Improving functional vision through training based on principles of behaviour analysis

(overview essay)

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Abstract: *This interdisciplinary article brings together teaching methodology based on applied behaviour analysis on one hand and the training of visual functions as used in special education on the other. It introduces the reader to issues of vision enhancement based on behavioural optometry and describes visual functions improvable by training. It also cautions against misconceptions and false promises as made by some providers of therapeutic services. The authors discuss in detail visual acuity exercises, eye movements and the evaluation of visual perception. Further, they address conditions and principles of behavioural training of visual functions and present practical examples of selected training procedures.*

Keywords: *behavioural optometry, applied behaviour analysis, ABC model, visual training, teaching, accommodation, convergence, fusion, vision*

1 Introduction

Social networks and various websites have recently become sources of misleading information, recommendations and instructions on how vision can be improved with exercise. An article published in 2020 under the title 'Eyes: Vision enhancement by exercise and modification of diet' states that people with visual impairment or blindness can attend courses where they will learn exercise procedures that produce a 'guaranteed' result. Further, this article claims that these courses get no mention in professional literature through efforts on the part of the health-sector lobby supported by manufacturers of eyeglasses aimed at preventing an outflow of customers (see 'Lepší oči' [Better Eyes], 2016; 'Děrované brýle – přirozené zlepšení zraku' [Pinhole glasses – for natural improvement of sight], 2017). So what is the reality? Most such articles draw from unsubstantiated or provably false information. Their purpose

is to extract money from the general public. In some cases, an author targets a group of people with serious visual impairment, promising to arrest deterioration or even a miraculous cure.

The procedures of behavioural optometry are based on scientific evidence. Behavioural optometry is a special optometric approach that uses elements of applied behaviour analysis in development in the USA since the 1920s. A. M. Skeffington, one of the founders of behavioural optometry, described basic areas of work leading to enhancement of the visual system as a whole. Behavioural optometry does not promise miracles. Its findings are applicable in the development of abilities connected with particular anatomical structures of the eye, so leading to enhancement of visual functions. The workings of behavioural optometry are based on a predetermined system of examination comprising tailor-made exercises and systematic evaluation of results.

2 Principles of behavioural training

A behavioural optometrist considers some, if not most, visual functions and abilities connected with vision learned behaviours. As many of these behaviours are learned in very early childhood, we have no memory of our own learning in vision. This explains why this way of thinking about vision may seem strange to us at first.

Exceptions to this are parts of the process of visual perception associated with reflex actions, such as narrowing or widening the pupils in reaction to changes in light intensity, or blinking when a gust of wind brushes the face or a speck of dust gets in the eye. These are not learned processes: they arise out of genetic predispositions and reflexive (i.e. independent of the will) actions by a living organism.

If we accept the thesis that vision is largely a learned behaviour, it is possible to apply general principles of learning not only for the enhancement of existing skills but also for correction of badly learned skills of vision and/or relearning of skills lost or diminished (due to accident or disability, for instance).

For the learning or training of visual functions, we can draw on basic principles of learning based on theories of behaviour as described by applied behaviour analysis, a scientific discipline concerned with understanding human behaviour so as to change it for the better (Cooper, Heron, Heward, 2007).

2.1 Vision and the ABC model

Behavioural optometry takes vision as a set of skills in the individual comprising behaviours that include the following: coordination of the extraocular muscles and the eyelid muscles, accommodation, ability to focus attention on a particular object or part of that object and maintaining this attention for a given time, ability to shift attention to a different object in the field of view.

The ABC model allows us to perceive every behaviour (B = behaviour), including vision in the context of and in connection with whatever immediately precedes that behaviour (A = antecedent) and whatever immediately follows it (C = consequence). When devising exercises informed by the behavioural optometry approach, we concentrate on the influence of/on antecedents and consequences of behaviour. The situations described in Table 1 below give examples of this. Whereas antecedents determine whether a given behaviour will arise or not, consequences affect whether in future such a behaviour will be more or less frequent or perhaps cease altogether. Although the consequence of a behaviour (C) cannot affect the behavioural act, for this has already occurred, it will affect the probability with which this or a similar behaviour will occur in future.

Table 1: *ABC examples*

Antecedent (A)	Behaviour (B)	Consequence (C)	Influence on future behaviour
Orthoptist's instruction to focus attention on a moving object	Focusing attention on and watching the object for a period of 10 seconds	Praise for successful completion of the task	Increase in frequency of focusing of attention
A powerful source of light coming from the right	Movement of the eyes to the right and focusing of attention on the source of light	Discomfort caused by glare	Decrease in frequency of looking directly at a powerful source of light
Presence of a book by a favourite author	Opening of the book and reading a chapter	Positive emotion and good feeling derived from the reading	More frequent reading books by this author in future

ANTECEDENTS (A)

We can perceive antecedents as stimuli or situations that come before the target behaviour in time (e.g. they occur immediately before performance of a visual act). The three basic groups of antecedents comprise (a) discriminative stimuli (SD), (b) motivating operations (MO), and (c) prompts. If we wish for a certain behaviour to manifest itself in an individual, these antecedents must act in the given environment at the given moment in the right degree. This applies to behaviours associated with exercises of behavioural optometry as to other behaviours. For this reason, a trained therapist – e.g. an optometrist, a low vision therapist, or a special educator – must ensure their proportionate impact at the right time. The management of discriminative stimuli, motivating operations and prompts is one of the so-called antecedent strategies, which should form part of every skills training exercise in behavioural optometry. Let us now look at the different antecedent types.

Discriminative stimuli (SD) signal to us whether or not a behaviour will be reinforced; in other words, whether it serves its function, so giving us what we expect

from it. The presence of SD signals the availability of reinforcement, so increasing the probability that a certain behaviour will occur in the individual. The absence of SD signals the unlikelihood of the behaviour leading to success (it will not be reinforced). Examples of a discriminative stimulus are the presence of a particular person (e.g. an optometrist or a low vision therapist) with whom the exercise is typically performed, and the instruction and/or challenge to perform the exercise.

Motivating operations (MO), also referred to as motivations, temporarily raise or reduce the value of reinforcement for performance of a target behaviour. MO is heavily dependent on satiation on the one hand and deprivation on the other. If, for instance, a person has gone for some time without imbibing liquid, he/she is subject to deprivation that manifests itself in thirst; the MO for liquids increases, as does the occurrence of behaviour leading to the quenching of the thirst. A therapist performing a behavioural optometrist's intervention can influence (in this case, raise) MO in his/her client by reinforcing (rewarding) the good performance of an exercise with an activity or a thing that is of high value but nor readily available to the client. These activities and things are highly individualized, so they must be adapted to each individual and set of circumstances, for purposes either of satiation or deprivation. For some, positive feedback from a low vision specialist is of great value; others (not least small children) will appreciate the picture they are given at the end of an exercise. If the intervention serves to affect (i.e. increase) the client's motivation, it is likely that his/her behaviour as associated with a particular exercise will occur with greater frequency and/or be of longer duration.

Prompts are special stimuli that help the individual perform certain behaviours he/she would not otherwise achieve. Prompts take different shapes and forms: a prompt can be physical assistance to initiate the performance of a certain exercise, the guiding of the client using verbal instructions, or the indicating of the direction in which the client should follow a moving object.

BEHAVIOUR (B)

A behaviour is any activity in an organism that is observable, measurable and repeatable. From the perspective of behavioural science, a behaviour is also an activity observable only by the individual concerned – in the form of thought, imagination etc. As mentioned above, learned behaviours can include a whole range of activities associated with vision. In order to change such a behaviour, learn new skills and/or eliminate ineffectual habits connected with vision use, it must first be defined in a way that can be observed and measured. Only thus will it then be possible to determine whether the intended change has occurred through the training of new vision-related skills. Such a description is referred to as the behavioural definition of behaviour. If, for instance, an exercise is performed for the improvement of binocular vision, it will be necessary to come up with a definition of the behaviour the individual should

achieve. This may consist in a description of the activity the individual will manage plus its circumstances, duration and result.

After the target behaviour has been thus defined, it must be properly recorded, and the records must be evaluated. Measurable behavioural characteristics include: frequency, i.e. the number of occurrences of a behaviour within a given time; the duration of the behaviour; elapsed time between the request and the start of the behaviour (known as latency); and intensity, i.e. the percentage of correct responses over a given period of time. Without records of behaviour, the initial state of a client's skills is impossible to determine, with the consequence that it is impossible to monitor the efficacy or lack thereof of the intervention. A basic rule of behavioural interventions (ergo interventions of behavioural optometry) is the making a decision on whether to continue and/or adjust the programme of intervention on the basis of measured data on behaviour. If the intervention does not have the intended effect on the target behaviour, the making necessary changes to the programme of intervention may be necessary to ensure positive results.

CONSEQUENCES (C)

For changes in behaviour including the learning of new vision-related skills, what comes immediately after the behavioural act (activity, exercise, etc.) is of the greatest influence. From the point of view of behavioural analysis, there exist five basic consequences of behaviour: positive reinforcement, negative reinforcement, positive punishment, negative punishment, and extinction. These five are not equally suitable for application in behavioural optometry. It is necessary to bear in mind that the terms 'positive' and 'negative' here do not mean 'good' and 'bad' respectively; they indicate whether a stimulus has been added to or alternatively removed from the environment. In the context of behavioural science, the meaning of the term 'punishment' does not correspond with that in common use.

Positive reinforcement

In the application of programmes of intervention in behavioural optometry, the principle of positive reinforcement should be used as often as possible. As a consequence of the client's behaviour, it increases the probability of future occurrence of a given behaviour. As for the positive nature of the reinforcement, a stimulus is added to the environment immediately after the client demonstrates the right behaviour. It is important to bear in mind that reinforcement can be considered such only if it results in higher probability of future occurrence of the target behaviour. Reinforcement can be considered anything that serves to reinforce. Social reinforcement typically takes the form of positive feedback or praise. It may also take the form of a sound signal to announce the successful completion of the exercise to the client. With children, this reinforcement may take the material form of a small reward (an edible sweet, for

instance) or a favourite activity. Reinforcement of a behaviour is highly individual. For this reason, a so-called preference assessment should be performed at the outset to establish which stimuli will serve as reinforcers in the individual in question.

Negative reinforcement
As with positive reinforcement, the consequence of negative reinforcement is an increase in the future occurrence of a target behaviour. Here, the word 'negative' means that a stimulus disappears from the environment after the individual demonstrates the target behaviour. Let us imagine a situation in accommodation training in which an aversive stimulus (an unpleasant noise, for instance) disappears as soon as the individual focuses attention on a given object. This principle is used in road safety; the aversive noise signals that the driver has not fastened his/her seatbelt, and it discontinues as soon as the driver fastens the belt. This principle has limited applicability in behavioural optometry.

Positive punishment
From the perspective of behavioural analysis, punishers are stimuli that follow an act of behaviour and reduce the probability of future occurrence of this behaviour in similar situations. Positive punishment contributes a new stimulus to the individual's environment. Let us imagine a pupil who has received a written reprimand for creating a disturbance in class. Although this punishment may serve to stop socially inappropriate behaviour, it has no impact on the forming of new behaviours or skills. The use of punishers is appropriate where the aim is to stop behaviour that may be dangerous for the client or his/her surroundings. Nevertheless, research has shown that the application of a punishment delivers a range of undesirable consequences. For this reason, punishment has limited applicability in behavioural optometry.

Negative punishment
Positive and negative punishment can arrest undesirable behaviour. With negative punishment, however, a stimulus from the environment will be diminished after the behaviour. Let us take the example of a child who has made a big mess in his/her room and so has been forbidden to play computer games that evening. The behaviour has resulted in the removal of a stimulus from the child's environment – in this case, provided by a tablet. Like positive punishment, negative punishment has very limited applicability in optometric intervention work with clients.

Extinction
The final possible consequence of a behaviour is extinction. This concerns the cessation of reinforcement in previously reinforced behaviour, so that the behaviour in question no longer yields what it once did. One might say that the behaviour is

no longer followed by a stimulus. This consequence leads to a gradual reduction in the incidence of the behaviour until the behaviour disappears entirely from the individual's repertoire. It is important to bear in mind that extinction is not in itself a way of learning a new skill. That skill must be built up gradually by use of principles of reinforcement. Extinction may be accompanied by a phenomenon known as an extinction burst. The behaviour in question may increase in frequency, intensity and/or variability for some time before it begins to decrease. Procedures based on extinction may be used in behavioural optometry where the aim is to eliminate inappropriate or non-functioning behaviour connected with vision. Such behaviour may result from various pathological conditions associated with visual self-stimulation. If we remove from the environment consequences that sustain the behaviour, the behaviour will lose its functionality and gradually become extinct.

When putting together a programme of intervention in behavioural optometry for an individual client, it is necessary to consider all parts of the ABC chain to ensure that (a) it contains a detailed description of target skills and behaviours to be practised and learned, antecedents that help in the setting of conditions to make it possible and, ideally, simple for the client to master the behaviour or skill, and (b) it exploits consequences for the influencing of the client's behaviour in accordance with the plan.

Visual functions suitable for development through exercise

Only the visual functions realized by the trainable anatomical structure of the eye can be exercised and improved. These functions include fusion, point and movement fixation and cooperation of the eyes for near vision, i.e. convergence, which is dependent on the functioning of the extraocular muscles for focusing on close objects; accommodation, which is related to the ability of the eye muscles to change the radius of the curvature of the lens; and eye-hand coordination. Visual impairments related to poor visual acuity, defects of vision caused by diseases of the retina and blindness cannot be influenced by exercise. Let us now look in more detail at functions improvable by behavioural therapy training.

Accommodation

Accommodation is the ability of the eye to refocus at different distances, i.e. to see clearly at distance and at close range. The ability to focus is determined by a field of vision defined by the closest and furthest points on which the eye can focus, respectively. In the course of a human life, owing to physiological change in the lens the closest point moves further away, making close-range focusing more difficult. Close-range focusing is achieved by means of a circular muscle that moves the lens, so changing its shape. The lens is connected to this muscle by a suspended device. The circular muscle has transverse striation, making it possible to train and so improve

the period of accommodation of near-vision focus. Application of this training is limited by the natural disruption to lens elasticity that tends to occur between 60 and 70 years of age. By this time, the lens is so hard that the circular muscle is no longer able to change shape and so focus at close range, resulting in the wearing of reading glasses (Hromádková, 1995).

Convergence

Close-range vision is also affected by convergence, one of the so-called vergence movements, by which the extraocular muscles move the eyes so that the image of the object of observation reaches the place on the retina where vision is sharpest. For near vision, both eyes move towards the nose, a movement known as convergence. The outward movement of the eyes away from each other is known as divergence. So that convergence is achieved for the subject to read and perform other close work easily, it is necessary for the extraocular muscles – as well as the accommodation apparatus – to be in good working order. The non-achievement of good convergence is manifested in the subject as increased fatigue, inattention, even double vision; in such a situation, it is necessary to train the (transversely striated) extraocular muscles (Hromádková, 1995).

Fusion

Fusion is the ability to combine visual information from both eyes in a single perception. In near vision, good fusion is highly dependent on convergence. If convergence is defective, fusion cannot be maintained, resulting in double vision. Fusion is also dependent on good alignment of the eyes. If, for instance, the subject has a strabismus (abnormal alignment of the eyes), there is no question of good fusion. Fusion can be trained and improved.

Strengthening functions of the visual centre

This can be achieved by special exercises for developing eye-hand and eye-foot coordination, which is manifested in faster assessment of visual phenomena by the centres of the brain and consequent reaction of the hand or foot.

Main aims of behavioural optometry

The principal aim of behavioural optometry is for the subject to achieve good coordination of the eyes during eye movements and fixation, good accommodation function, functioning eye-hand coordination, visual and integrated imaginativeness, prevention of visual stress and/or development of computer vision syndrome, and well developed sensory-motor coupling. The goal is to improve low-performance binocular vision to the point of optimization, to improve accommodation ability, and to detect and address various other symptoms that impair the performance of the eyes.

Completion of such training reduces the incidence of asthenopic difficulties in the client, which include headaches, problems with concentration, blurred vision, unstable text when reading, and apparent spots before the eyes. The training also reduces difficulties with refocusing for distance and difficulties with eye movements.

Behavioural optometry is not intended only for clients with visual impairments, however. The client is maybe someone who wishes to improve their visual functions. Such a client may be an athlete, e.g. a goalkeeper for whom a greater field of view means higher sporting achievement, or a gamekeeper, whose ability to keep the eyes in focus for longer makes performance of his occupation easier.

For successful application of behavioural therapy training, a test of visual functions must be performed before commencement of the intervention. This assesses visual acuity in each eye separately and both eyes together, the mobility of the extraocular muscles, convergence capability, and nerve function. In the course of behavioural therapy training the client obtains a lot of information about the quality of his/her vision and many recommendations for exercises for performance alone and/or using special aids (Vymyslický, 2007).

Behavioural vision exercises: procedure

The **first step** is a basic diagnosis of visual functions (visual acuity, visual field, eye movements). This is to determine the current state of the visual system and the client's subjective and objective difficulties, and to assess options available to the client.

A *visual acuity diagnosis* is performed using optotype wall charts with letters, pictures and LEA symbols.

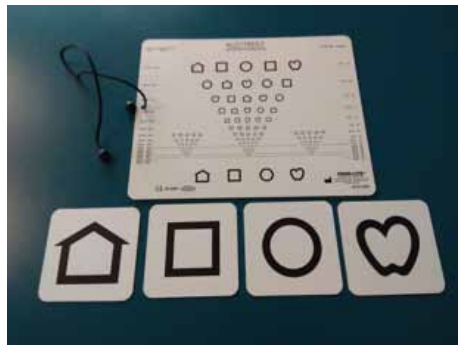

Figure 1: *LEA Symbols*

Visual field can be assessed by confrontation test. A confrontation test consists in the examiner sitting opposite the examinee. When the examinee's right eye is being tested, the left is closed while he/she looks directly at the examiner's open left eye (the examiner's right eye is closed). As the examiner moves a target object outwards,

inwards, up and down, the examinee should report where in the visual field he/she sees the object and when it disappears from view. If the examinee reports seeing the object at the same time as it is seen by the examiner, the examinee's visual field is judged to be in good order, as the visual fields are in confrontation.

An *eye movement diagnosis* is performed next. The examinee looks at the target object with both eyes as the examiner moves it inwards and outwards and in various directions, all the while observing the examinee's eye movements. The diagnosis can be supplemented with a cover test, in which each eye is covered in turn with a fogged covering aid; the examiner checks whether the eye that cannot see the target object at a given moment is stable, and, if not, how it deviates.

A suitable training programme for the improvement of the client's visual functions and a period of time in which this will be carried out are determined on the basis of this diagnosis. The client is motivated to complete the programme successfully. Finally, suitable practice aids are selected (Vymyslický, 2007).

The **second step** concentrates on correction of established errors of vision and training of good eye movement. Principles of behaviour analysis are applied for the correction of errors. Errors of eye movement result in difficulties with eye-hand coordination, disorientation when reading, including skipping lines, difficulties when copying text, and reduction of work-related performance and efficiency (Hosek, 1997).

The **third step** concerns accommodation diagnosis and training and convergence training. The diagnostic and exercise tool is shown in Figure 2. For diagnosis, the examinee looks through a flipper whose upper and lower halves are of different optical powers. The aim is first to focus through the upper half, then to look through the lower half and focus. Healthy eyes can manage 15 such changes per minute. If fewer than 15 changes are managed, accommodation training is needed (Vymyslický, 2011).

Figure 2: *Tool for accommodation diagnosis*

Work is concentrated on developing the ability of near-vision convergence for the long term. Further, it is concentrated on diagnosis of positive relative accommodation, flexibility of accommodation, width of accommodation, speed of accommodation and accommodation endurance. If any of the above parameters do not achieve the required functional quality, the entire visual system will experience difficulties. These manifest themselves in problems when reading, reduced perseverance when reading, and problematic switching between near and distance vision. Problems also occur with changes of viewing distance (e.g. when driving a car) (Vymyslický, 2008_a), (Vymyslický, 2008_b).

The **fourth and final step** is diagnosis of the quality of the visual system, using tests of visual-spatial ability (recognition of spatial orientation of an object), visual motor integration (eye-hand coordination), ability to analyse (visual memory) and visual-auditory integration (Vymyslický, 2008_c). This step uses a special aid called a Brock string.

Figure 3: *Brock string*

Activities in the exercise programme

The programme is so composed that each eye is trained separately; for instance, fixation, eye-hand coordination, reaction time etc. is trained in first one eye, then both eyes together. Performance of these exercises should be based on principles of behavioural therapy. The average daily training programme comprises a number of pre-planned activities of approximately 15 minutes' total duration. The aim is to achieve improvement of individual visual functions through exercises tailored to the needs of a particular person (Vymyslický, 2007_a).

Sample exercise 1: Eye movement / thumb tracking

The aim of this exercise is improvement of eye movement, accommodation and convergence.

Procedure: The client will watch his/her thumb – in horizontal, vertical and diagonal position, then at distance and at close range.

Step by step
1. The principle informing the exercise and the benefits to ensue from it are explained to the client.
2. The client performs the first round of the exercise; the instructor corrects errors.
3. The exercise proper is performed, first monocularly (right, then left eye), then binocularly, for 1 minute in each case.
4. After performance of the exercise, the client is praised.

Sample exercise 2: Simulation of accommodation

The aim of this exercise is practice of smooth, gradual and calm accommodation and convergence.

Procedure: The nearest point of observation is 30 cm from the subject, the most distant 2 m. The object of observation is moved closer and further away slowly and continuously. Alternatively, the client walks towards and away from a point on a wall.

Step by step
1. The principle informing the exercise and the benefits to ensue from it are explained to the client.
2. The client performs the first round of the exercise; the instructor ensures that the client fixates correctly on the distant point.
3. The exercise is performed by each eye separately, for 2 minutes in each case.
4. After performance of the exercise, the client is praised.

Sample exercise 3: Body position in space

The aim of this exercise is improvement of spatial orientation through the training of spatial vision.

Procedure: The client throws wooden skewers into a plastic tube. The client's task is to hit the target in all axes.

Step by step

1. The principle informing the exercise and the benefits to ensue from it are explained to the client.
2. The client performs the first round of the exercise; the instructor pays attention to how the client approaches the throwing of the skewers and whether he/she makes the maximum effort.
3. The exercise is performed. The client looks with both eyes simultaneously. The exercise lasts 3 minutes.
4. After performance of the exercise, the client is praised.

3 Conclusion

The training of visual functions within the framework of behavioural optometry is a demanding, long-term process. Performed correctly, however, it will glean positive results (Nováková, 2007). It is necessary to approach this training as a comprehensive methodology comprising demanding initial diagnostics, regular training that applies principles of behavioural analysis, and regular evaluation of progress and consistency in the client's performance. People who have undergone behavioural training of visual functions testify that it has improved their reading, writing, and performance of homework and schoolwork in general. They also state that they can now apply greater concentration to work and study, better understand written text, better manage stressful situations, that their powers of imagination have improved, and that they are generally more contented.

References

[1] Cooper, J. O., Heron, T. E., Heward, W. L. (2014). *Applied Behavior Analysis* (2nd edition). Harlow: Pearson.

[2] Děrované brýle – přirozené zlepšení zraku. (2017). *Jak zlepšit zrak* [online]. Jak zlepšit zrak [retrieved 2020-10-28]. Accessible at: http://jakzlepsitzrak.cz/derovane-bryle/.

[3] Hosek, E. T. (2007). Funkcionální optometrie – teorie a cíle. *Česká oční optika* [online]. 48(2), 50–51 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2007_02.pdf.

[4] Hromádková, L. (1995). *Šilhání*. Brno: Institut pro další vzdělávání pracovníků ve zdravotnictví v Brně.

[5] Nováková, M. (2007). Vizuální terapie. *Česká oční optika* [online]. 48(4), 32–33 [retrieved 2020-03-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2007_04.pdf.

[6] Oči – zlepšování zraku cvičením a úpravou stravy. (2020). *Úspěšná léčba: ucelené webové stránky o zdraví – příroda uzdravuje* [online]. Úspěšná léčba. [retrieved 2020-10-28]. Accessible at: http://jakzlepsitzrak.cz/derovane-bryle/.

[7] Vymyslický, I. (2007_a). Úvod do vizuální optometrie. *Česká oční optika* [online]. 48(3), 38 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2007_03.pdf.

[8] Vymyslický, I. (2007_b). Vizuální optometrie (Part 2). *Česká oční optika* [online]. 48(4), 32–33 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2007_04.pdf.
[9] Vymyslický, I. (2008_a). Vizuální optometrie (Part 4). *Česká oční optika* [online]. 49(2), 32–33 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2008_02.pdf.
[10] Vymyslický, I. (2008_b). Vizuální optometrie (Part 5). *Česká oční optika* [online]. 49(3), 34–35 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2008_03.pdf.
[11] Vymyslický, I. (2008_c). Vizuální optometrie (Final Part). *Česká oční optika* [online]. 49(4), 48-49 [retrieved 2020-09-24]. Accessible at: https://www.4oci.cz/dokumenty/pdf/4oci_2008_04.pdf.[12] Vymyslický, T. (2011). Vizuální optometrie v praxi [online]. [retrieved 2020-10-27]. Accessible at: <https://is.muni.cz/th/k18d9/>.
[13] Zdravý zrak přirozeně. (2016). *Lepší oči* [online]. Zrak pro život. [retrieved 2020-10-28]. Accessible at: https://www.lepsioci.cz.

Illustrations

Figure 1: LEA symbols

Vrubel, M. (2020). Personal archive.

Figure 2: Tool for accommodation diagnosis

Vymyslický, T. (2011). Vizuální optometrie v praxi [online]. [retrieved 2020-10-27]. Accessible at: https://is.muni.cz/th/k18d9/.

Figure 3: Brock string

Vymyslický, T. (2011). Vizuální optometrie v praxi [online]. [retrieved 2020-10-27]. Accessible at: https://is.muni.cz/th/k18d9/.

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