Looking for Learning
Audition - Vision - Counting

Overcoming Visual and Auditory Developmental Deficits In Children and Teenagers

Information Booklet

A comprehensive introduction
for
Parents - Teachers - Therapists - Doctors
and
Specialists and Practitioners in the Field of
Special Educational Needs
from BlickLabor, Germany

Recommended Reading

Prof. Dr. Burkhart Fischer
Blick-Punkte
Neurobiological Principles
of Vision and Saccade Control
ISBN 3-456-83147-1
(only available in german)

Prof. Dr. Burkhart Fischer
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Introduction

This brochure gives an overview of the work of BlickLabor, its scientific basis and its practical application in dyslexia, dyscalculia, learning difficulties and ADHD.

BlickLabor offers assessment and training in low level auditory and visual processing. These functions are indispensable in nearly every learning process. Developmental deficits in auditory and visual processing can hinder reading, spelling, writing and arithmetic skills.

Overcoming developmental deficits makes learning easier and facilitates higher learning processes - in some cases it is the first step to enabling learning and reading processes in general.

Training in these fundamental skills is not a substitute for teaching and learning, neither is it a treatment for dyslexia, dyscalculia or ADHD. However, overcoming visual and auditory processing deficits provides a solid foundation school progress.

Contents

BlickLabor

BlickLabor today is a private research facility and assessment centre, which has been been promoted as an advisory board for over ten years by the University of Freiburg. BlickLabor's work is based on over 30 years of research into visual and auditory processing by the Optomotor Research Group at the University of Freiburg.

Research into Visual and Auditory Processing

Over this period a complete set of diagnostic tools and matching training programmes have been designed, scientifically standardised and evaluated. These are used to assess and improve the levels of low-level visual and auditory functions.

"Vision" and "audition" refer to neuro-processing functions, specifically to the transfer of incoming information from the eyes and ears to the various neural centres within the brain. All learning processes depend on the accurate reception and reliable processing of incoming signals from the sense organs. The various centres in the brain transform this incoming data into conscious perception. Consequently, it can be said, "*We do not see with the eyes and we do not hear with the ears, but with our brain!*"

Eye and Ear Tests

The eyes and ears, as physical sense organs, should be checked by a doctor, optician or hearing specialist prior to an appointment with BlickLabor. The diagnostic and training programmes at BlickLabor do not correct eye and ear weaknesses. These deficiencies may contribute to learning difficulties.

Diagnosing of Visual and Auditory Deficits

Vision, including saccade control (the control of rapid eye movement), subitizing (the recognition of patterns in a single glance) and audition (the discrimination of sound) are the basis of higher cognitive processing.

The standardised tests developed by BlickLabor assess whether the visual, auditory and subitizing capacities of an individual match the results of those of a similar age. Individual results are compared with those of an age-matched control group. Developmental deficits are diagnosed when individual results are significantly below the control group. In these cases a training recommendation is made.

Assessment, Training and Costs

Each assessment takes 20-30 minutes. A full assessment, including the analysis of the data, written report and a consultation, lasts about two hours. Assessment fees range up to € 280,-- depending on the number of areas tested.

Developmental deficits can be overcome by specific training programmes. These have been integrated into a hand held device that can be used for daily practice at home for a period of between three to five weeks. The rental for the device is € 95,-- plus a fee of € 3,-- per day.

At the end of the training parents receive a detailed written report. Regular, short daily training can correct deficiencies in auditory and visual processing as well as in saccade control and fixation.

Educational Implications

Research shows that improvements in visual and auditory processing transfer to learning in school. Students with dyslexia, dyscalculia and Attention Deficit Disorders tend to have developmental deficits between 30% and 70% below those of a similar age. Improved auditory and visual processing will not necessarily remedy all aspects of dyslexia but it ensures that students will not be disadvantaged by undiagnosed visual and auditory deficits throughout their school careers or throughout their lives.

The approach developed by Dr. B. Fischer, at the University of Freiburg, is a key strand in a strategy to overcoming reading, writing, spelling and number difficulties and complements existing educational approaches to dyslexia.

Visual Processing and Saccade Control

"Seeing" requires the active participation of the brain. "Seeing" does not only depend on the eyes as 'physical projectors' of pictures on the retina but also on the processing of the incoming signals by the brain and on the motility of the eyes.

In the centre of the retina of the human eye is a special spot called the fovea. This is the area with the highest resolution and the highest concentration of receptors and nerve cells. The fovea is the sharpest point of vision or acuity. The areas of the eye further from the fovea are less focused with less light, consequently peripheral vision is less sharp. Saccade control is the ability of the eye(s) to fix or focus on a particular point. To obtain a complete picture of the visual field a normal adult has to perform between 3-5 saccades or "snap-shots" per second, including the corresponding breaks, in order to bring all the visual field into focus. All the details are captured in these serial images. The brain organises this temporal sequence so that it appears to us as an unbroken image.

Try the optical illusions at the back of the book
to become aware of saccades!

The Optomotor Cycle

The continual process of fixation and saccades is performed automatically as part of the optomotor cycle. The voluntary control of the direction of sight is used to focus on specific targets and to ignore others. The functions of this cycle are: a saccadic eye movement performed by reflex, express saccade (8), control of the reflex by fixation, voluntary gaze control (14), attention (9) and the performance of voluntary saccades (11). These functions are measured and analysed under standardised conditions in two different tasks.

1. In the **Prosaccade Overlap Task** the person being tested focuses on a central stimulus until a new target randomly appears to the left or right. The time it takes to "fix" on the new target is measured. The fixation of the eyes on target is called a "saccade". Some people react too quickly ("express saccades") and tend to make more errors in visual processing.

2. In the **Anti-Gap Task** the person being tested focuses on a central stimulus as before, but when the new target randomly appears the person is instructed to consciously look away, i.e. to move the eyes in the opposite direction of the new target. The test measures the voluntary control of eye movements.

Eye movement is measured by infrared reflection. This is harmless and there is no physical contact with the eye. These tests permit the quantitative analysis of fixation, express-saccades and voluntary control. These methods can also be used as a supplementary diagnostic tool in neurology, psychiatry and other developmental deficits (5).

A detailed account of the neurobiological principles of vision and eye-movements can be found in Prof. Dr. B. Fischer's book 'Looking for Learning'.

The Development of Saccade Control

This tracking of the visual field by saccades is learned during the first years of life but it does not reach its optimum performance until the ages of 17 to 20. Some aspects of visual processing are well-developed by

the age of 10, acuity or sharpness of vision is even fully developed by the age of 7. However, the latest research shows that fundamental visual and aural processing of many children and teenagers remains uneven until the maturation is completed. From the age of 40 many performances decline.

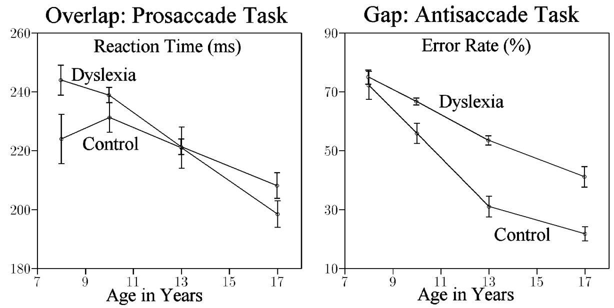


Chart 1 shows the age development of error-rates in the Anti-GapTask (right) and the reaction times in the Prosaccade OverlapTask (left) in the 7 to 17 year age range. These show that saccade control takes years to develop and mature.

The stability of gaze control also plays an important role in dyslexia and needs to be accurately assessed. Gaze control also develops until the age of 18 but it does not correlate with other variables in saccade control.

Dyslexia

Reading, writing and spelling make high demands on visual and auditory processing. Saccade control, the ability to focus and refocus the eyes on specific points, is essential for the acquisition of reading skills. If saccades occur too quickly insufficient information may be taken in and letters, words or phrases may be misread or skipped. If there is binocular instability, i.e. if one or both eyes drift from the point of focus, then reading may be both tiring and frustrating. Mirror writing, the reversing of letters and words may be symptomatic of deficiencies in neural processing that no amount of teaching will overcome.

Fluent readers perform an almost automatic and reliable cycle of saccades and fixation. They also intervene in this automatic process by voluntary action so they can, for example, pause over a longer word or backtrack in order to re-track a difficult phrase.

People with dyslexia struggle to read and write even though they are of average and above average intelligence.
BlickLabor analysed and compared the results of saccade control of

dyslexic and non-dyslexic children and teenagers. Chart 1 (right) shows systematic differences in errors between these two groups but not in reaction times (left). The gap in error rates is significant and increases with age. Even at age 7 children in the control group (non-dyslexics) are very weak in voluntary control of eye movements. However they make enormous and rapid progress to the age of 13 while the dyslexic children increasingly lag behind, by as much as 5 years in arrears.

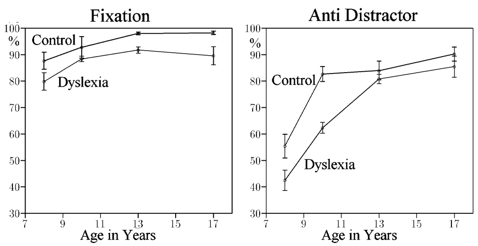
The percentage of children who are significantly below the levels of the control group increase from 30% in younger children to 60%in teenagers. Dyslexics not only have deficits in saccade control they also have solitary or a combination of weaknesses in audition, higher cognitive processing of incoming signals, memory and processing speech.

Dynamic vision

Visual processing depends on visual acuity (static vision) and on the accurate temporal separation of successively incoming pictures generated by rapid eye movements. This functional aspect of vision is called 'dynamic vision" and is the outcome of the magnocellular system (13).

The magnocellular system is linked to other brain structures in the pre-frontal cortex, which are necessary for the focus of attention and saccade control. Post-mortem dissections of human brains (10) and modern functional brain imaging (CRT) (3) show development deficits in the m-system of dyslexics (15)

A test was designed to analyse various sub-domains of dynamic vision. It requires the identification of the last orientation of a rapidly rotating stimulus. The test contains three sub-domains: Fixation (the stimulus rotates in the centre), Jump (the rotating stimulus jumps to the left or the right), and, Anti (the rotating stimulus occurs beside a distracting stimulus, challenging the person to ignore the distractor). Dyslexic children (as a group) show significant deficits in both the fixation and anti-task (Chart2).



The data in Chart 2 (left) shows that almost all children and teenagers are able to focus on a target. There is some development and progress until the age of 13 but little after. However, when the distractor is used Chart 2 (right) the failure rate increases, with growing deficits in dyslexic children to the age of 13. Peak performances are found in the 18 to 35 age range, but the average 45 year old adult does not achieve the results of 8 year olds.

Training in Saccade Control

Dynamic vision requires accurate saccade control. This fact can be used for training purposes as long as the other weak sub- domains in saccade control have been precisely identified through assessment. Chart 3 shows the data of dyslexic children before and after training. The reaction times of the prosaccades (mean values of the whole group) did not change significantly but the error-rate in the Anti-Gap task decreased significantly. About 85% of the school children who performed regular and frequent training improved in saccade control (6).

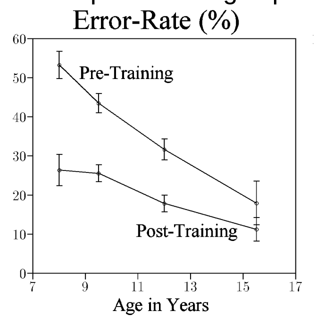


Chart 3

Monocular Training in Saccade Control in Binocular Instability

Binocular stability of gaze is determined by the measurement and analysis of both eyes simultaneously. Ideally, when focusing both eyes should either not move at all, or, move at the same velocity in the same direction. Different eye speeds indicate binocular instability. This may lead to reading difficulties. A monocular training (occlusion of one eye) is recommended when subjects have significantly longer periods of binocular instability than the control group. The maintenance of the angle of conversion is stabilised in 80% of the subjects (N=24).

Note: The effect of training on saccade control or binocular instability on individuals can only be verified by a follow-up examination of eye movements.

Training in Saccade control and Reading Skill Acquisition

It is unlikely that long standing difficulties in complex processes such as reading can be ameliorated by a few weeks training in saccade control.

However, if deficits in saccade control or binocular instability are the only or main problem there may be significant progress in a relatively short period. For example, after the training shown in Chart 3 a reading test was re-administered. There was an immediate reading improvement in approximately one third of the children. The reading test itself was not a sufficiently sophisticated instrument to record important changes. For example, some children decreased their reading speed (registered as 'worse') but also decreased their error rate ('better') and were graded under 'no significant change'. Other children improved their line tracking and improved the (re-) finding or current reading positions; others started reading independently or improved their handwriting.

Chart 4 shows the data from an experimental study of two dyslexic groups. Both groups were tested in saccade control and only those subjects who were significantly below age-matched norms were included. Only one group was given training in saccade control and both were given the same reading lesson. The experimental group that received training reduced reading errors by 45% while the control group managed a 22% reduction. Over half the participants in the experimental group reduced their error rate by over 50%, while no one in the control group did so. The benefit of training in saccade control in relation to reading was greater for older children than for younger.

The acquistion of reading, writing and spelling skills involves many brain centres and cognitive operations as well as muscular and emotional responses. It is improbable that one overall solution will be found for dyslexia. Consequently, a strategy is required tackle the range or reading difficulties Training in saccade control lays the foundation for scholastic progress by improving the reception of incoming data and it is a key strand in a strategy for tackling reading, writing and spelling difficulties.

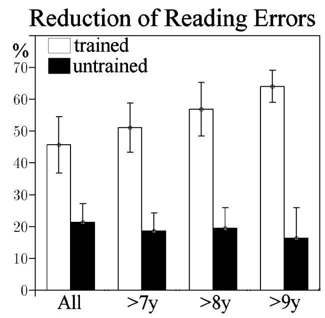


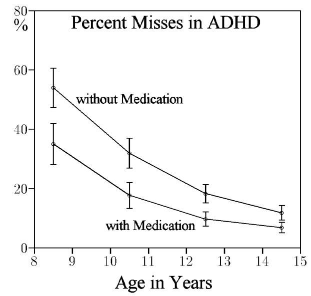
Chart 4

Attention Deficit (Hyperactivity) Disorder

AD(H)D covers a complex range of behavioural deficiencies. Key symptoms include hyperactivity, short-attention span, and lack of motor-control. The cause of these syndromes may be in the lack of frontal lobe functions (concentration, attention, focused action and planning of action). Many children with ADD or ADHD are also dyslexic and/or dyscalculic.

50% of all ADD children suffer from a weak voluntary control, i.e. they do not succeed in the Anti-Gap Task. The tendency to be easily distracted shows in the number of uncorrected errors in the Anti-Gap Task and an increased number of unexpected saccades during fixation periods.

Ritalin (active ingredient: Methylphenidate) is the most common medication. It is useful in many cases and improves saccade control (Chart 5) but only for a few hours (12). AD(H)D children improve saccade control with training irrespective of whether they are taking Ritalin or not. The improvements are usually stable, relapses are rare even if the treatment with Ritalin is discontinued.



Auditory Discrimination (Language Free)

Basic audition skills (low level auditory processing) develop and mature as an integral part of growing up. Normal daily practice in hearing and the acquistion of language skills contributes to a satisfactory level of development. Some children lag behind but there are no obvious indications until schooling begins. Problems then may manifest as reading, writing, spelling, arithmetic or other learning difficulties. Those children who sing or play an instrument develop their auditory skills. Low level (meaning 'fundamental') auditory skills can be rapidly improved in many cases by daily practice. The ability to discriminate volume, pitch and gaps is vital for decoding stressed or unstressed syllables and words, the rise and fall of speech, and the gaps within and between words. Blicklabor offers diagnosis, assessment and training in four areas of auditory discrimination:

Volume:	identifying which sound is louder or quieter
Pitch:	recognizing which sound is higher or lower
Gap:	recognizing longer and shorter gaps between sounds
Time Order:	identifying the order of two identical sounds heard right and left in random order

Chart 6 compares the results of auditory assessments of readers with and without reading difficulties from the age of 8 to 16 years.

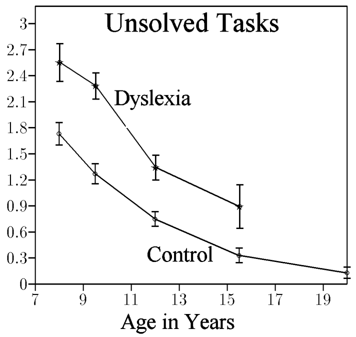


Chart 6

The dyslexic group lag behind at all ages. The analysis of the scatter of significant individual results of those in the dyslexic group rises from 30% in younger children to 70% in teenagers.

Transfer of Low Level Auditory Skills to Writing and Spelling

Deficits in auditory discrimination can be diagnosed, assessed and improved by evaluated training programmes. Success rates range from 40% to 80% depending on the task. Successful training in auditory skills transfers to language skills. This was demonstrated in research using nonsense words and a diagnostic writing test (17). Chart 7 shows the mean percentiles before and after auditory training.

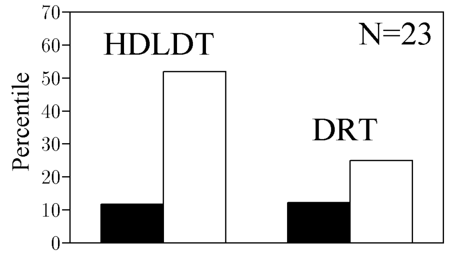


Chart 7

All subjects who previously had significantly low scores in spelling nonsense words gained age equivalent results after successful auditory training. Most of the subjects gained results in line with their chronological age (percentile 30 or better) in the diagnostic reading test. The best improvement in type of writing error was shown in the decreased number of perceptive errors. Errors in relation to writing rules showed no significant improvement (17).

Subitizing and Dyscalculia (Arithmetic Deficits)

Subitizing (from Latin 'subito" - at once) is a special (peripheral) visual capacity to recognize items in one short gaze. Deficits in the capacity may lead to problems in the acquistion of basic arithmetic. Number skills correlate with the recognition of small numbers of items. The development of this capacity can be measured and analysed by the subitizing test. In this test the subjects have to recognize a number of items (1 to 9 small circles) appearing randomly on a display for 100 milliseconds. A key- press records the number of items. Chart 8 compares the age development of dyscalculics with a control group.

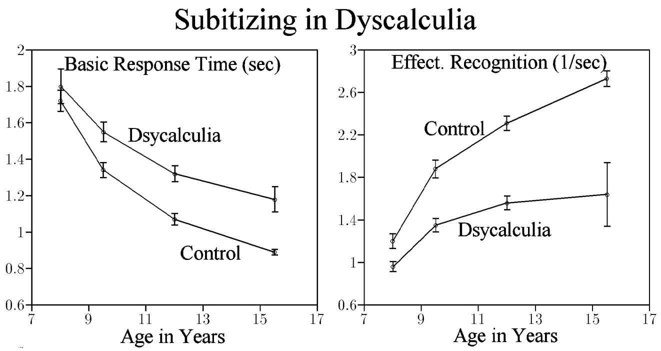


Chart 8

The capacity to subitize develops over time. Even 15 years olds have not reached adult norms. Dyscalculics exhibit developmental deficits from age 7 onwards. A study with the Pedagogical University of Freiburg, Germany showed that (depending on age) 40% to 70% of dyscalculics have deficits in subitizing.

Subitizing and Dyslexia

The assessment of dyslexic subjects in subitizing show similar results to Chart 8. The pattern of age development is replicated and 30% to 70% of dyslexics (depending on age) show significantly low (percentiles lower that 16) scores.

Training in Subitizing and Acquisition of Arithmetic Skills

The evaluation of the training of 160 dyscalculic children and teenagers showed a 75% improvement in both of the two relevant parameters (basic reaction time and effective recognition rate). Another 21% improved at least in one or other parameter. In a further study at a German elementary school a group (N=21) of dyscalculics aged between 7.5 and 8.8 years with developmental deficits in subitizing were divided into training and waiting groups and given a parallel form of an arithmetic test (DEMAT 2+). The first group received training in subitizing, the other did not. Both groups continued with their normal lessons during and after the training. After ten weeks of schooling each group re-took the arithmetic test when the training had been completed. Chart 9 shows before and after comparisons for each group.
Children who successfully completed the training improved their mean

scores significantly (in 7 out of 10 areas) by 4 credits (p=0.001), whereas the mean scores of the waiting group fell slightly. The best seven came from the training group and the four weakest came from the waiting group.

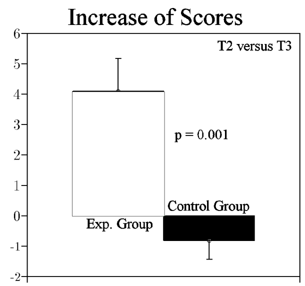


Chart 9

Developmental Deficits and Other Conditions

There are multiple causes of developmental deficits and they often involve brain functions. Depending on which areas and functional systems are affected, specific training could improve saccade control, visual and/or auditory processing.

Children with low range intelligence (who for this reason are not regarded as dyslexic but still have learning difficulties) often have weak frontal lobe functions which become apparent in the Anti- Gap Task. Many of these children attend various therapies. They may also benefit from training in dynamic vision, saccade control, auditory discrimination and subitizing in order to facilitate further developmental and learning processes. A study of 49 children aged 9 to 16 at a Special Needs Schools showed that most children were out of range in tests of visual or auditory processing. No child was in range in all the tests.

Latest Research News

These projects and investigations are currently running:
1. The effects of subitizing training on Dyslexia.
2. Problems of saccade control, vision and audition in pupils at special needs schools.
3. Language free and language related auditory discrimination and training measures for old people.
4. Subitizing and auditory discrimination in pre-school children.

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BlickZentrum Freiburg (FBZ)

FBZ is the hub and headquarters of all services offered by BlickLabor including research. It also co-ordinates BlickMobil partner practices and BlickLabor centres in Germany and abroad. All training devices are ordered and rented from FBZ. BlickZentrum is responsible for the maintenance and programming of training devices, the downloading and analysing of data, and the provision of detailed individual written reports. A phone number is available for frequently asked questions regarding training.

BlickLabor (Freiburg)

BlickLabor offers diagnosis, assessment and training to children, young people and adults in Freiburg, Southern Germany. Professor Dr. B. Fischer may also be contacted here.

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BlickMobil

Assessment and training is available in many areas of Germany and abroad. In addition, BlickLabor sends its own personnel to carry out assessments in partner practices throughout Germany, Switzerland, Luxemburg, Austria and other european countries. BlickLabor will also consider making special arrangements if there are several children to be assessed on one day. We make these arrangements because we want to minimise the family's travel time and costs. All testing equipment is provided by BlickLabor and the data is analysed straight away. Parents normally receive a written report at the the feed- back session. To find your nearest testing centre, please contact BlickMobil.

BlickMobil

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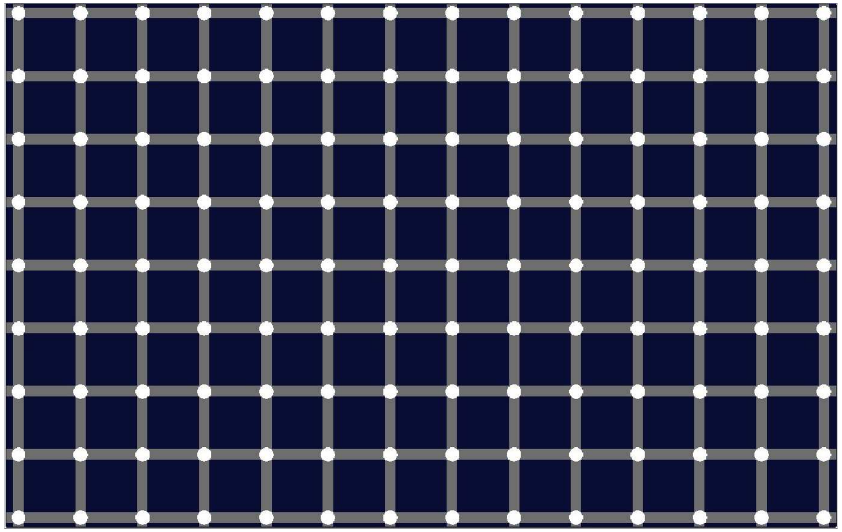
Experience Your Own Eye Movements

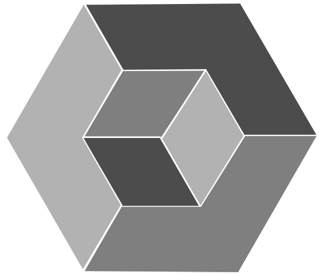


Look at this diagram. The white dots, situated where the grey lines cross, appear to flicker. This "flickering" is caused by rapid eye movements or saccades as the eyes focus and shift to different aspects of the optical illusion.

When you focus on one crossing to check whether a dot is black, it changes back to white. Flickering stops when you stop performing rapid eye movements or saccades.

The process of reading requires accurate and rapid eye movements in order to focus and track letters, words and sentences. Inaccuracies and slowness often lead to tiredness and reading difficulties. Training in visual processing can correct or
lessen deficiencies.

We do not see with the eyes, but with the brain.



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