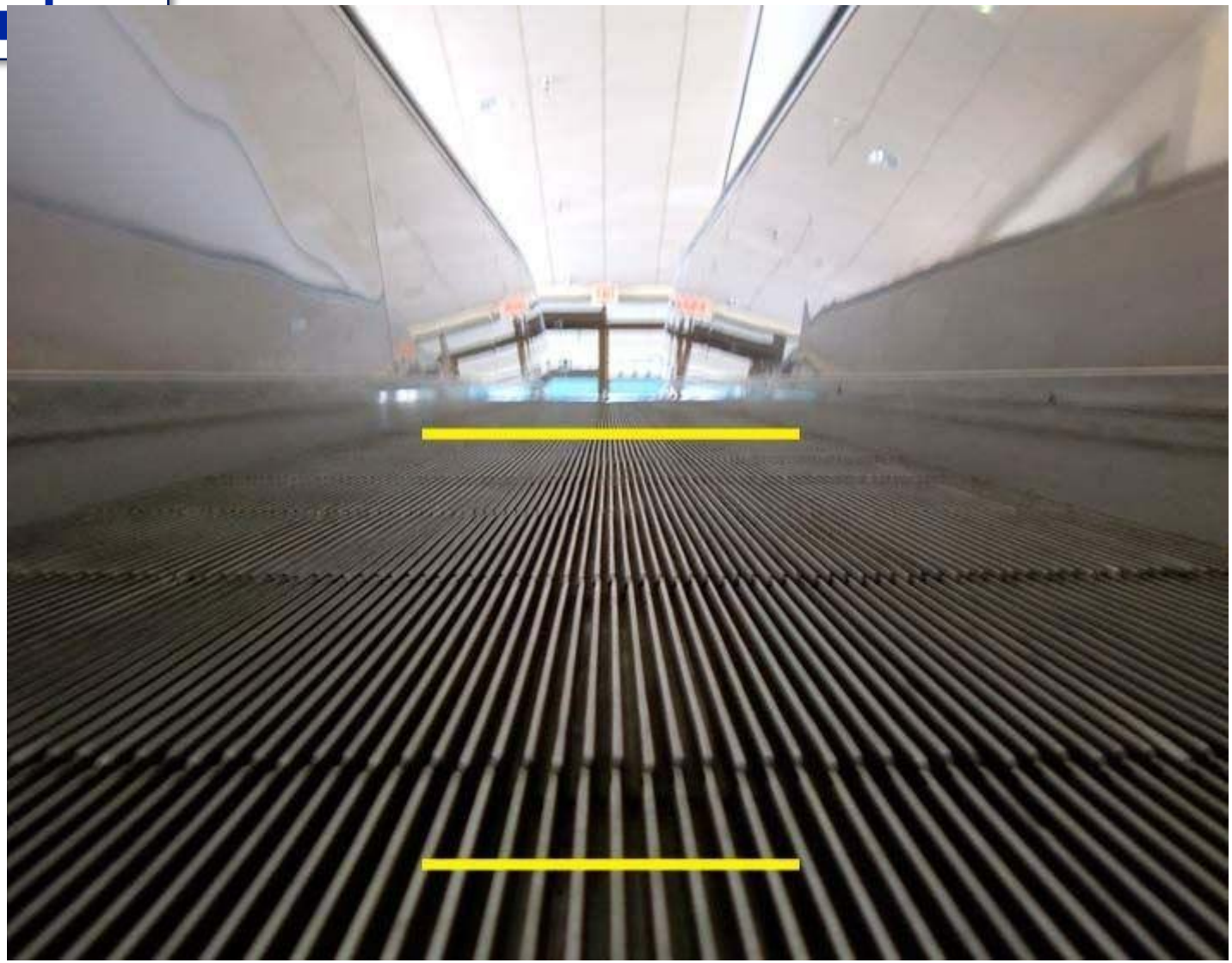


Illusions



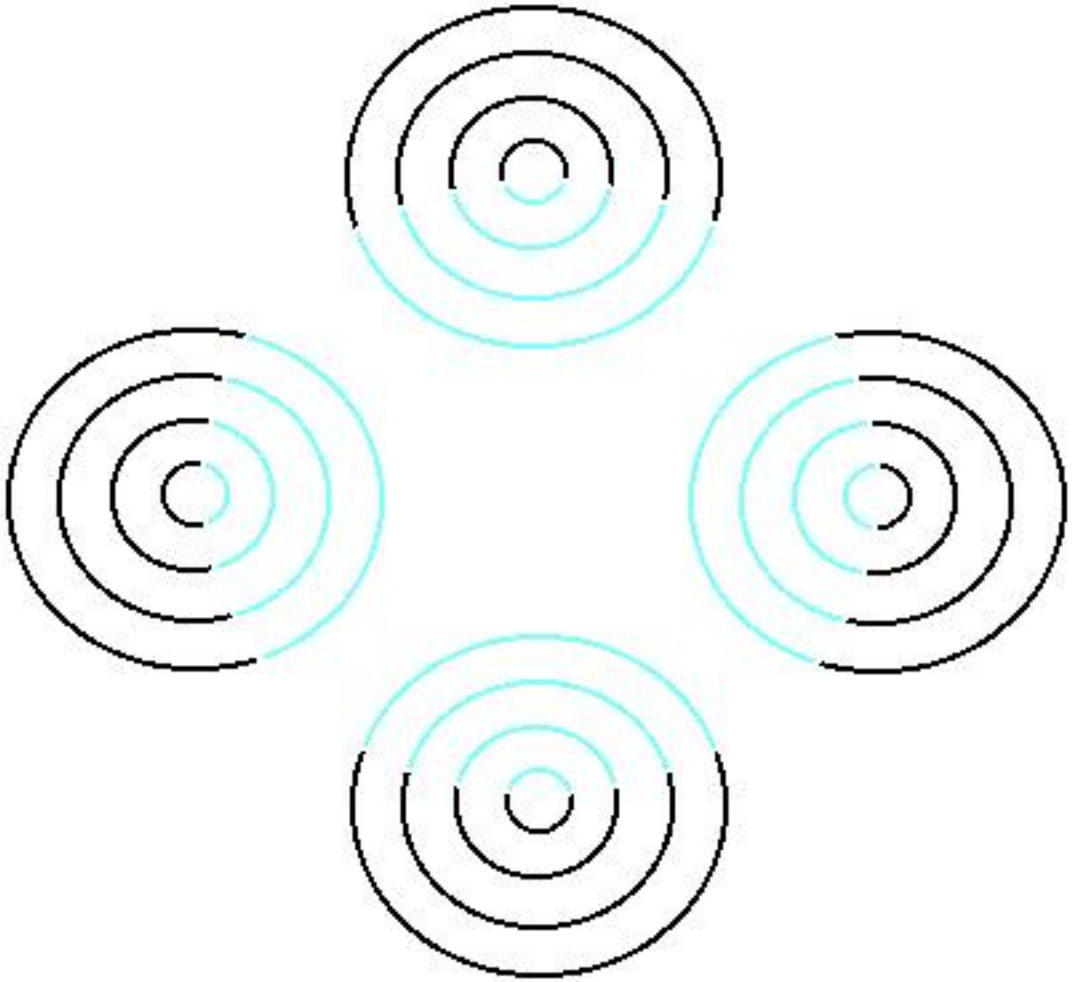
Are the insides of the figures colored?

Illu



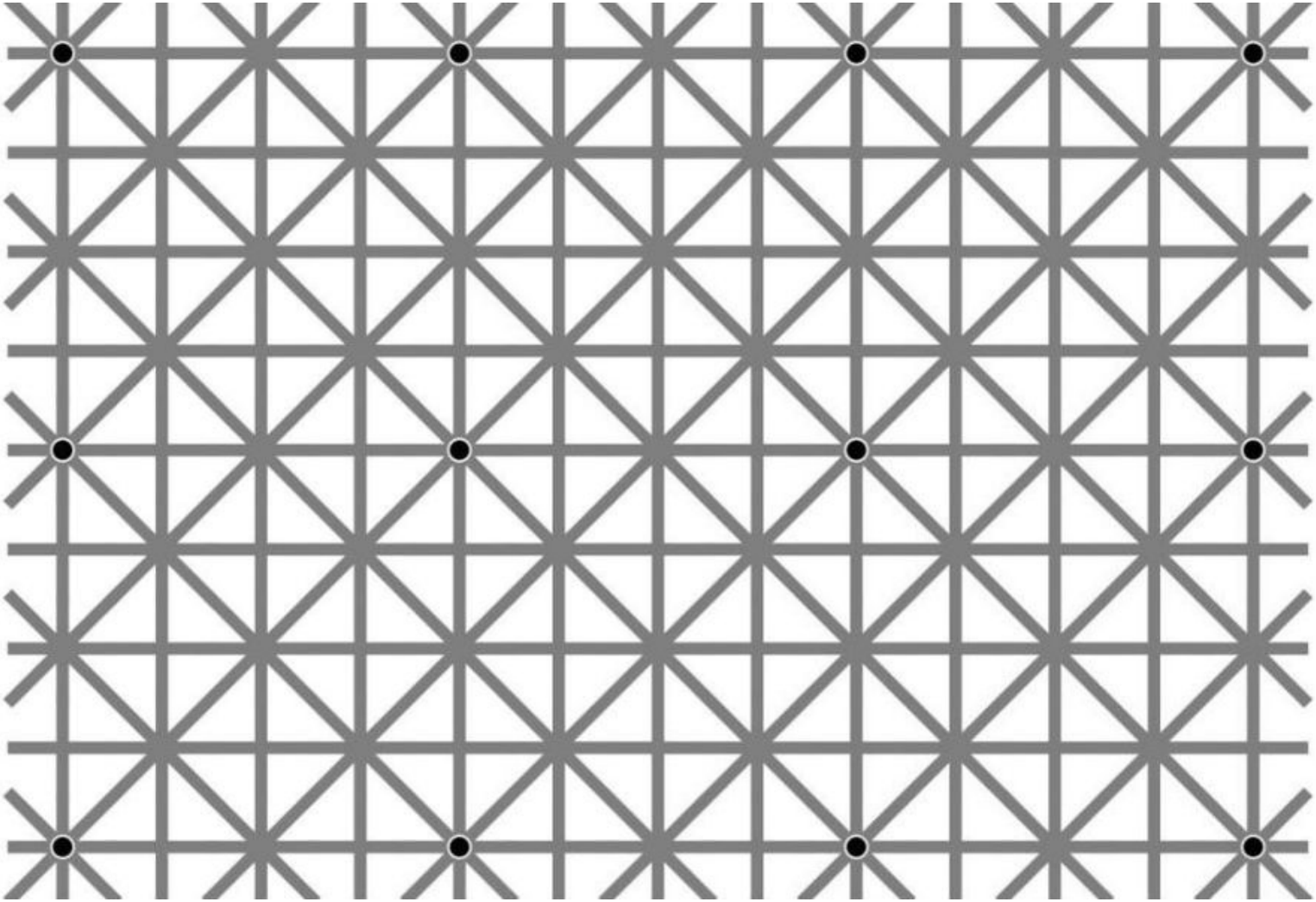
Which of the two yellow lines is longer?

Illusions



Can you see the large green circle?

Illusions

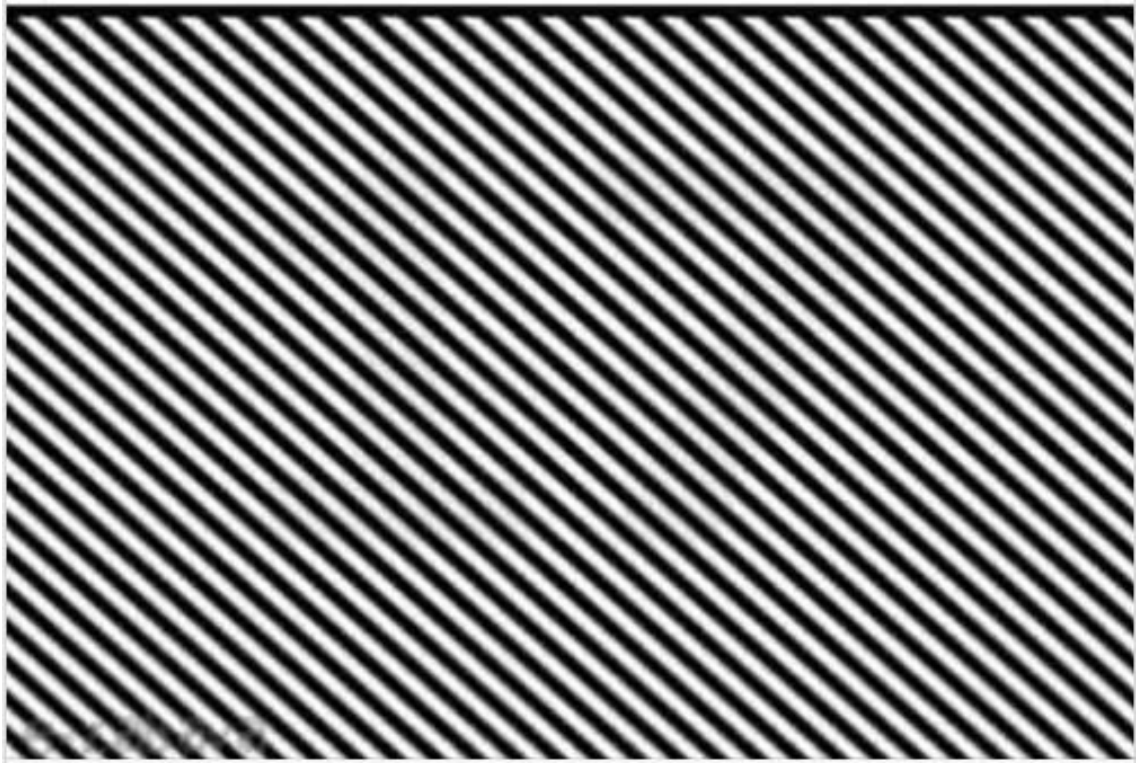


How many black dots are there in the picture?

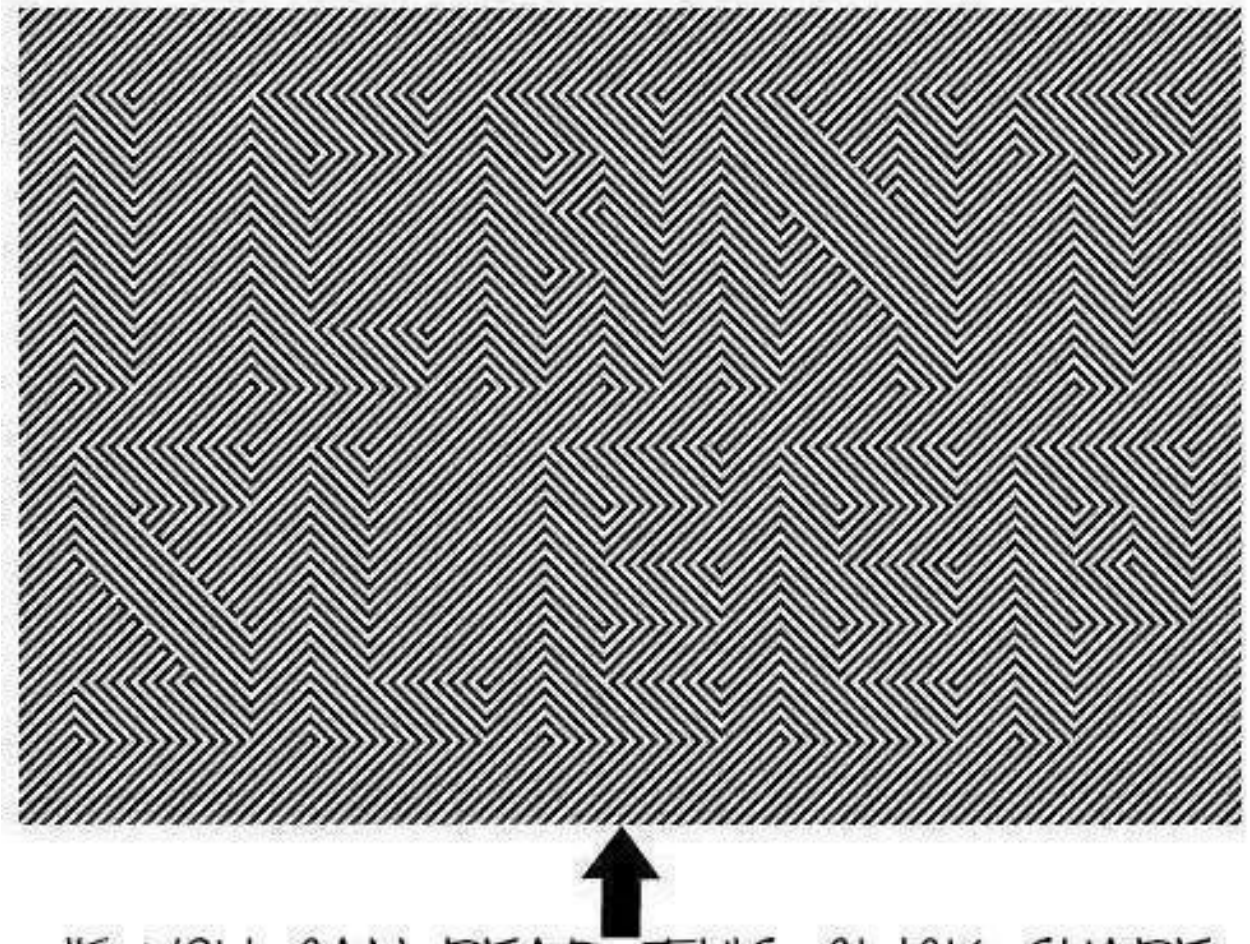
Illusions

Can you see it?
I do NOT!

Only 3% of people have the ability to see the number on the photo...
Click share if you are one them...



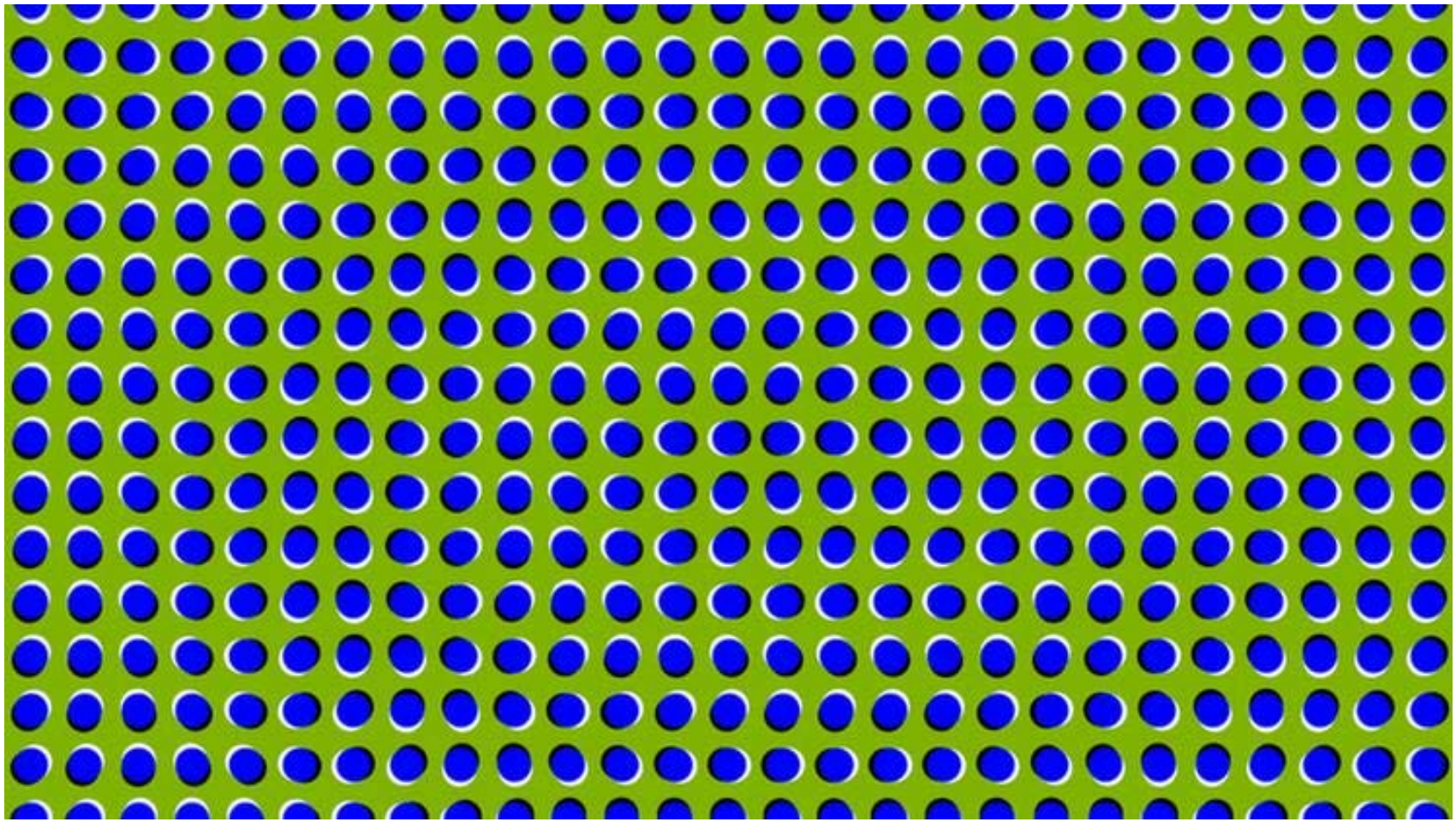
Illusions


IF YOU CAN READ THIS CLICK SHARE
See how many of your friends can read it too...

Illusions

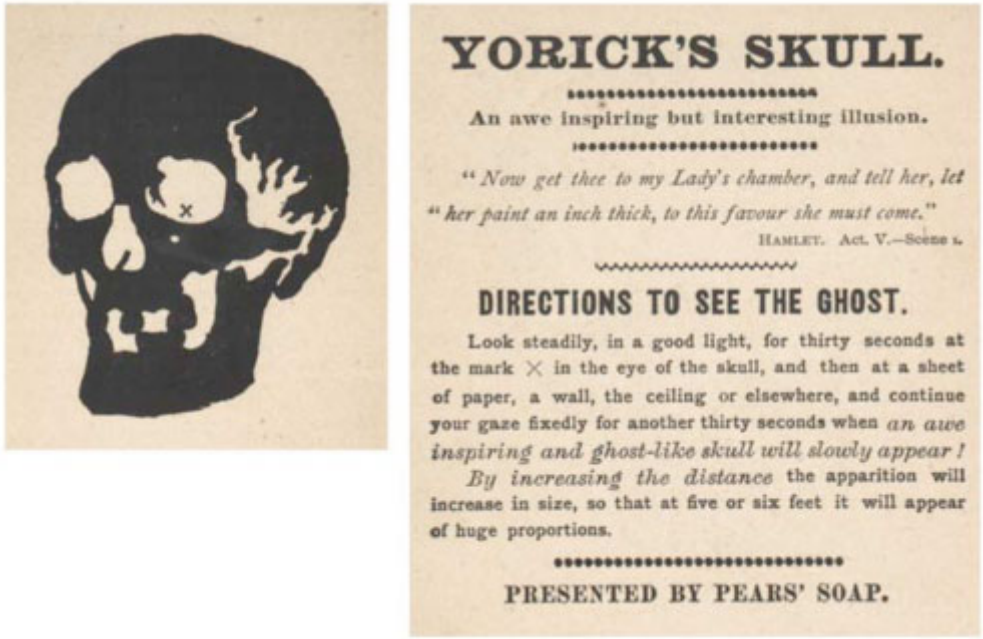

Wpatruj się w kropki na nosie dziewczyny
przez 30 sekund, a potem odwróć się,
spójrz szybko na ścianę i zacznij mrugać.
Zobaczysz co się stanie.

Illusions



Illusions

Illusions



YORICK'S SKULL.

An awe inspiring but interesting illusion.

"*Now get thee to my Lady's chamber, and tell her, let her paint an inch thick, to this favour she must come.*"

HAMLET. Act. V.—Scene 1.

DIRECTIONS TO SEE THE GHOST.

Look steadily, in a good light, for thirty seconds at the mark × in the eye of the skull, and then at a sheet of paper, a wall, the ceiling or elsewhere, and continue your gaze fixedly for another thirty seconds when *an awe inspiring and ghost-like skull will slowly appear!*

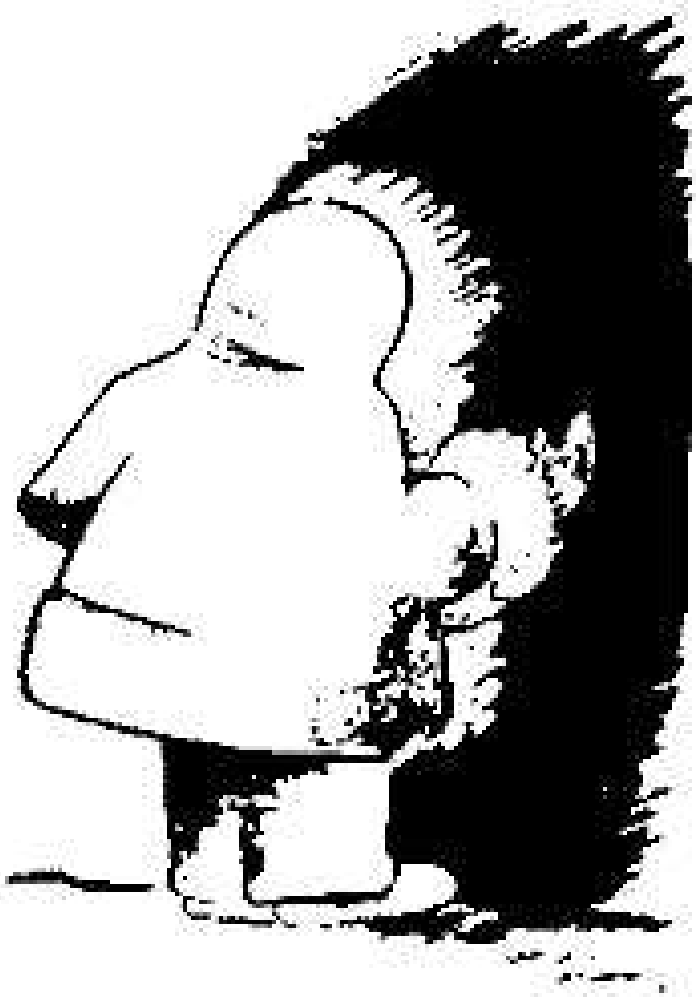
By increasing the distance the apparition will increase in size, so that at five or six feet it will appear of huge proportions.

PRESENTED BY PEARS' SOAP.

When you stare at an image, the neurons in your retina eventually adapt to this unchanging stimulus and stop responding to it. If you then look away, you can see a ghostly afterimage during the brief period that it takes for your neurons to reset to their responsive state. To experience a vintage afterimage illusion, stare at the X in Yorick's left eye socket for about 30 seconds. Then look away at a wall or piece of paper, and you will see a ghostly apparition.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

Our experiences determine what we perceive

Our experiences determine what we perceive



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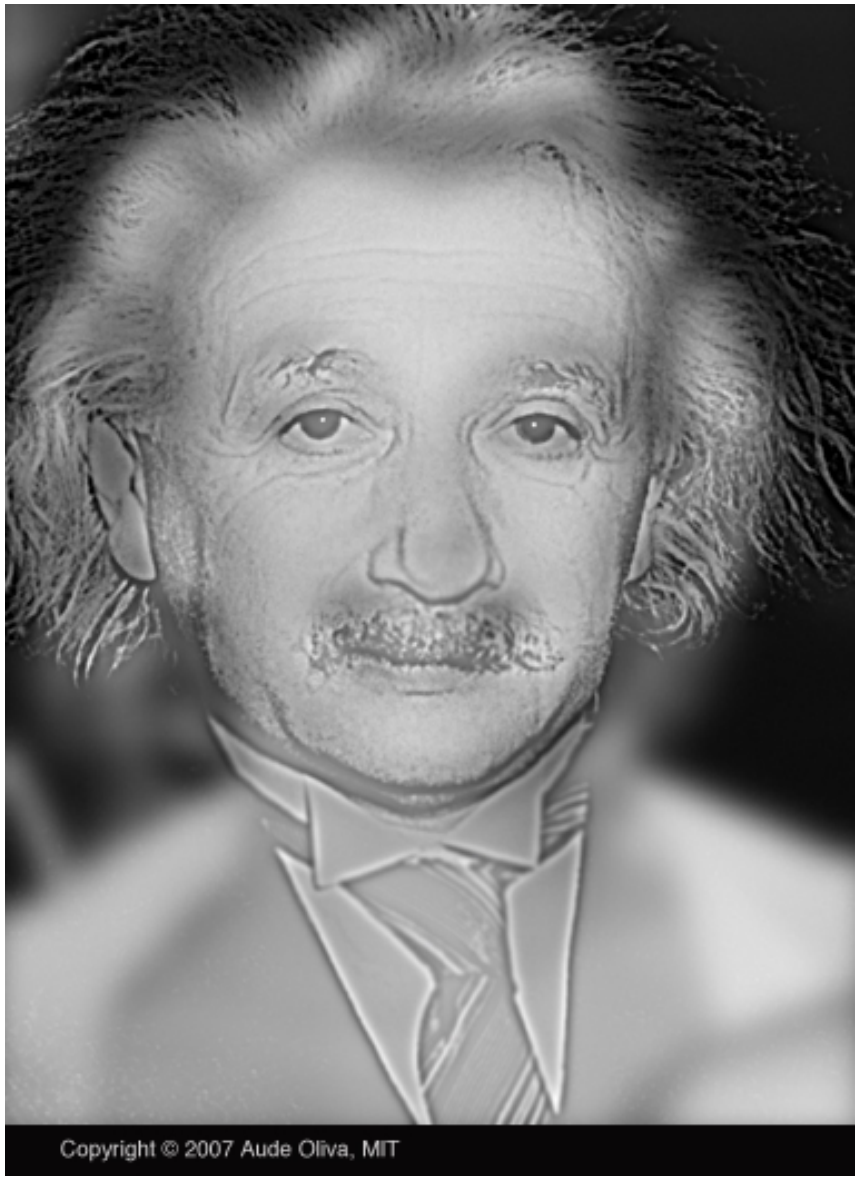

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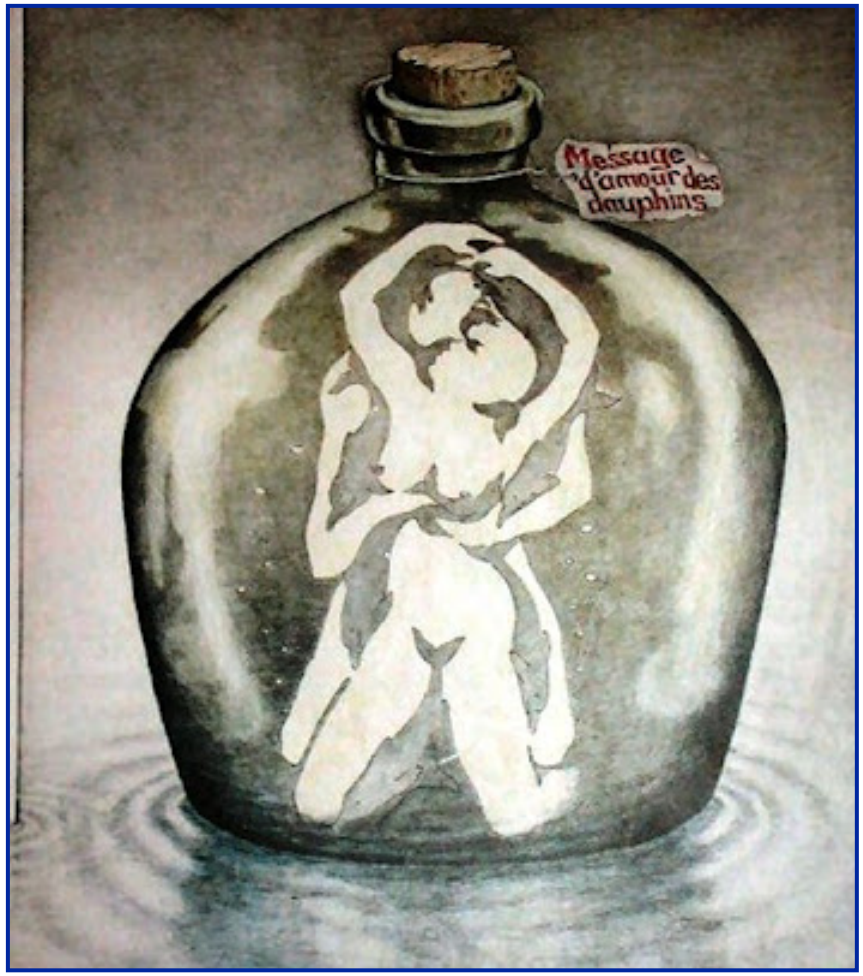
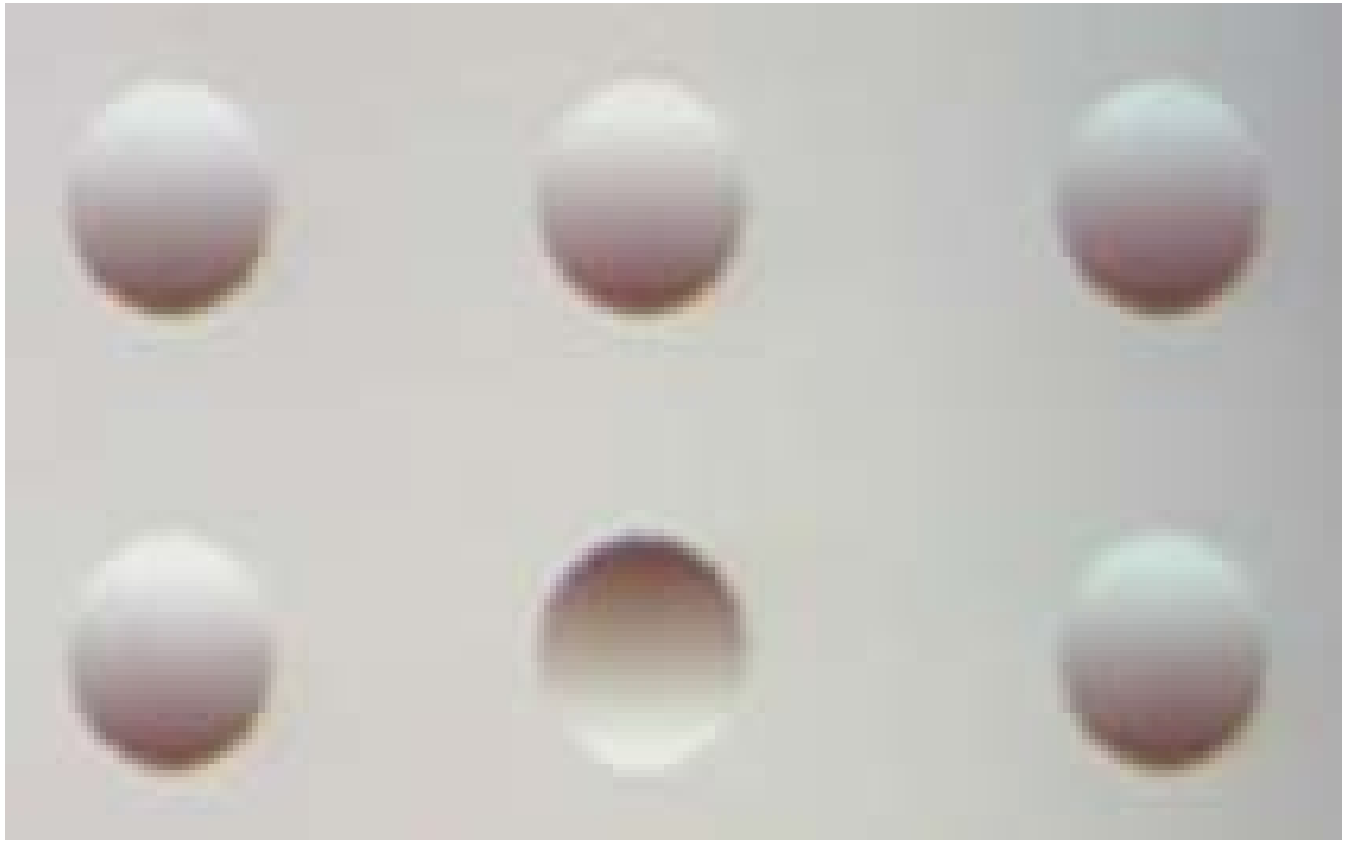


The way we see things depends on our frame of mind. In this illusion, Message of Love from the Dolphins, adult viewers see two nude lovers embracing. But when young children look at this image, they see only dolphins.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

Our experiences determine what we perceive



How many convex and concave dots do you see?
http://homepages.inf.ed.ac.uk/amos/visualillusion.html

Our experiences determine what we perceive

How many convex and concave dots do you see?
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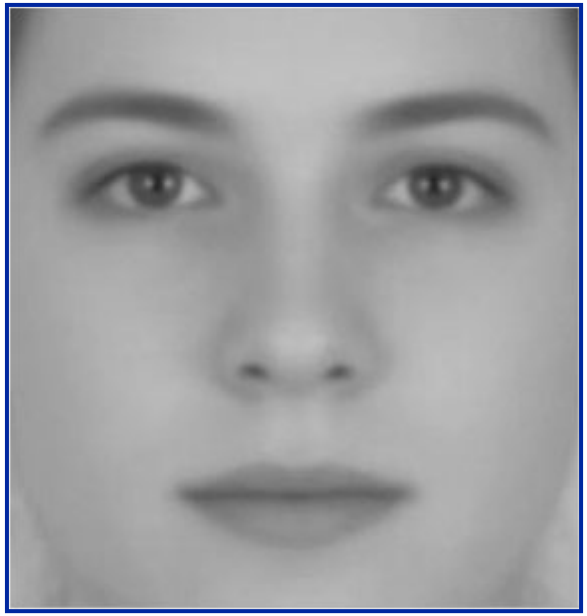
Our experien ceive

How many convex and
http://homepages.inf.ed.ac.uk

Our experien ceive

How many convex and
http://homepages.inf.ed.ac.uk

A boy or a girl?

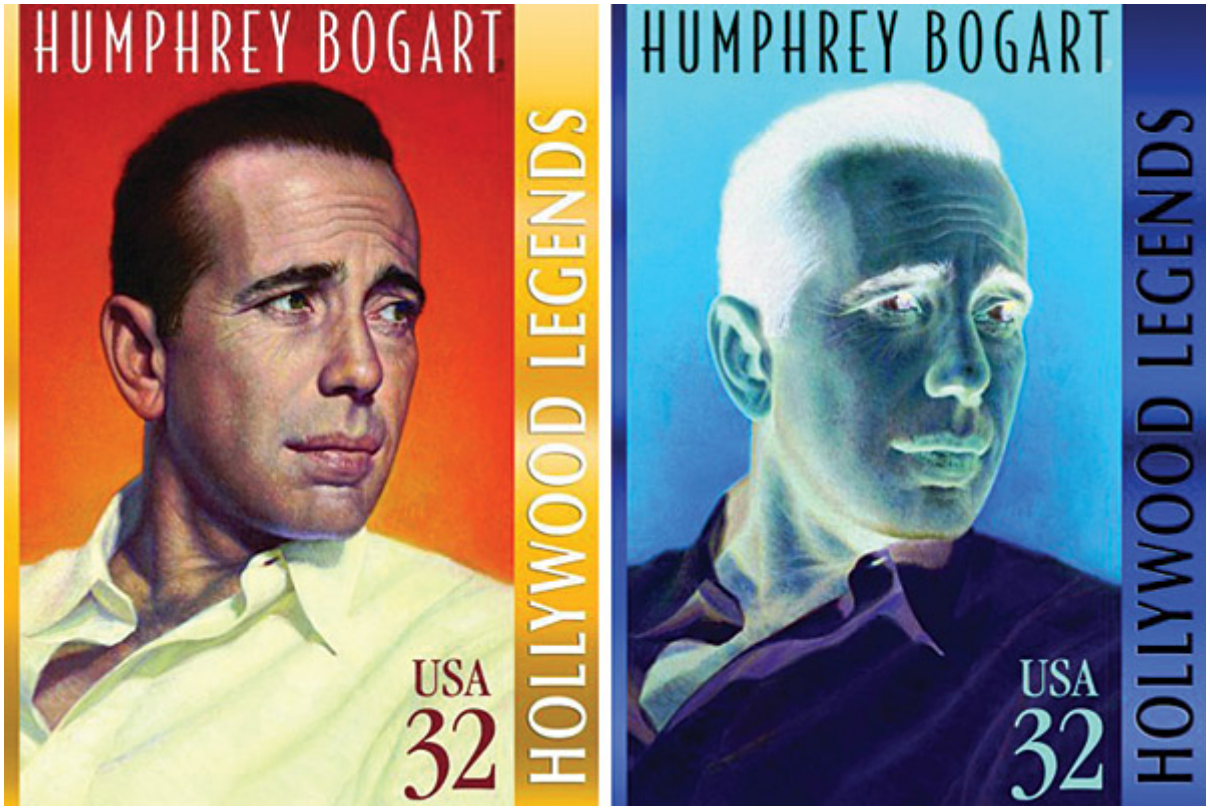


A boy or a girl?

Our experiences determine what we perceive

Our brains are exquisitely tuned to perceive, recognize and remember faces. In the Illusion of Sex, by Gettysburg College psychologist Richard Russell, the left face is perceived as female while the right face is perceived as male. But the two images are actually identical, except that the contrast between the eyes and mouth and the rest of the face is higher for the face on the left. This illusion shows that contrast is an important cue for determining the sex of a face. It may also explain why cosmetics make women look more feminine.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

Our experiences determine what we perceive

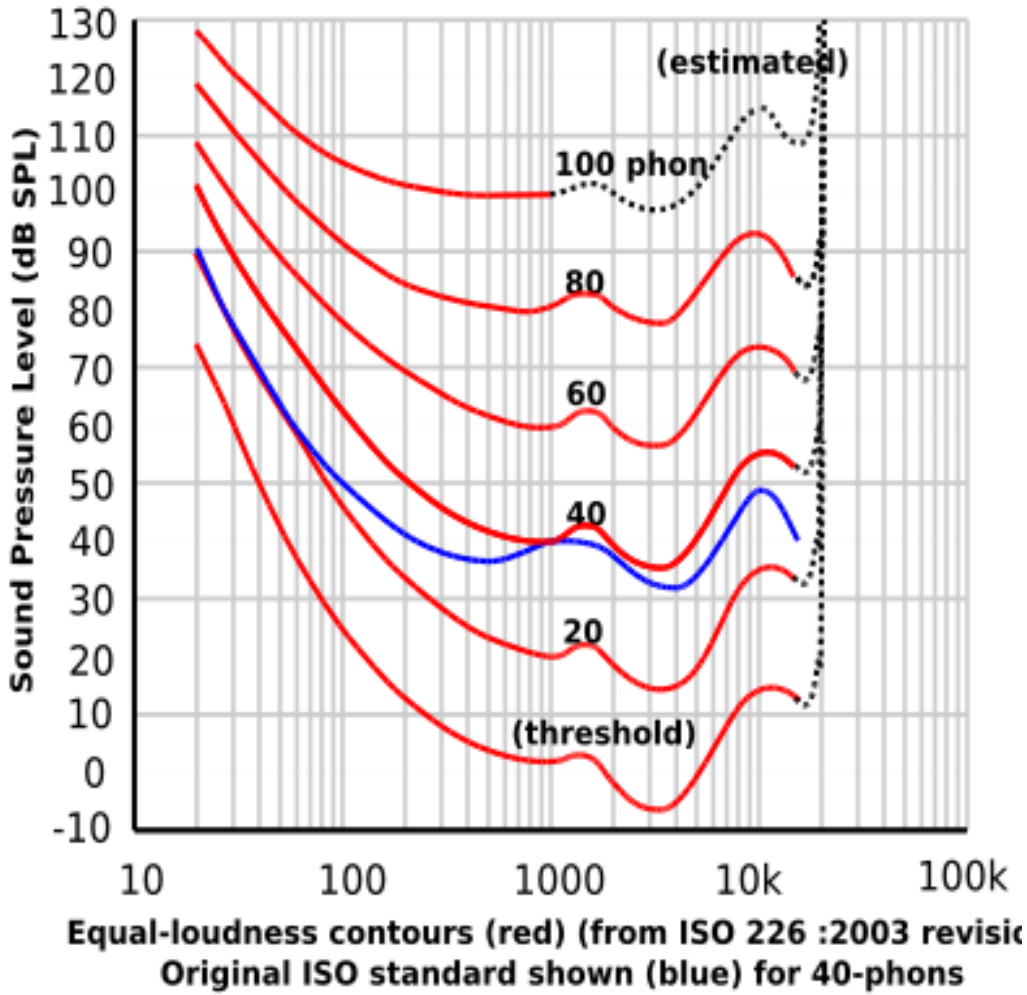


As social primates, humans have a keen interest in where people are looking. Vision research Pawan Sinha of the Massachusetts Institute of Technology shows us with this illusion that our brains determine gaze direction by comparing the dark parts of the eyes (the irises and pupils) with the whites. In the normal photograph of Humphrey Bogart, the actor appears to be looking to his left, but in the photo negative he appears to be looking in the opposite direction even though his face is still turned toward the left. Even though we know that the irises are white in the reverse image, we can't change our perception of the illusion.
http://www.scientificamerican.com/slideshow.cfm?id=169-best-illusions

The impact of age on vision ☹

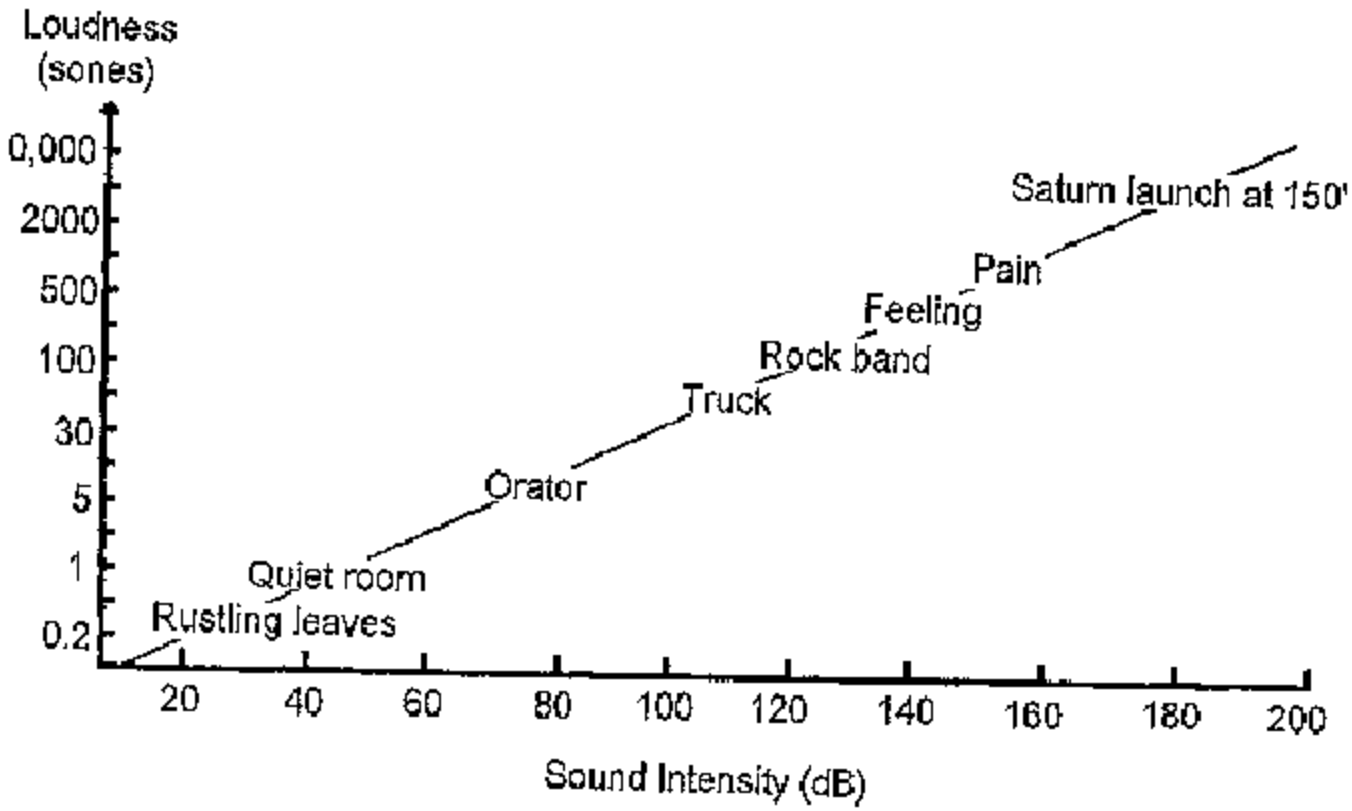
Senses: Hearing

Psychological metrics: Phons

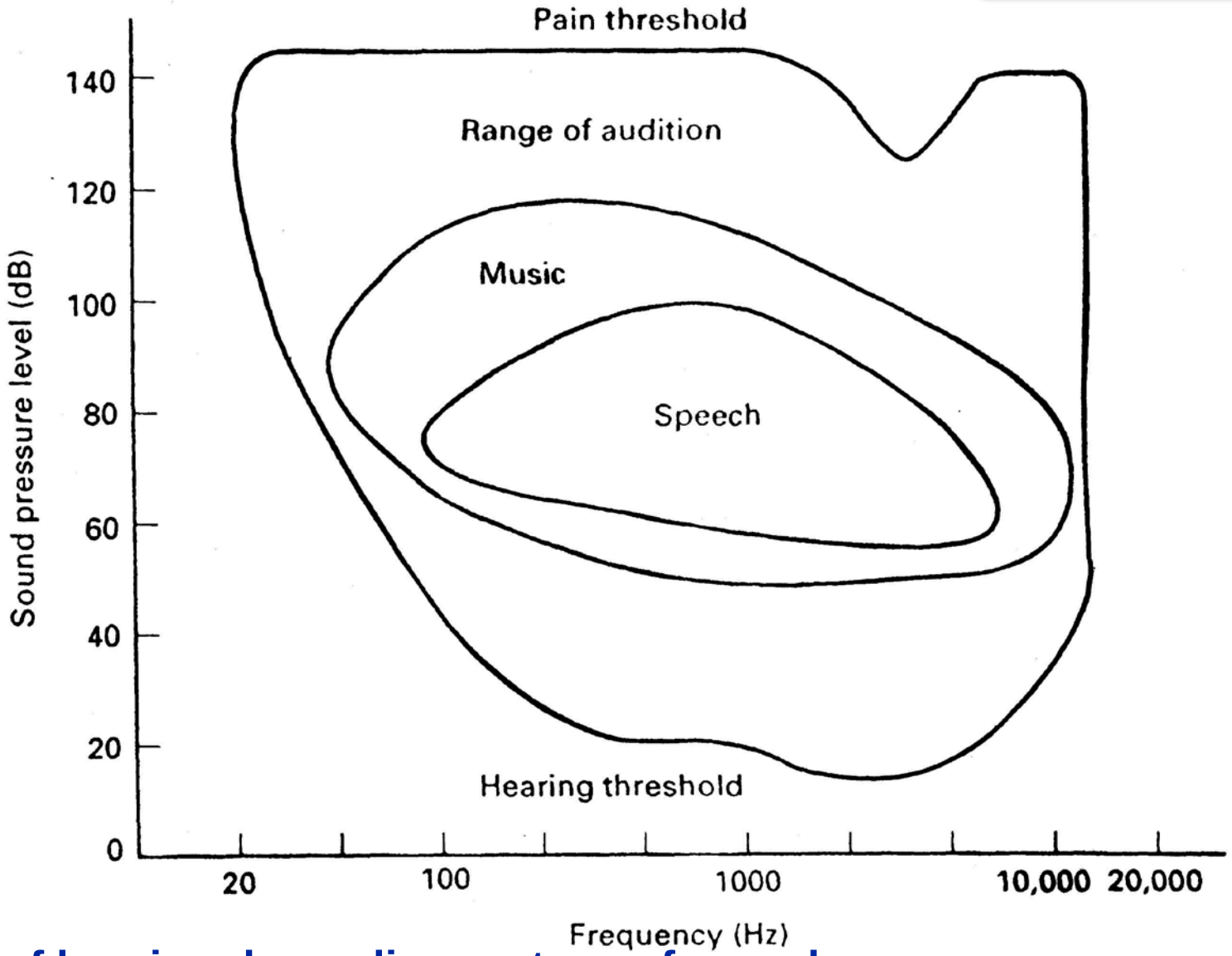


What can we hear?

Psychological Metrics: Sones

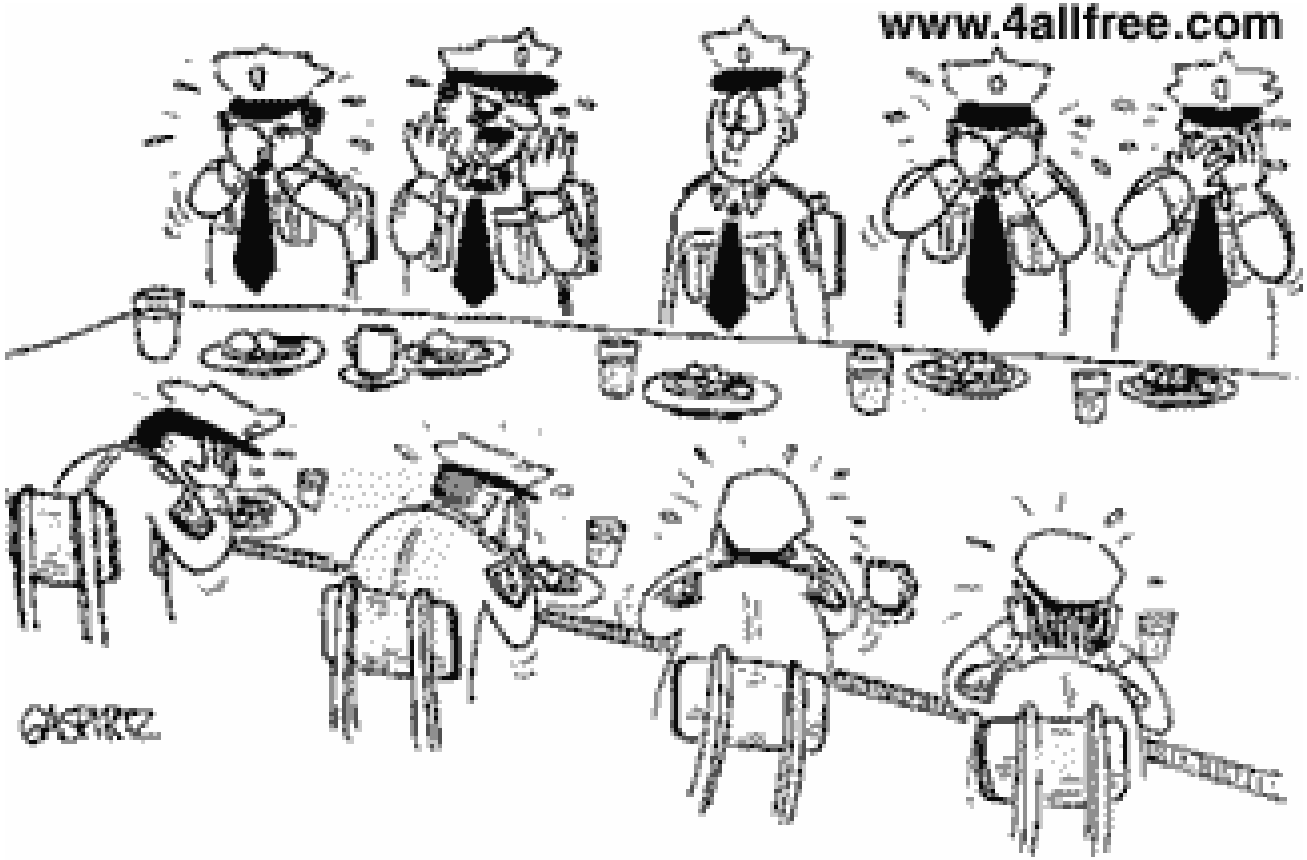


Measurement of intensity of sound



Range of hearing depending on type of sound

Hearing is imperfect



Nice delivery, John. But I asked you to "say grace," not to "spray mace."

Selection of Subjects and Stimuli

Selection of subjects and stimuli

No matter what experimental research you are doing, you need to select the participants (subjects). Very often you do it by sampling a population.

Paradox of sampling: On one hand, the sample is of no use to us if it is not truly representative of the broader population that we are interested in. On the other hand, to know what is representative, we must know what the characteristics of the population are, so that we can judge whether the sample reflects them properly, but in that case we have no need of the sample at all.

Probability sampling plan: Employing a probability sampling plan enables the researcher to know reasonably, though never for sure, that the sample is representative of its population. The sample must be (1) unbiased (2) stable (have a relatively small variance; if the variance is large, we need more subjects).

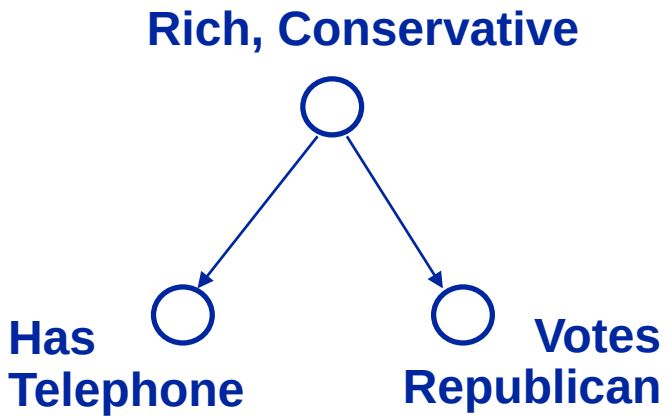
Selection of subjects and stimuli

Two notable examples of what and how can go wrong:

A telephone poll that surveyed the American population about who will win the presidential election (1960s?). The polls predicted a landslide Republican victory. The facts were that Democrats won by a large margin.

The experimenters had a very biased sample because those Americans who had phones (a phones was a bit of a luxury item) were voting conservative (Republican); effectively, the poll was a complete fiasco.

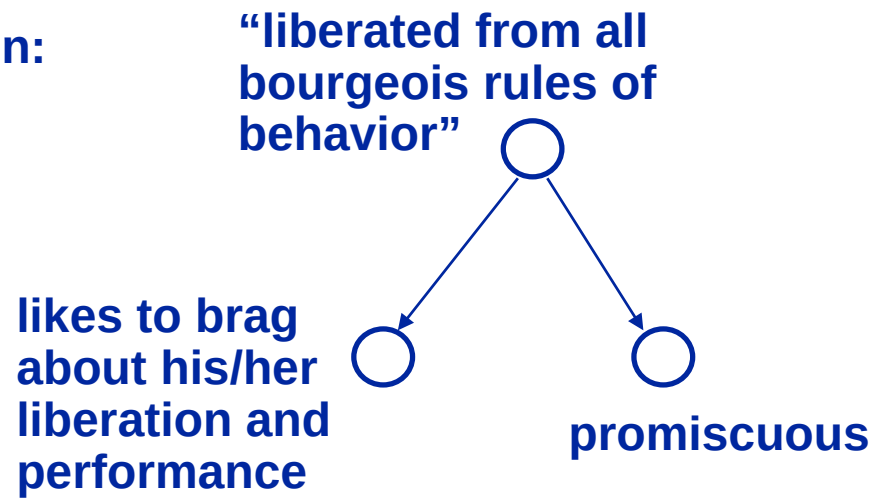
A possible causal explanation:



Selection of subjects and stimuli

Kinsey report on the sexual lives of Americans, conducted in 1960s. They relied mainly on volunteers and their conclusions were absurd, for example that 80% of all married people were unfaithful or that 20% of Americans were homosexual.

A possible causal explanation:



Selection of subjects and stimuli: Volunteer bias

Volunteer bias effect

Another example: “do-it-yourself” polls conducted by some radio stations

Tip of the day:
Did you know that volunteers usually score higher on IQ tests than non-volunteers?

Selection of subjects and stimuli: Non-response bias

Non-response bias effect

Not everyone who is contacted by any type of researcher will automatically agree to participate as research subject. Typical response rate is 5%. High rate of non-responders impairs the validity of survey studies.

There are several ways to increase the response rates in survey research, such as one or more follow-ups, contacting respondents before they received the questionnaire, offer financial incentives, use “high-powered” hand-stamped mailings, sign the cover letter (put Prof., Ph.D., University of Pittsburgh, etc.).

Selection of subjects and stimuli: Non-response bias

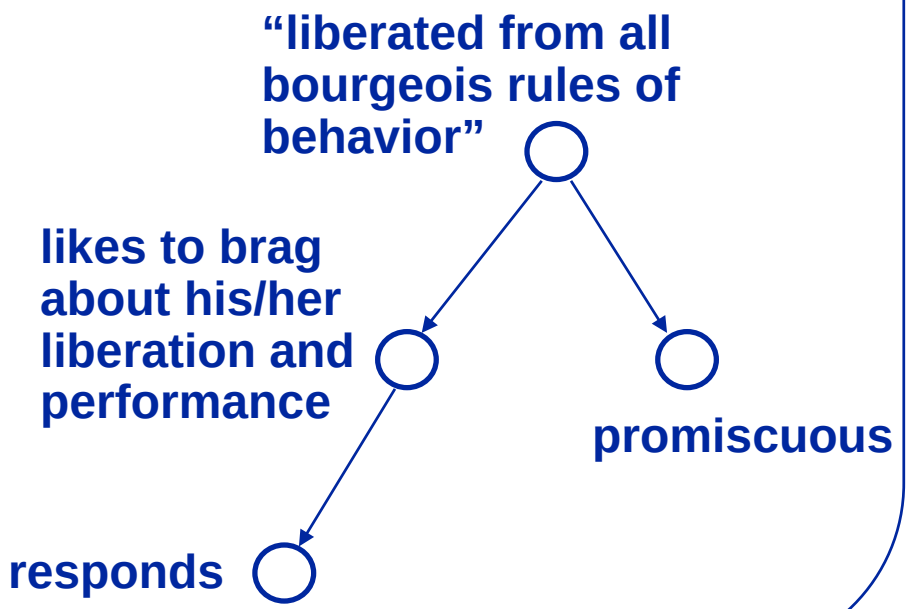
Non-response bias effect

We could easily reproduce Kinsey's result by approaching a random sample of Americans if the response rate were low.

The new study conducted at the University of Chicago was much better than Kinsey's.

To control for non-response bias, they sampled the population and then followed the selected sample up until they got about 70% response rate.

They had to approach some subjects 14 times!



Selection of subjects and stimuli

Whatever methods are used to increase the compliance rate will not eliminate the bias - they will hopefully reduce it.

Paying the subjects, bugging them until they agree to participate, or playing on their guilt (“we need you for the sake of science”) will introduce biases, but they are not as bad as the bias introduced by volunteering or not volunteering.

Subject-Experimenter Effects

Subject-experimenter artifacts

The experimenter is often the measuring instrument in the study.

The subject often has a pre-conceived notion of expectation.

Artifacts: Uncontrolled factors that might jeopardize the results.

Subject-experimenter artifacts: Psychological problems that might arise between subject and experimenter.

Assuming that the effects are unintentional, there are two types of subject-experimenter effects: (1) non-interactional, and (2) interactional errors.

Subject-experimenter artifacts

Examples:

Good subject effect: Subject tries unconsciously to please the experimenter. ("Is this what you want me to do?")

Apprehension effect: Effect due to the surrounding of being observed.

Subject-experimenter artifacts

Non-interactional effects:

Observer effects: Errors in observation.

Interpreter effects: Systematic errors in interpretation.

Intentional effect: Dishonesty or sloppiness.

Interactional experimenter effects:

Biosocial effects: Due to age, sex, race.

Psychological effects: Due to personality, temperament.

Situational effects: Due to context, situation.

Expectancy effects: Due to expectation, self-fulfilling prophecy.

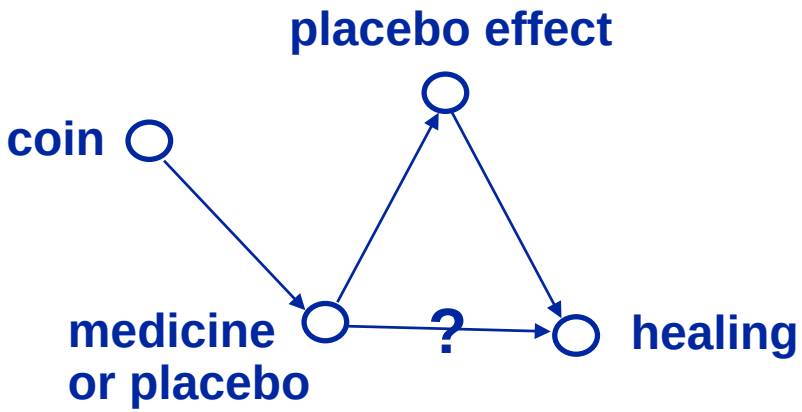
Some history: Does anybody know who “Clever Hans” is? Maze dull and maze smart rats?

Controlling for subject-experimenter artifacts

Six basic strategies:

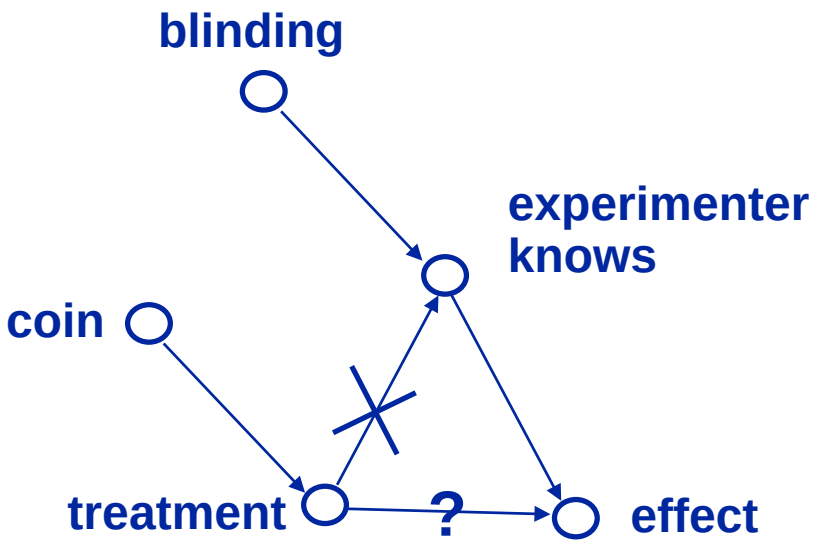
- **Increase the number of experimenters**
- **Observe behavior**
- **Look for ordered effects**
- **Blinding**
- **Minimizing contact**
- **Expectancy control**

Controlling for subject-experimenter artifacts: Placebo effect



By administering placebo to the control group we can compensate for an alternative path from medicine to healing (note that randomization will not break outgoing links).

Controlling for subject-experimenter artifacts: Blinding



Blinding breaks the path from treatment to the subject-experimenter effects (note that randomization breaks only incoming links).

What should we do?

After the whole long list of things that can go wrong in experimentation, Rosenthal & Rosnow (Chapter 6, page 134) write (very true in psychology, where they come from):

"With rare exceptions, progress does not occur in science simply as a result of 'crucial' experiments. It occurs because competent observers, aware of the errors in the data, employ different strategies, replicate and cross-validate, do experiments and quasi experiments, perform studies in the laboratory and in naturalistic settings. Research results, over the long run, may point in a particular direction, but in the short run the research will always be mixed and call out for further investigation and analysis. The scientist's job is never done. As Boring (1969) put it, scientific truth remains forever tentative, subject always to possible disconfirmation. It is this undeniable aspect of science that is a source both of intellectual challenge and of frustration. But whatever is the momentary disappointment, there is always some interesting, elusive question waiting to be asked - and then answered. Subject-experimenter artifacts do not destroy our opportunities to do good research, but instead make us aware of the errors in the data - and, of course, the limitations of all human understanding."

Concluding Remarks

- Our senses and reasoning capabilities are quite limited.
- So is our knowledge.
- We need to realize our limitations, possible errors, and then try to minimize them.
- Every experiment is conditioned on its background: laboratory, subject population, setting, exact wording of the instructions. Replicate, interpret, form a more general theory.
- Experiments: data points to which we are fitting a curve. When simple, simple structure, when complex, then multidimensional (2 points to draw a line in a plane; easy problem, then few aspects are enough to construct a theory).
- Describe your experiments in detail, even the fact that one of the subjects was not able on Monday (page 97 Kaplan).
- Watch out (first your and then your neighbor's eye).