Teacher and Technician Sheet

In this practical students will:

- Carry out the practical, making careful observations about what is seen and whether there are any differences between group members.
- Use their knowledge and understanding of how we perceive objects to explain observations and the differences between group members' observations.
- Apply and test their explanations by altering the speed and designs on the spinners.
- Think about how differences in observations and misinterpretations of information may apply to other experiments, and what implications this may have.

Introduction for teachers:

(This topic could start with a group discussion on the idea of an optical illusion. Have they seen one and if so can they describe it? During this discussion the teacher introduces the following ideas, especially the words in bold.)

When we see, it is because the eyes have received **stimulation** from **light** and the **brain** has **translated** that stimulation into information.

The strange thing is that our 'eyes' can be deceived. This is because our brains can misinterpret the stimulation. When this happens we call it an **optical illusion**. An optical illusion is any effect that deceives the **eye** and **brain** into perceiving something that is not present or incorrectly perceiving what is present. There is a known strobing effect caused by some patterned (checked) clothing on black and white television or B&W programs on television that causes a colour effect.

An important area of illusion in art is the creation of the perception of a **three-dimensional (3D)** object from the **two-dimensional (2D)** surface of a painting. This is usually done using **shadow, line and shape**. In the eye, **depth** is perceived by a colour-blind process in which it is the different hues or **luminance** that determines depth to our vision of an object. Often an object is perceived because we fill in the detail based upon strategically placed shapes or upon the perception of an object at speed. This experiment is concerned with speed. The next experiment (How many black circles can you see?) is concerned with line, shape and colour.

Pupils can work in groups of three for the activity, each with a different style of Benham Disk. Three examples are provided on a separate sheet. This would allow for group work and promote discussion between groups of pupils.

It is important that the pupils discuss what they see without any prompts since each will see something slightly different. This can form the basis of a discussion about whether we can trust our eyes and what we see.

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Curriculum range:

All ages can take part in this activity since the aim is to gain some understanding of the thinking of the artist and psychologist when trying to understand sight and perception. It links with:

- setting up simple practical enquiries, comparative and fair tests;
- reporting on findings from enquiries and observations, including oral and written explanations, displays or presentations of results and conclusions;
- using straightforward scientific evidence to answer questions or to support their findings;
- asking questions and developing a line of enquiry based on observations of events in the real world, alongside prior knowledge and experience;
- using appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety;
- making and recording observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements;
- presenting observations and data using appropriate methods;
- interpreting observations and data, including identifying patterns and using observations, measurements and data to draw conclusions;
- presenting reasoned explanations, including explaining data in relation to predictions and hypotheses;
- the concept of an optical illusion and how it relates to the perception of the world around us; and
- how we see things and how that sight can be fooled by the use of line, shape and colour.

Hazard warnings:

There are no hazards in this practical other than the use of a pin to hold the card circle onto a pencil to allow it to spin freely.

Equipment:

- 1 piece of white card (about A4)

- 1 pencil with a good depth of eraser on the end of the pencil
- 1 black crayon or felt tip pen
- 1 protractor
- 1 pair of scissors
- 1 drawing pin
- Photocopies of the disk patterns (below)
- Electric hand held mixer (if available)

Technical notes:

Pupils can draw their own disks but they do need to be carefully drawn so for the first run it might be better for each to have a photocopy of one of the disks below. Once they have tried this they can make their own.

An alternative to the use of the pin method is to glue the disk on to a dowel rod, hold the dowel in an electric drill, and use the drill to spin the disk. Alternatively the disk is attached to a pencil or attached with blue tack to a hand held fan.

A hand held electric food mixer could be used and then the speed could be varied.

The higher the speed, the more stroboscopic artefacts can occur, due to the interaction of the cycle rate of some types of lamps and the display of the rotating wheel. The effect is similar to that of the backward rotating spokes on wheels in some movies. It might be better to do the experiment in daylight.

Students will probably be able to see the black and white effect give way to colour. Different colours can be observed in the different bands of the disk. These change depending on the pattern on the disk, the speed used and, perhaps, the observer.

Results:

To start with spin the disk at high speed. The arcs will appear in weak (unsaturated) colours, for example, a red-brown in the centre three arcs. By reversing the spin, you can change the colours. The effect is also present at slower speeds but in this case the hues may change. Different colours can be observed in the different bands of the disk. These change depending on the pattern on the disk, the speed used and, perhaps, the observer.

If you take a photograph of the spinning disk the colours will not be there.

Going further:

Try making different patterns such those examples of Benham Disks below.

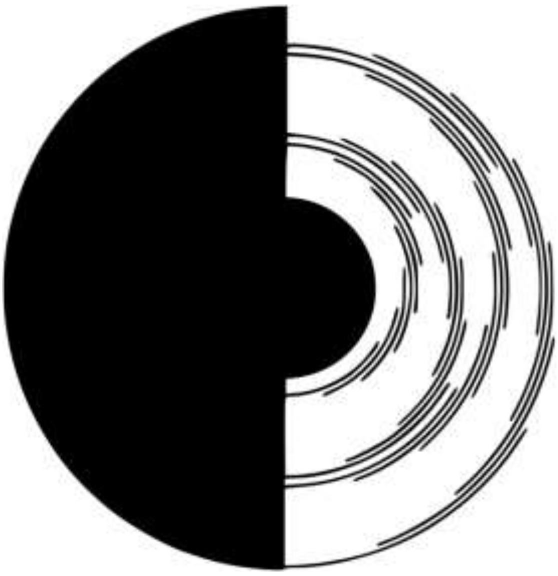
Try drawing your own design on the white half of your disk. Try spinning the disks at different speeds.

Use the same group of people to observe and compare the range of results.

Is there any pattern to the perceptions of the colour and shapes seen?

Does the same person see the same range of effects in each disk design?

Examples of Benham Disks:



Images courtesy of Wikipedia

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