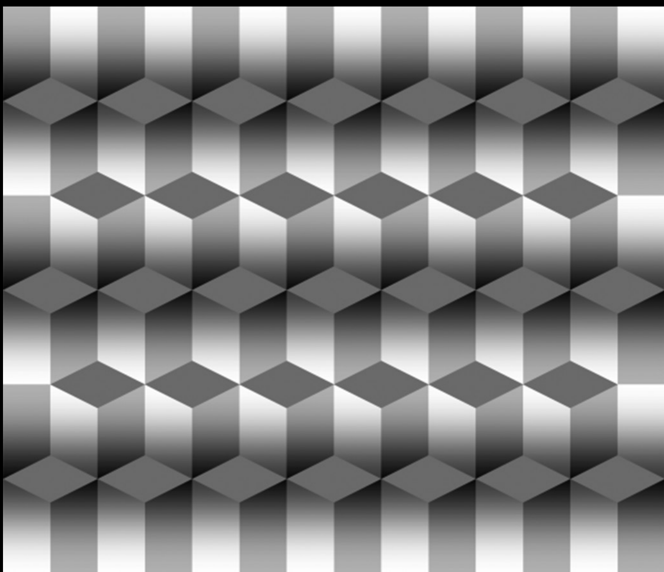
visual perception



and other phenomena

sdc colour experience

Visual perception

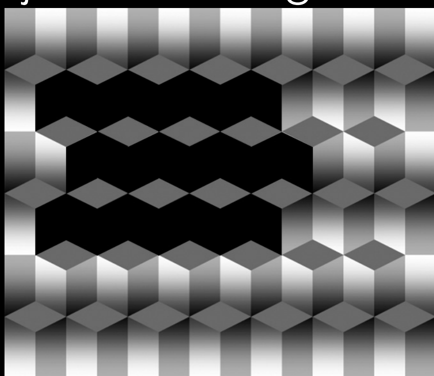
Visual perception is the process of using vision to acquire information about the surrounding environment or situation.

Perception relies on an interaction between the eye and the brain and in many cases what we perceive is not, in fact, reality.

There are four different ways in which humans visually perceive the world.

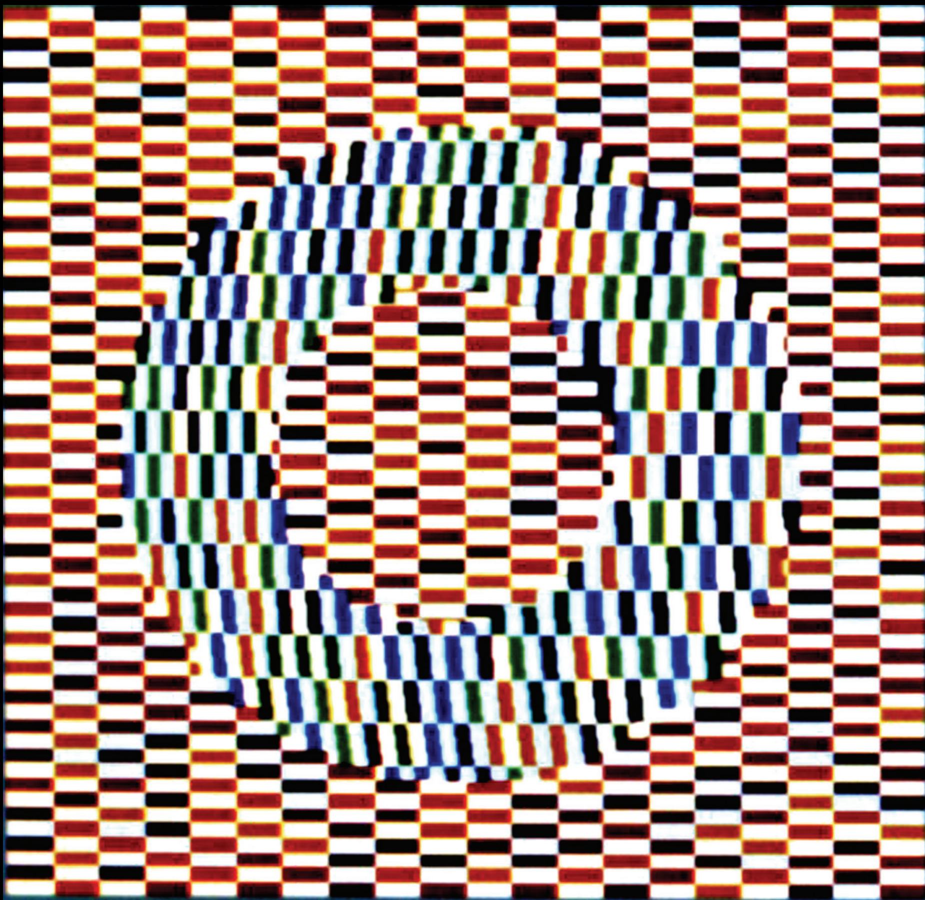
When we observe an object we recognise:

brightness,
movement,
shape,
colour.



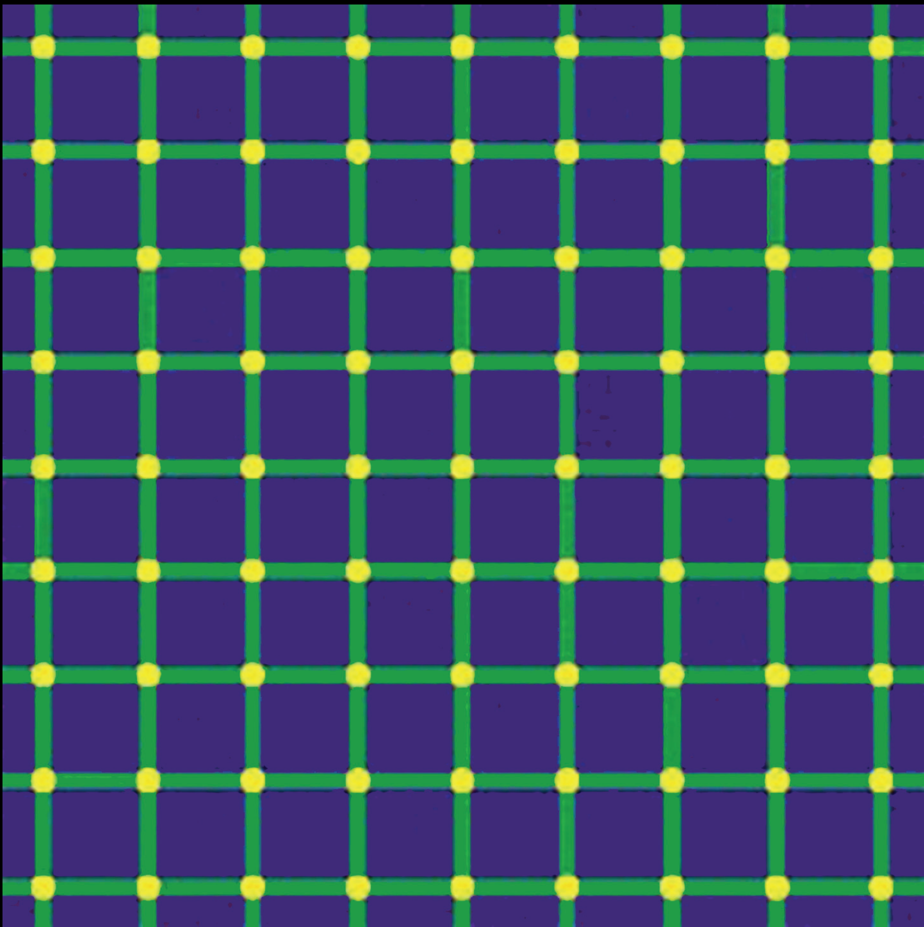
The illustration on the front cover appears to have two distinctly different sets of horizontal diamonds, one darker than the other. As shown above with an area removed this is an incorrect perception as in reality the diamonds are all identical.

Ouchi effect



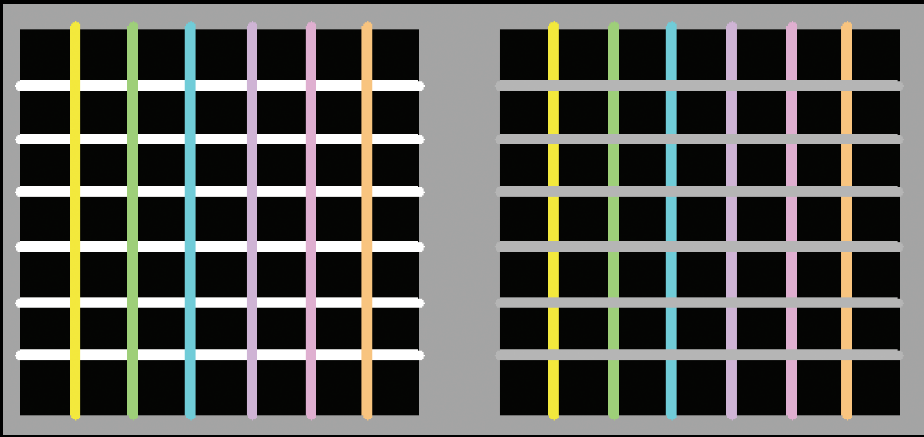
Named after the Japanese artist Hajime Ouchi who discovered that when horizontal and vertical patterns are combined the eye jitters over the image and the brain perceives movement where none exists.

Blinking effect

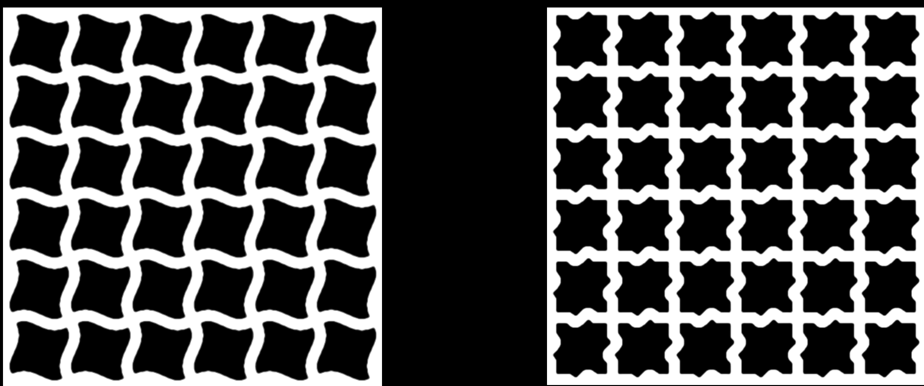


Try to count the dots in the diagram above. Despite a static image, your eyes will make it dynamic and attempt to fill in the yellow circles with the blue of the background.

The reason behind this is not yet fully understood.



When coloured lines cross over neutral background the dots appear to be coloured. If the neutral lines cross the coloured then the dots appear neutral.



When the grids are distorted the illusion is reduced or disappears completely as shown in the examples above.

Dithering

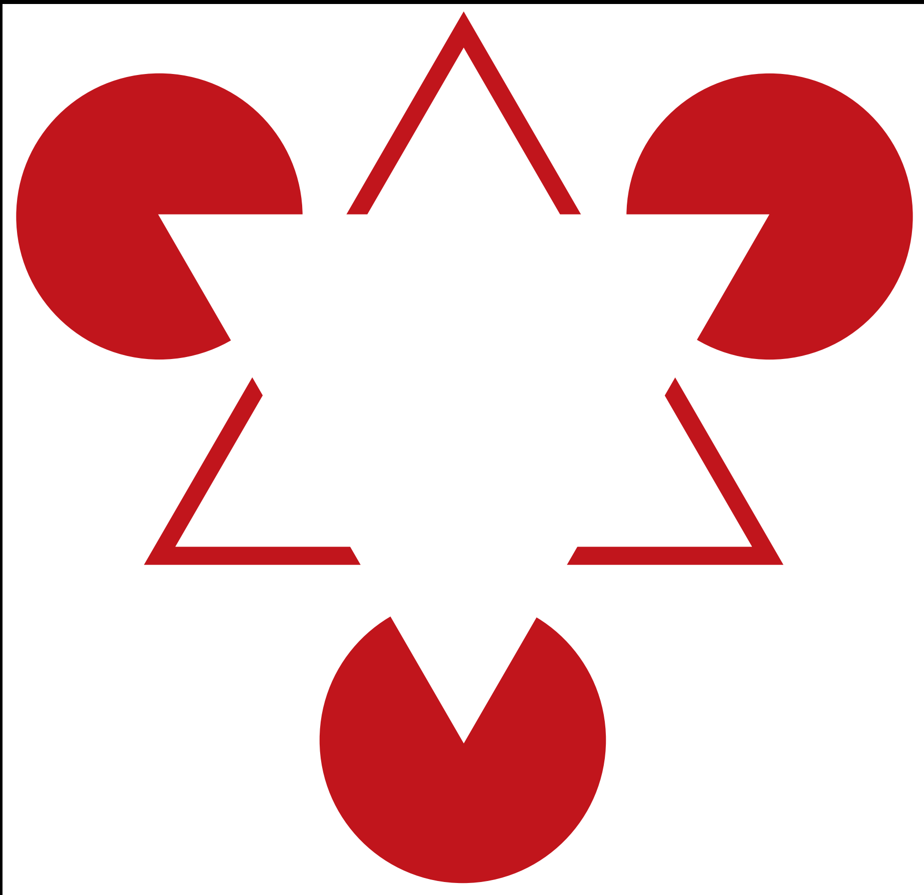
This is a colour reproduction technique in which dots or pixels are arranged in such a way that allows us to perceive more colours than are actually there.

This method of 'creating' a large colour palette with a limited set of colours is often used in computer images, television and the printing industry.

A simple example is an image with only black and white in the colour palette.
By combining black and white pixels in complex patterns an illusion of grey can be created.

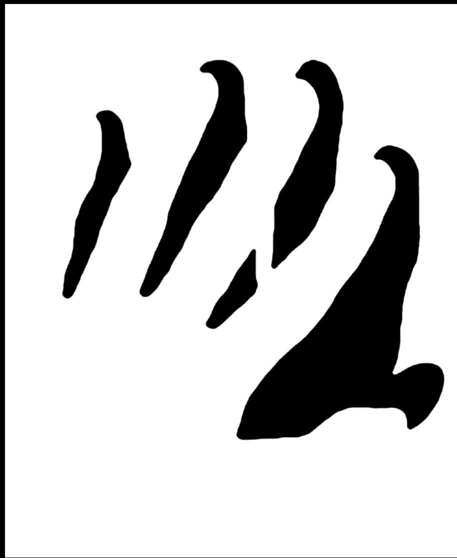
The above image illustrates the difference between the left eye consisting of millions of colours and the right eye which has only 256 colours. The dithering effect allows us to recreate the millions of absent colours so we are able to visualize the images as virtually identical.

Pattern recognition

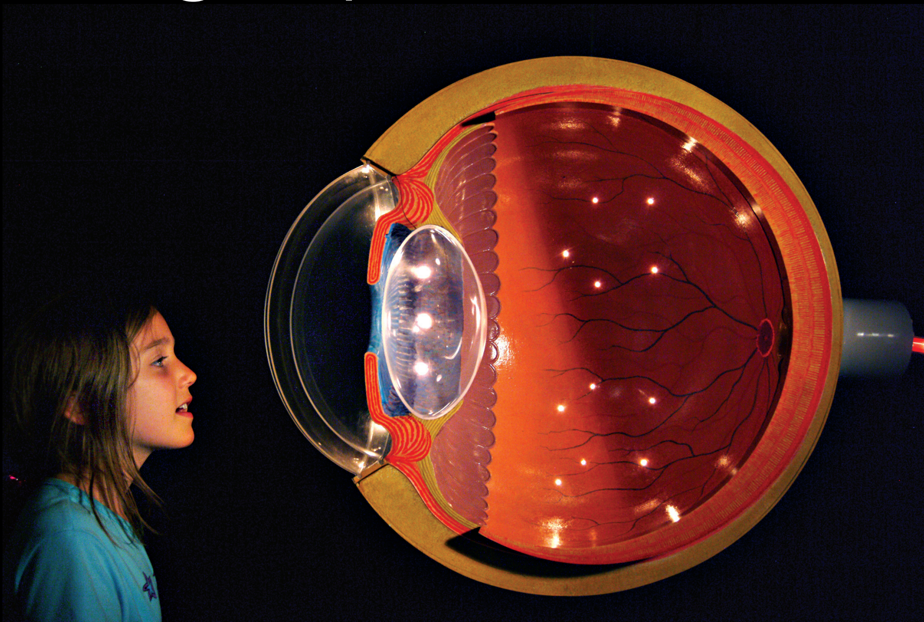


When looking at the image above the brain automatically perceives triangles. The notched circles and angled lines suggest gaps in which objects should be. Your brain recognises the pattern and fills the gaps to create a white triangle over a red triangle.

Your brain has millions of images stored away. Has your brain seen images similar to the two on this page before? Can you recognise them? The answers are inside the back cover.



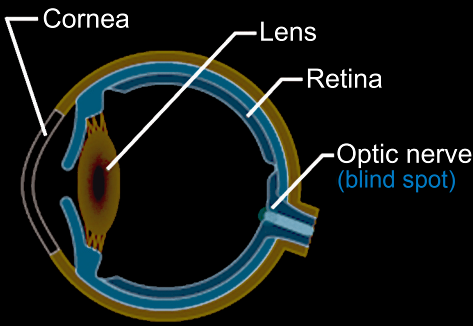
Filling in phenomenon



Our eyes do not give us a complete picture of the world around us. When we look at something only a tiny area is clear and in focus, the rest is vague and blurred. This is because most of the light sensitive nerves in the eye are concentrated directly opposite the pupil in an area about 1.5mm across called the macula.

Each eye also contains an area that has no photoreceptors. This area is known as the blind spot and it is where the optic nerve leaves the retina.

As the blind spot of each eye is not central, but to one side, when both eyes are open they compensate for each other.



To prove the blind spot does exist simply carry out the following experiment.

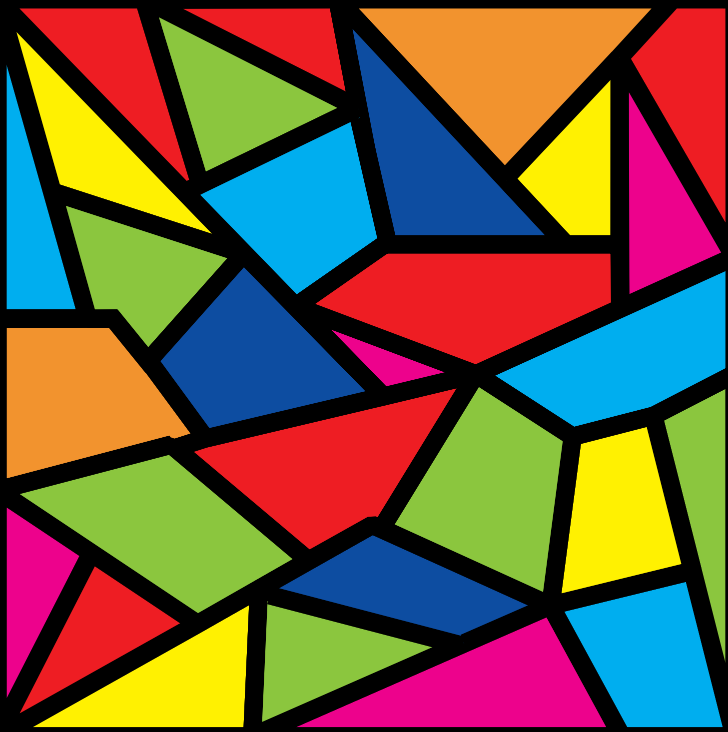
Close your right eye and look at the cross on the diagram below with your left eye. Start about 60cm (2ft) away from the page and move slowly towards it. You will find that at a certain distance the dot 'disappears'. When this happens you know that the light reflected from the dot is hitting your blind spot.

Notice that the dot is replaced not by a black region but by a blank white space. This is because the brain 'fills in' with the most likely stimulus, which in this case is the surrounding white area. If you want to find the blind spot in your right eye turn the page upside down and close your left eye.

Borders and framing colour

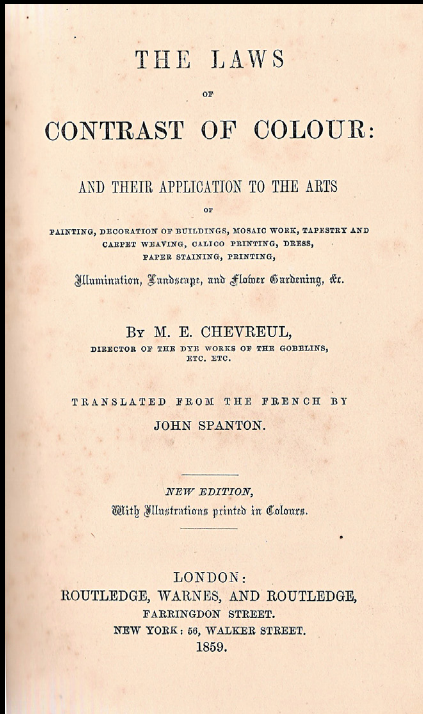
The above example illustrates a number of brightly coloured geometric shapes. Although there are no lines separating any of the colours, where two complementary, or near complementary, colours are in contact an illusory black line appears as the brain tries to create its own border.

When the colours are actually bordered, or framed, with a black line, as illustrated below, they appear brighter and more vibrant. The tactic creates a certain effect which helps prevent colours clashing. Notice how the colours below appear significantly brighter than the same colours on the diagram to the left.



This effect is commonly used to enhance colour in applications such as stained glass design.

Simultaneous contrast



THE LAWS

OF

CONTRAST OF COLOUR:

AND THEIR APPLICATION TO THE ARTS

OF

PAINTING, DECORATION OF BUILDINGS, MOSAIC WORK, TAPESTRY AND CARPET WEAVING, CALICO PRINTING, DRESS, PAPER STAINING, PRINTING,

Illumination, Landscape, and Flower Gardening, &c.

BY M. E. CHEVREUL,

DIRECTOR OF THE DYE WORKS OF THE GOBELINS, ETC. ETC.

TRANSLATED FROM THE FRENCH BY

JOHN SPANTON.

NEW EDITION,

With Illustrations printed in Colours.

LONDON:

ROUTLEDGE, WARNES, AND ROUTLEDGE,

FARRINGDON STREET.

NEW YORK: 56, WALKER STREET.

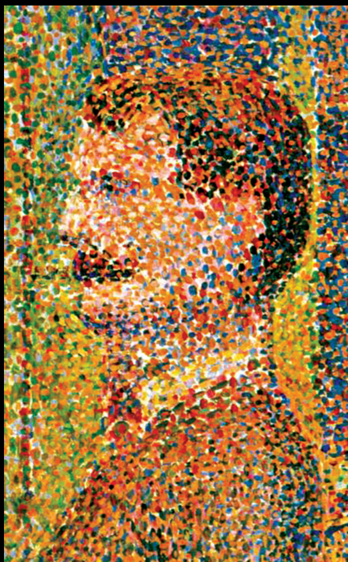
1859.

Michel Eugène Chevreul, while working as director at the Gobelins Tapestry Works in Paris, noticed that when two coloured yarns were placed next to each other both colours appeared to change. His study of this became the basis of the Law of Simultaneous Contrast.

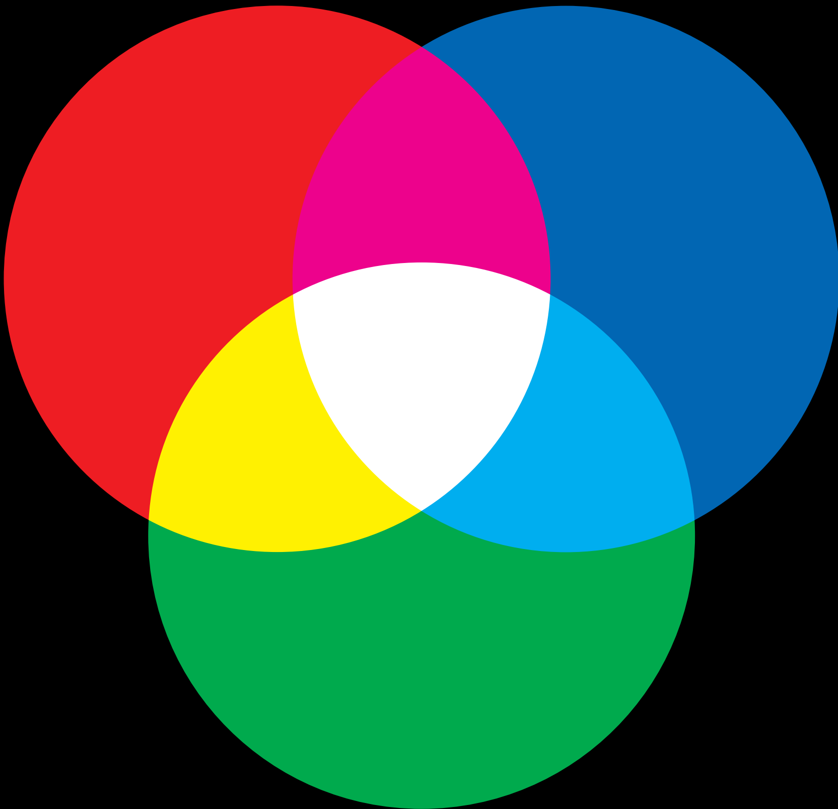
In 1839, after a prolonged period of experimentation and study, he published the first book outlining the fundamental principles of the visual interaction of colour. This book was later translated into English as *The laws of contrast of colour and their application to the arts*.

Chevreul was influential in contemporary French art through Charles Blanc's book *Grammaire des arts du dessin* which was more accessible, aimed at artists and heavily cited Chevreul's work. In particular the pointillist movement used the Law of Simultaneous Contrast to great effect.

The image on the right is detail from *La Parade* by Georges-Pierre Seurat (1889). You can see the individual dots of colour, each of which reacts with the surrounding area to produce a wider range of colours than are actually there.



Simultaneous contrast explained

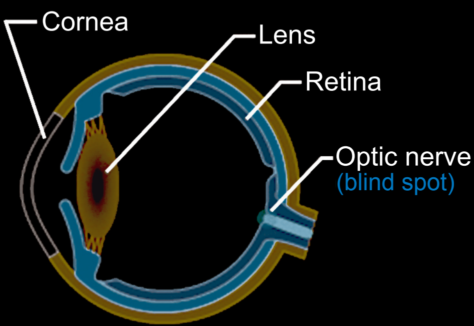


The diagram above illustrates that when the three primary colours of light, red, green and blue, are shone in such a way that they overlap each other an area of white light is produced. We can use the above colours to produce a colour circle as shown opposite. If we mix the two colours of light from opposite sides of the circle, for example blue and yellow, we will produce white light. (Since yellow is a mixture of red and green light we are mixing red, green and blue light, the primary colours of light known as the additive primaries)

Colours at the opposite sides of the colour circle are called **complementary colours**. So it can be seen from the circle that the complement of yellow is blue, red is cyan and green is magenta. When any two complementary colours of light are mixed together white light is produced.

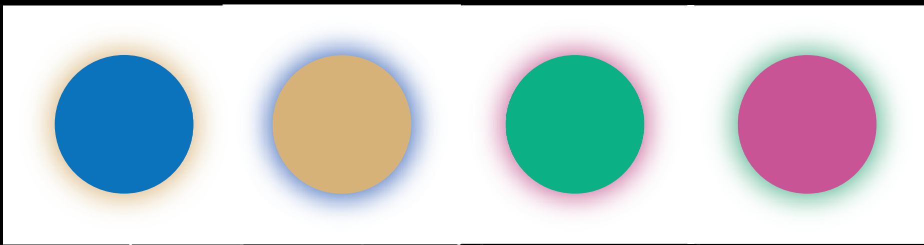
Simultaneous contrast explained

The original simultaneous contrast effect as first observed and recorded by Chevreul is now readily understood.



The light and colour sensitive nerves in our eyes are situated on the inner surface of the back of the eyeball, an area known as the retina.

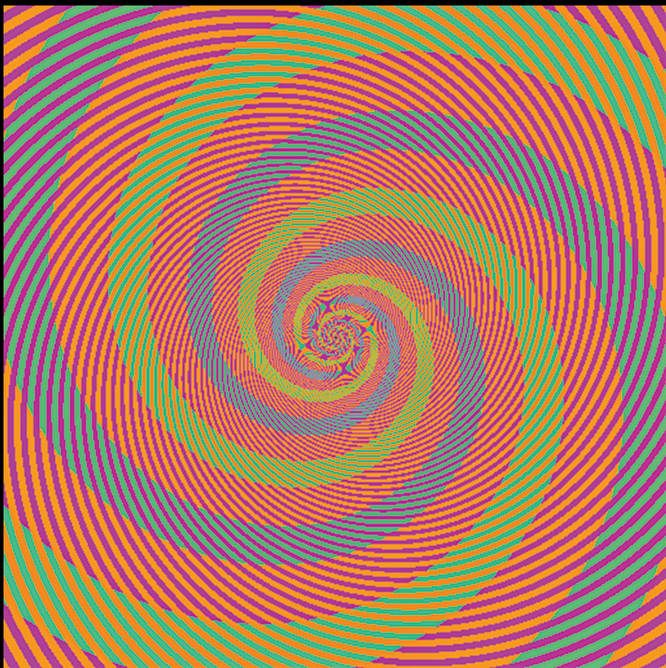
In order to explain the phenomenon in simple terms imagine looking at a blue dot on a white background. Where the blue light from the dot strikes the retina the area becomes overloaded and fatigued. The fatigue also spreads to the area close to, but outside, the blue dot. As this area is fatigued, or fed up with blue, our brain removes blue from the white light and thus we perceive this area of white as yellow – remember that blue and yellow are complementary and combine to produce white light. The effect is that we



perceive a blue dot with a yellow halo.
As colours are rarely seen in isolation let's see what happens if we have two areas of different colour in contact with each other, for instance green and yellow. Where they come in contact the green will be perceived as bluer and the yellow will seem orange as each induces its complementary

colour just outside the borderline.
You will need to look at the linked colours for around 30 seconds to fatigue the receptors on your retina and observe the effect.
However long you look at the separated colours you are unlikely to perceive anything other than flat colour.

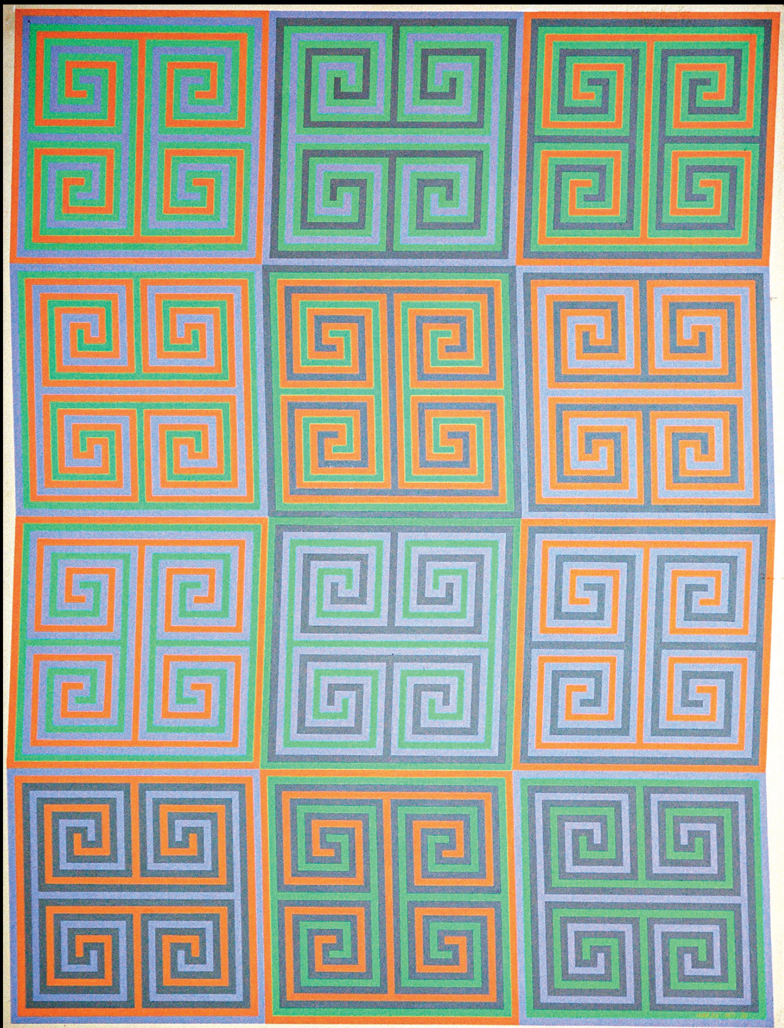
Simultaneous contrast examples



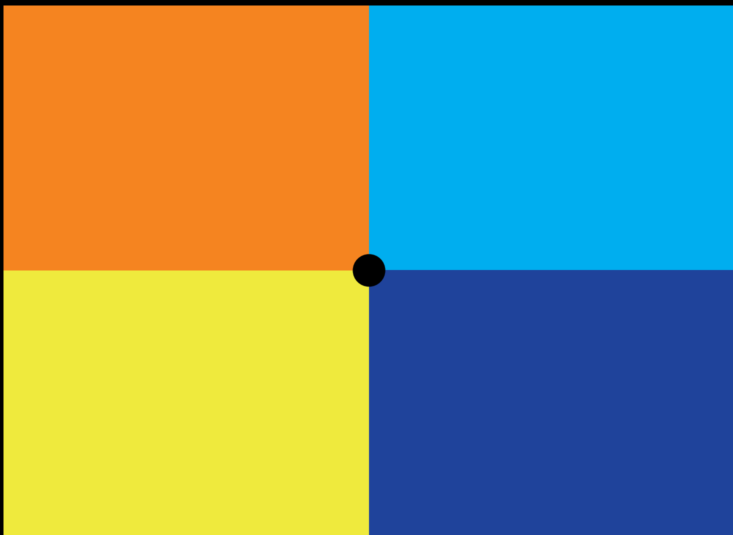
This illustration is the ultimate example of how simultaneous contrast can significantly affect your ability to accurately recognise colour.

Look closely at the image above and count the number of different colours. We would expect you to be able to see an orangey-red, a magenta, a blue and a green. To see how many colours are actually used refer to the inside back cover.

Simultaneous contrast as used by Sydney Harry in 1971to produce this work entitled *Multiple fret* which uses only 4 colours.



Chromatic adaptation and after image



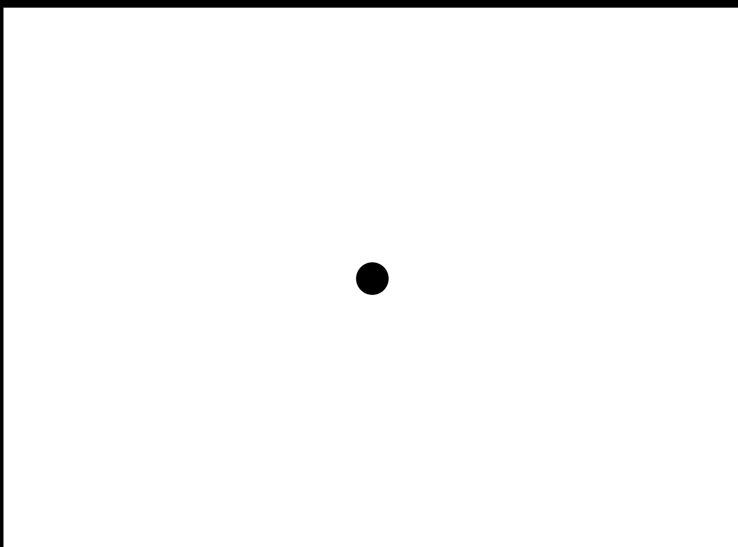
This ‘adaption’ mechanism occurs when our eyes adjust to certain colour stimuli.

For example after wearing a pair of tinted sunglasses for a period of time your eyes gradually adjust so that colours appear normal. When the sunglasses are removed colours appear abnormal until the eyes have readjusted.

Staring at the dot on the diagram to the left for half a minute will allow your eyes time to adapt to the stimulus of the coloured rectangles.

If you immediately transfer your gaze to the dot on the image below you will initially see the same four colours but with the red and yellow on the right and cyan and blue on the left. However as your eyes readjust you will see the colours gradually fade until a white rectangle remains.

This effect is sometimes known as successive contrast and is due to the same fatigue that causes simultaneous contrast. The four colours have been chosen to be complementary pairs so they appear to change places.



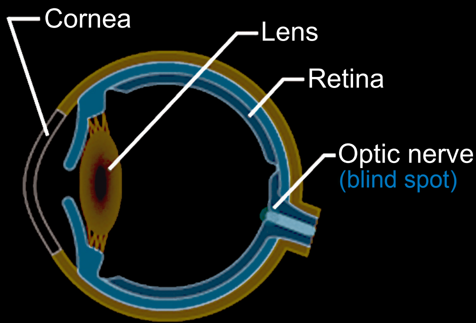
Mach band effect

This phenomenon is named after Ernst Mach who, in the 1860s, was the first person to observe and record the effect.

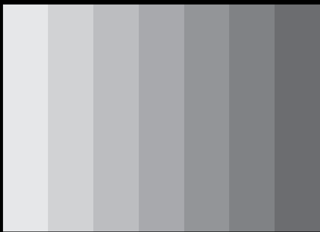
The effect is observed near the boundaries between areas of differing illumination or tone when bright or dark bands, that do not in fact exist, are observed.

Unlike simultaneous contrast, which is a colour effect, Mach bands can be observed without colour as they are directly related to the eye's ability to detect light and dark.

The retina contains two types of light sensitive cells or photoreceptors called rods and cones. The rods are more numerous, some 120 million, and are more sensitive than the cones. However, they are not sensitive to colour, only light and dark. The 6 to 7 million cones provide the eye's colour sensitivity.



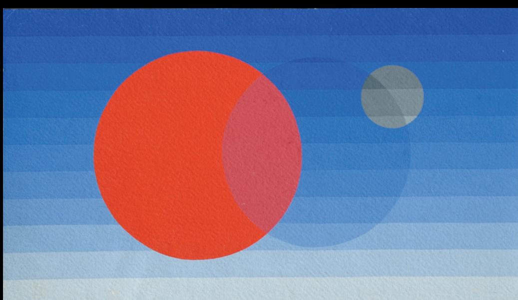
The simultaneous contrast effect is created by the cones whilst the Mach band is mainly created by the rods.



In the two examples above the vertical bars are identical, flat tonal areas. The Mach band effect is clearly visible on the left hand image where the bars are in contact, but nonexistent on the right when a gap is introduced.

When the light sensitive rods in the retina are exposed to the bars in the left image the brain automatically exaggerates the difference in tone in the area of contact.

This is done by making the lighter tone lighter and the darker tone darker where they meet. This increases the definition between the bars and also creates the fluted effect seen above and in the example to the left.



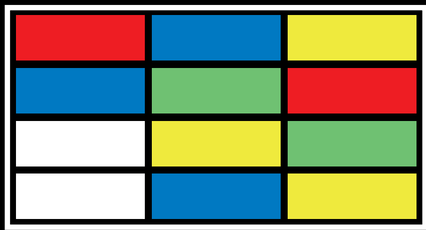
Sydney Harry's *Dark Moonshadow* ca.1968

Stroop effect

yellow	red	black
white	blue	green
green	red	yellow
blue	white	red

First of all read the words in the rectangle to the left as quickly as possible. You will probably find no difficulty whatsoever.

Now read the colours in the rectangle to the right. This time you will find the exercise a little more difficult as you are used to reading words – not colours.



yellow	red	black
white	blue	green
green	red	yellow
blue	white	red

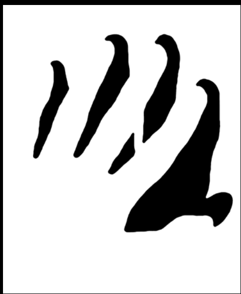
In this third example read the colours not the words. You will find this much more difficult and the task will take longer.

In 1935 John Stroop, an American psychologist, described the way the human brain has difficulty in coping with two conflicting pieces of information at the same time. He demonstrated this with his Reading Colour Names experiment.

In the third example above, reading the words rather than the colours is easier as reading has become an automatic process.

Answers

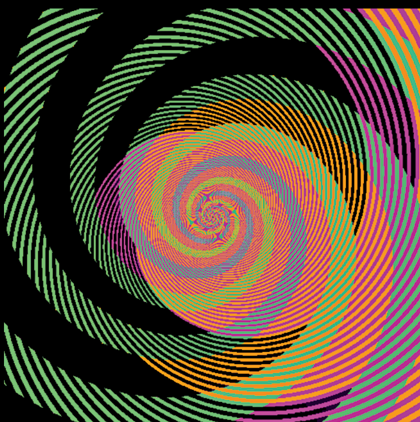
The pattern recognition pictures are:



a hand casting a shadow pressing against a wall

a Dalmatian dog, head down facing away

In the simultaneous contrast example there are only 3 colours used. The 'blue' and the 'green' are actually the same colour, but are perceived to be different. This can be seen when the adjacent colours are removed as below.

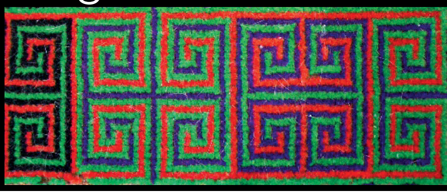


Why is understanding perception important?

For the majority of people, and certainly for designers, it is colour, tone and shape as a visual experience that is important. It is how they appear that conveys real meaning and acts as a stimulus to our emotions.

Because of this it is important that designers working with colour, tone, texture and shape fully understand that it is the viewer's perception that matters and this will be affected by the context in which these elements are placed. Once understood this will assist designers in avoiding mistakes and can also be used to their advantage in developing innovative designs.

Sydney Harry's command of the Law of Simultaneous Contrast enabled the production of this carpet design using only three colours of yarn



Sponsorship of this booklet is in remembrance of Derek Moorhouse, whose work in textiles and colour was an inspiration to others. May this booklet encourage you to achieve your full potential. The rest of your life is in front of you – make the most of your opportunities.

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