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14. Improving learning for children with intellectual disabilities with a focus on visual functioning

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Abstract Children with intellectual disabilities more frequently exhibit problems in vision than children without these disabilities. Assessment and treatment pose challenges to the eye health system. In this chapter the authors argue that assessment and intervention of visual problems in children with intellectual disabilities also should take place in a school setting. A theoretical framework and case illustration will be presented, followed by a discussion which sets out the implications for learning and development.

Keywords visual assessment | intellectual disability | visual functioning | vision stimulation | schools

INTRODUCTION

Vision has a unique position in learning. It connects us to others through the very first smile as a newborn, influences the development of motor activities, and helps us to understand our surroundings. Many brain areas depend on the visual inputs received through the eyes and are forwarded through a complex neuro-network. Childhood is a critical time for brain development and fundamental for developing vision qualities essential for children's functioning and learning. All learning is brain activity where new synapses are built or strengthened through stimulation and repetition (Lövdén et al., 2013). If the brain has sustained damage either before, during or after birth, these processes may be disturbed and may require more stimulation to develop. Children with intellectual disabilities have been found to have a high risk of having vision problems (Kaur et al., 2016). In the Netherlands 70–90 percent of children with intellectual disabilities have been found to have a visual impairment (Kaur et al., 2016). The numbers are similar in the UK (Black et al., 2019) and in India (Katoch et al., 2007).

Because vision is learnt and researchers have found that it is possible to develop vision functions through structured stimulation (Barraga, 1964; Cyvin & Wilhelmsen, 2008; Sterner, 2004; Wilhelmsen & Felder, 2021b), teachers should learn how this knowledge can be used in an educational setting for children with an intellectual disability. In Tanzania there is no mandatory vision screening of children, including children with an intellectual disability.

Built on the findings from Narayanasamy et al. (2016), who ascertained that nearly 70 percent of the activities in a classroom are vision-based, we will outline in this chapter that intact visual functioning is a pre-requisite for learning in school. We will first establish the theoretical framework by describing the vision process, visual assessment, and intervention and their importance for learning with a focus on learners with intellectual disabilities. This will be followed by illustrating assessment and intervention procedures of a child with an intellectual disability in a school in urban Tanzania before the discussion and conclusion.

This chapter is based on research conducted for an MA degree at Tumain University in Tanzania. The research was financed through the project *Securing Education for Children in Tanzania* (2017–2021) funded by the Research Council of Norway (NFR). Western Norway University of Applied Sciences (HVL) and its partners, Koblenz University of Applied Sciences, Germany, and Patandi Teachers College of Special Need Education, Tanzania, received project funds which focused on the significance of children's vision for reading and learning. The project arranged the CPD course *Vision for Reading and Learning* (30 credits) for teachers and special needs teachers. The course was modelled on the original education programme for teachers at HVL. The aim was to educate teachers in pupils' vision development, how vision functions can be assessed, and give insight in how vision impacts reading and learning. Through lectures and supervision from researchers and vision specialists from HVL (Felder et al., 2021), they also learned to implement stimulating vision lessons based on individual vision needs. Five candidates received scholarships to pursue a master's degree on this topic following the successful completion of the CPD course. The case study presented here was part of one of these studies. The author was at the time of study a special needs teacher of the intellectually impaired.

THEORETICAL BACKGROUND

The entire vision process starts with the eyes receiving light from the surroundings and forwarding it to huge neuro-networks and several brain areas where it is perceived as visual information connected to colours, forms, location, or movements.

These visual signals are put together in different locations of the brain and influence the development of functions like language, social, and motor activities and memories. Good visual information and memories are important for understanding the surroundings and developing cognition and reflective thinking. A well-functioning visual system is necessary for clear inputs needed in daily activities, social communication, and academic skills. Damage to this neurological network results in serious problems, including vision reductions (Alimović, 2017; Das et al., 2010; Joshi & Somani, 2013; O'Hara et al., 2010).

Vision problems connected to intellectual disabilities

In the brain there are intensive activities taking place for building and developing the neurological network. Synapses between different areas of the brain are established and strengthened through experiences, repetitions, and human interactions (Schiller, 2010). Researchers found that three-year-old children have more than twice the amount of brain activity than adults (Pellisier, 2016).

Although vision problems among children have a severe negative influence on their development and learning, their vision problems are very often undetected, especially when the child has an intellectual disability (Alimović, 2017). If the child is a slow learner or has problems with concentration, copying, hand-eye coordination, or learning in general, their challenges are most likely explained by their low intellectual potential rather than by disturbed vision functions (O'Hara et al., 2010; Oullette-Kuntz, 2005; Sutherland et al., 2002).

Children with an intellectual disability often have functional problems, including vision reductions (Alimović, 2017; Das et al., 2010; Joshi & Somani, 2013; O'Hara et al., 2010). In a study from India, 50 percent of 664 children with severe learning impairments had ocular disorders, or eye movement problems (Gogate et al., 2011). Particularly children with Down's syndrome have visual problems that need to be addressed by the eye health community (Wajuihian, 2016). The presence of a visual impairment in children with intellectual disabilities can compound the problems these children already face, since cognitive development in children can be altered, delayed, or even impaired depending on the severity of the visual impairment and educational intervention. An important question to ask is, however, whether disturbed vision plays a role and might negatively influence the child's behaviour, even their intellectual development and their learning (Cyvin & Wilhelmsen, 2008).

Most visual impairments in the world are due to treatable visual problems, such as refractive errors (WHO, 2021), which often require the prescription of eyeglasses. The problem is that those more treatable and perhaps less visible visual problems are not always assessed and treated properly. This is particularly true for children and youth with intellectual disabilities.

The number of children with an intellectual disability combined with vision problems differs in several studies. One reason is the criteria for defining a vision problem. Many researchers include only children with low visual acuity or blindness based on the WHO's old classifications system, ICD-10. Here a visual acuity of 0.3 or less at distance or a reduced visual field of 20 degrees is classified as low vision. Although the number of children with a visual impairment based on these categories is high, the new criteria for vision impairment in ICD-11 (WHO, 2020) have included those with a visual acuity less than 0.5 and even ocular motor problems and neurological vision disturbances shall be considered regarding functional vision. These are vision qualities often affected in children with an intellectual disability (Alimović, 2017).

The most frequent ocular motor reductions are connected to weak accommodation and convergence capacity and other binocular problems, which disturb the stereo vision and often result in double vision. Reduced accommodation gives blurry or unclear inputs, and weak convergence makes the gaze from each eye fixate on different spots. The result is that elements are seen double, or they might change position when tired (Stidwill & Fletcher, 2012). These confusing visual inputs may, among other things, lead to balance problems and dizziness, unclear information from the surroundings, challenges with performing activities where eye-hand coordination is needed, mixing the position of tiny inputs, misunderstandings non-verbal communication, and misinterpretations of visual information in social settings. Also, the concentration capacity and endurance for near activities will be demanding.

Stimulating vision

Vision problems are normally treated with refraction, surgery, and sometimes exercises. Daw (2014) claims that reduced visual acuity ought to be treated through activities, movements, and ocular motor exercises, and when needed refraction (eyeglasses) might be used. Of course, illnesses like cataract and corneal opacity must be treated first; therefore an ophthalmological examination to exclude eye health problems is necessary. Researchers have shown that structured stimulation makes it possible to get the eyes to work together and reach increased binocular functions (Cyvin & Wilhelmsen, 2008). Although it is important to start as early as possible, even adults might have positive effects from structured vision training (Voss et al., 2013). Different vision qualities can be improved through suitable exercises or vision stimulation, and a better visual acuity through steadier ocular motor functions can be achieved (Wilhelmsen & Felder, 2021b). Visual training is conducted by different professionals, like optometrists, opticians, teachers of the visually impaired, and occupational therapists when trained.

Nathalia Barraga (1964) was the first vision teacher to teach visually impaired children to use their vision better through structured vision lessons. She stimulated children's ability to focus on letters, pictures, and objects, compare them visually, and note differences, and in this way, she improved their overall visual perception. This programme improved their functional vision and resulted in positive changes in their learning and development. Later, other researchers have shown that structured vision stimulation and activities have a positive impact on children's visual, educational, and social development (Cyvin & Wilhelmsen, 2008; Sterner, 2004; Wilhelmsen & Felder, 2021b).

These improvements even increase children's reading skills (Wilhelmsen & Felder, 2021b). Wilhelmsen & Knudsen (2020) were able to show how vision and reading can improve through structured visual stimulation where visual functions, particularly accommodation, convergence, and binocular visual acuity, are strengthened through systematical challenges.

In a most recent study, Black et al. (2019) point out that eye health care provided in a special education setting has measurable benefits for children's vision and behaviour. This may be particularly true in Tanzania, where the health care system is stressed and where there is neither the eye health infrastructure nor the ability of parents to take their children to eye facilities or pay for treatment. In many countries it would be virtually impossible for children to receive vision training in a private office setting. In Tanzania 80 percent of people work in the informal sector without any health insurance, and 13 million Tanzanians live below the poverty line. Tanzania is ranked 159 out of 189 in poverty by the United Nations Development Programme (2019). Especially in the cities, people must generate their income on a daily basis (Suhr et al., 2020). Many families cannot take their children to an eye health care provider in a faraway hospital or spend money on glasses – particularly when the glasses break and must be replaced. Thus, the possibility of including vision assessment and structured vision stimulation in schools should be explored.

A stimulation programme must build on a thorough visual assessment. Das et al. (2010) point out that all children with special needs require this. Much too often the attention is paid to the child's primary disability, such as intellectual disability, and the visual impairment may be overlooked and thus not investigated (Dinukumar et al., 2019). It is sometimes a challenge to assess children with intellectual disabilities because they might lack the ability to cooperate and communicate at the required level (Dinukumar et al., 2019; Gogate et al., 2010), but with patience, a familiar environment, and material adaptation, it is possible (Das et al., 2010).

The time needed to improve vision and its use in daily life through stimulation depends on many factors. Some researchers have conducted experiments on shorter periods such as one lesson each day for three or four weeks (Wilhelmsen & Felder, 2021b) when others have had programmes over months. This was especially the case when Cyvin & Wilhelmsen (2008) trained a five-year-old girl with brain damage. In a period of five months, she went from having a visual acuity of 0.16 to 0.8, which was significantly better. This change in visual acuity means an increase in detail vision from a serious low-vision level (ICD-11) to an age-equivalent visual acuity (Wilhelmsen, 2012). The changes in her activity level were huge, and the functional effects included a much better balance, increased physical activities, more precise eye-hand functions, and more adequate social behaviour. Prior to the vision lessons she needed a walking frame due to her balance problems. The parents had been told that she would need this support for the rest of her life. But when her eye movements developed and her double vision disappeared, she could walk on her own (Wilhelmsen, 2010).

Inspired from case study research, the authors will use a case study design in the following paragraphs as a method to describe the assessment and intervention process of an 11-year-old child in Tanzania. The case study is used pedagogically to illustrate the complexity of the assessment and intervention process for teachers and educators among others. We want the teachers to obtain insights into the complexity of vision and how they can analyse the student's visual challenges and treat and stimulate them in an educational context so that novice teachers can understand the complexities of analysis and the possible search for solutions (Grauer, 2012).

THE ASSESSMENT AND INTERVENTION PROCESS – BARAKA

> As a research method, case studies also analyze a particular set of issues within the educational context and could easily be used in narrative form to serve as the basis of a pedagogical tool.
>
> (Grauer, 2012, p. 69)

We present here the case of Baraka. He is 11 years old and enrolled in first grade in a separate unit for children with intellectual disabilities at a public primary school in an urban area of Tanzania. He is one of 900 students at the school. Baraka has been diagnosed with a severe intellectual disability (AAIDD, 2010), which places him in an IQ-range of 20–35. He was chosen for the assessment and subsequent intervention because his teacher suspected some vision problems. Sometimes he rubbed his eyes, and often he covered one eye during near work. Baraka is ambulatory and communicates through gestures, single words, facial expressions, and even shorter sentences. His endurance is short, and he works slowly.

Ethics

Dignity and respect were important aspects in working with Baraka. It was important to make sure that he was not harmed in any way. It was important that the child knew the intervener well and vice versa. Particularly important was to know how he could comprehend instructions (verbally, through signs or pictures), how he communicated, and how he was most comfortable and motivated during the entire assessment and intervention. Thus, the principal investigator of his visual functions responsible for assessment and intervention was also his classroom teacher who specialized in educating children with an intellectual disability. In addition, the teacher had taken the CPD course *Vision for Reading and Learning* through the project. As a professional in educating children with special needs, the teacher was familiar with the ethical guidelines for this work (Harcout et al., 2011).

All the ethical rules for this assessment and intervention case study were followed by getting permission from Tumain University, the Meru District Executive Director, the Meru District Primary Educational Officer, and the head of the public primary school where the data was collected. The lessons during the intervention phase were part of Baraka's school day, and his parents received a letter with information about the new exercises in school and the purpose and use of them. Data collected were all confidential, no real names are used, and the data is only used for the purpose of this study.

Assessment – methods and materials

All information obtained was through record review, direct experience in working with Baraka, data collection, and observation. The assessment and intervention took place in the child's natural environment, the classroom, or a room adjacent to it. As Das et al. (2010) point out, those are some of the conditions that are important when assessing children with intellectual disabilities. Children with an intellectual disability can be challenging to assess (Gogri et al., 2015), and the assessment is complex and time-consuming. It requires the presence of people who know the child well. During the assessment some of Baraka's ocular motor functions and his visual acuity were measured with the tests presented in Table 14.1.

Table 14.1: The elements of vision assessment with instruments

Functions	Instruments used for screening
Distance Vision Acuity	LEA-VA-test for distance (3 m) with five symbols per row
Near Vision Acuity	LEA-VA-test for near (40 cm) with five symbols per row, and cover test
Accommodation	Push-up method with ruler and a fixation object with a tiny figure
Convergence	Push-up method with ruler and a fixation object with a tiny figure

Visual acuity: The LEA-charts are a collection of objective and standardized visual acuity tests (LEATest, 2021) which have been specially developed for and found useful for screening young children (Becker et al., 2002) and those with an intellectual disability (Eisenbarth, 2018).

The LEA-charts are used in many countries for mandatory vision screening of children (Griffiths et al., 2019). The results give an insight in the ability of the child to see tiny details to ensure that reduced vision is not disturbing the child's development, academic learning, or social life (CASH, 2021). Visual acuity is in many screening procedures only measured at a particular distance of 6 or 3 metres. The LEA distance chart is standardized for 3 metres. The symbols on the charts are clear and easy to perceive when the size is adequate: a circle, a quadrant, a house, and a heart. The children can even choose the names they find suitable for the symbols. The symbols are arranged with five on each row. The tests are even equipped with an extra pointing board for children who are not able to say or uncomfortable with saying the names of the symbols. The children must look at the chart from the actual distance and then point at the same symbol in front of them to indicate what they have seen. With Baraka the visual acuity was also measured at near with a LEA-chart designed and standardized for 40 cm (see Table 14.1). He needed a lot of time and encouragement to complete all tasks and a quiet environment to concentrate on the activities.

Accommodation and convergence

Together with an effective visual acuity, it is important to have a flexible, well-functioning, and precise ocular motor capacity so the gaze can move around collecting visual information from the surroundings. In Baraka's case the only ocular motor functions assessed were the accommodation and convergence capacities (see Table 14.1).

For clear and good vision inputs at near, the eye lenses must have a good capacity for accommodating their shapes to focus on the actual distance (Stidwill & Fletcher, 2012). At the same time the two eyes must turn inwards, converge, so the gaze from each eye can land on the very same spot. Only with a suitable accommodation and a precise and stable convergence is it possible to give the brain a clear and single picture. The accommodation must be kept stable even during the saccades, the very fine and fast gaze jumping, which is used for collecting information from pictures, the surroundings, or a text. If these oculomotor functions are weak, they will disturb a good visual acuity for prolonged work at near.

A difference between the near and distance visual acuity is often a sign of disturbed capacity for accommodation, but in addition to the visual acuity tests, a push-up test was completed for measuring accommodation and convergence (Table 14.1). This is an international standard procedure where the person being tested fixes their gaze on a tiny figure which is moved towards the area between the eyes (Koslowe et al., 2010). For accommodation capacity the person being tested must report when the figure turns blurry. For evaluating the convergence, the examiner checks that both eyes follow the figure the whole way forward towards the face. The normal range of accommodation and convergence is when the capacity is still there even between 7–5 cm from the eyes (Scheiman et al., 2003).

When assessing children with an intellectual disability, it is often difficult to get a reliable measurement of the accommodation because it is difficult to verbally tell the examiner when the figure on the fixation object becomes blurry or unclear. It is easier for the observer to get a more objective result of the convergence capacity. Here it is possible to observe if one or both eyes drift away from the gaze position they focus on. One eye or both eyes may turn outwards, inwards, up, or down. These tests require a professional observation competence. Baraka's teacher had this competence and used her observational skills to assess him.

Observation is a valuable supplement of information obtained together with standardized tests, structured techniques, and standardized methods (Cargan, 2007). Baraka was also observed for head position, tearing, lazy eyes, and time span used, distance from the forms, and his ability to see details in pictures.

Assessment results

Visual acuity: For children between 11–12 years the near visual acuity is normally 1.1 when measured binocularly, using both eyes together, with the near LEA-chart (Wilhelmsen, 2012). The diagram (Figure 14.1) shows that Baraka had a lower visual acuity at near compared to the 3 m distance. This was the case when he used each eye alone (od and os) and both eyes together (ou), binocularly.

Near visual acuity has normally reached the same level as the visual acuity at distance when the child is around 12 years old. This is because accommodation develops up until this age. Baraka has the same visual acuity level at distance when

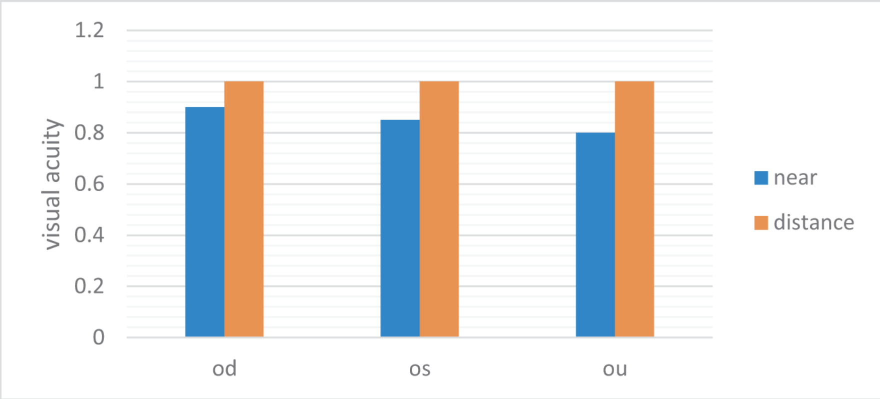

Figure 14.1: Baraka's visual acuity for the right eye (od), left eye (os) and for both eyes together (ou) at near (blue) and at distance (orange) measured with the LEA near and distance charts.

he looks with each eye alone as when he uses them together, binocularly (ou). This is not the case for his near visual acuity. Here each eye has a better visual acuity on its own compared to the result binocularly. With the right eye (od) alone he has the very best result (Figure 14.1). Mostly the dominant eye is the best eye so for him this could be the right eye. But Baraka's left eye is interrupting a clear image so much so that the binocular visual acuity is lower than even his best eye. This is a sign of binocular problems (Stidwill & Fletcher, 2012; Wilhelmsen, 2012), and probably it is the reason for why he often covers one eye for near work.

At distance the visual acuity is expected to be slightly better than at near because it does not require the same accommodation capacity (Wilhelmsen, 2012). Normally the binocular visual acuity will be somewhat better than each eye separately (Stidwill & Fletcher, 2012). Baraka reaches 1.0 with each eye alone and both together which means that he does not have binocular problems when his eyes are parallel, and the motor activities are easier.

Accommodation and convergence: Accommodation and convergence were measured with push-up methods where a tiny fixation figure is moved towards the face at eye-level to the area between the eyes. The accommodation test requires a good understanding and observation capability from the tested person. "Tell me when the figure turns unclear or foggy" is the task. This is a challenge with children and even sometimes with adults, so for a child with an intellectual disability the result might be rather inaccurate. For convergence measurement the teacher has to observe the eye movements and reactions of the child with the utmost care, and it is thus more accurate.

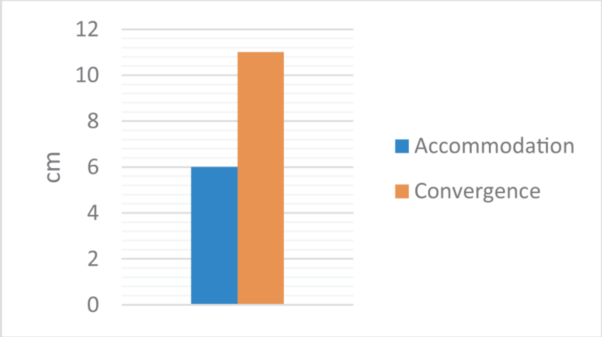

Figure 14.2: Baraka's accommodation result and convergence capacity on the first assessment.

Figure 14.2 shows a large gap between the accommodation of 6 cm and the convergence which is an observation of problematic binocular vision at 11 cm from the eyes. At 11 cm the eyes drift in different directions. When the gap between accommodation and convergence measurement is this large, it indicates that the accommodation result may be too good, perhaps incorrect. These two functions normally follow each other closely because there is a need to accommodate the lenses together with the convergence of the eyes when looking at something coming closer and closer (Stidwill & Fletcher, 2012).

The assessment results revealed that Baraka had problems with his vision, first of all in the area of visual acuity at near which could indicate accommodation problems. This was not found on the accommodation test which was, however, not that reliable because it probably was a difficult task. He also showed challenges connected to convergence which might give him double vision. This explains why he was covering one eye during near work in school. The tests, especially the near tests, were so challenging for him that his eyes started to tear up and the procedure was time-consuming due to his need for breaks.

In the next paragraph we will briefly describe the intervention process he went through with his teacher for the stimulation of disturbed vision functions.

Intervention – methods and materials

Exercises developed for stimulating visual fixation and other specific ocular motor functions were used in 14 lessons to see if they could strengthen Baraka's functional vision (Lane, 2005; Wilhelmsen & Felder, 2021b). When it comes to intervention, the lessons had to be built around Baraka's individual vision needs, his intellectual level, interests, and endurance capacity. This was done through motivating activities where accommodation, visual focusing, and rapidly reacting vergence/convergence are stimulated. The exercises and activities had to vary in duration, speed, content, and forms and sizes. During the activities the teacher observed changes in performance. It was important that his teacher worked with head and body position and eye-hand coordination and used monocular and binocular activities. The equipment used is presented in Table 14.2.

Table 14.2: Equipment used in the structured intervention for stimulating Baraka's ocular motor functions and visual attention

Vision functions	Equipment	
Visual acuity, fixation, accommodation, convergence, saccades	• Lettercards • Domino tiles • Number lists • Square blocks of different colours • Pictures of different sizes • Simple and complicated puzzles • Balls	• Small dolls • Coloured dots • Beads • Other tiny objects • Lists of letters used on different distances

A total of 14 lessons were spread over four weeks, and each lesson had a duration of 30 minutes. The teacher observed Baraka's head and gaze position and his non-verbal behaviour during the vision lessons. This required close and careful observations. It was important to see the distance he used for managing the tasks. Observations during the lessons were noted on a checklist for whether specific behaviour was present or absent (Jackson, 2008).

In the beginning of the vision lesson period, it was hard to motivate Baraka to do the exercises. But in the third lesson he managed better, and the motivation increased. The teacher analysed which activities he found motivating. A ball was used for example, and he was eager to throw or kick it when it was given to him but could not catch it or kick if it was moving towards him. This was probably also due to binocular problems with convergence and double vision. Since Baraka began to enjoy the activities, he wanted to continue with the lessons after the initial intervention programme was finished.

Results intervention

After the intervention period Baraka's convergence had improved from 11 cm to 4 cm. This indicates a stronger eye motor control and power which will give him clearer inputs and a better endurance for near work. Baraka saw also more symbols on the visual acuity tests, both at near and at distance after the intervention. This is probably an effect of better eye motor control, especially a steadier fixation (Srebro, 1983).

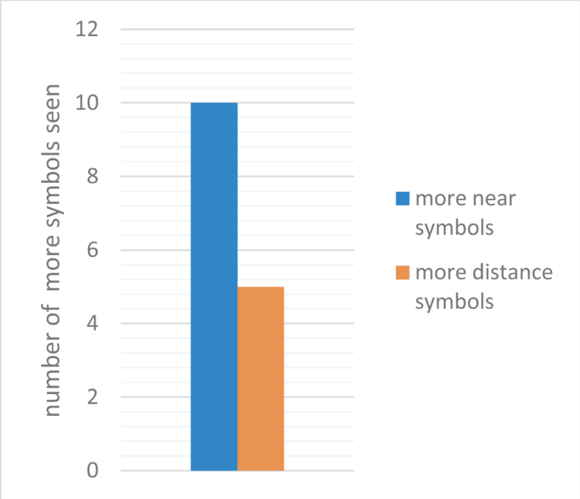

Figure 14.3: Baraka's changes in symbols seen on the visual acuity charts at near, blue, and at distance, orange.

The accommodation and convergence test were repeated after 14 vision lessons, and Baraka showed better results on both. On the accommodation test he said the figure was clear 2 cm closer to the eyes than on the first test. This result might be as unreliable as the previous test, but a better visual acuity at near is also a result of a strengthened accommodation. It is, however, difficult to quantify the change in accommodation because it relies on their own response.

When it comes to the convergence, he could keep his eyes fixated on the same place 5 cm in front of his eyes. This is a large improvement, and the result is now in the normal area (Wilhelmsen, 2012).

It is, of course, important to keep in mind that there is learning in repeating a test, but the results on visual acuity at near and the convergence were rather convincing and have to be seen together with Baraka's increased visual performing.

Two different checklists were used to record information about the child's vision before and after stimulation. One form was used for the test results and the other for observations of the behavioural performance or lack of performance. For Baraka it was observed that he had a straighter head position after the weeks with training. He managed the test quicker and his eyes were not tearing up. Even with his exercises he worked quicker, was motivated, and was able to find more details in pictures he was looking at.

The teacher who evaluated Baraka saw several changes in his behaviour and performance. He made good progress in these four weeks, much more than she had ever seen before. The results motivated the teacher to work further with systematic vision exercises with him and other students. She saw that Baraka made progress and was much more motivated to engage in near vision activities. His posture, visual attention, sports activities, and self-esteem all improved per teacher report.

DISCUSSION

Following the theoretical framework, a case study of assessment and intervention practices, was presented. The assessment revealed that Baraka had problems with visual acuity especially at near, as well as accommodation and convergence. After the intervention, it appeared that Baraka's visual functions improved and are comparable to other studies in this area (Barraga, 1964; Cyvin & Wilhelmsen, 2008; Sterner, 2004; Wilhelmsen & Felder, 2021a, 2021b). However, also other variables might have contributed to the improvement, such as his getting more familiar with the activities and tests and being more motivated to engage in the tasks during the intervention.

To be classified with an intellectual disability does not inform educators what kind of learning problems a pupil is facing. Baraka had a severe intellectual disability classified with an IQ between 20–35 (AAIDD, 2010). MentalHelp.net (2021) informs us that the American Psychiatry Association (APA) no longer uses IQ scores for classification but to identify the degree of support needed in the areas of conceptual skills as well as social and practical life skills. Their definition of a severe intellectual disability is:

> Severe intellectual disability describes 3 to 4 percent of this population. Communication skills are very basic. Self-care activities require daily assistance. Many individuals in this category will require safety supervision and supportive assistance. Residence in supported housing is usually necessary.
>
> (APA definition according to MentalHealth.net, 2021)

It is recommended that people with intellectual disabilities get support for their development, education, daily life, community living, employment, health and safety, behaviour, social activities, and security and rights (AAIDD, 2008). Detecting a vision problem and improving the children's visual ability could greatly contribute to improvements in those areas and thus result in a better quality of life. Currently, pupils with intellectual disabilities do not usually receive a vision assessment in Tanzania.

In a study by Alimović (2017), insufficient convergence and near point of accommodation were detected among many children with intellectual disabilities.

This was also the case for the child presented in this study. Even among pupils in the "normal" population these ocular motor problems are common, but as part of a neurological history they occur even more frequently.

The authors do not know what caused Baraka's intellectual disability. However, accommodation and vergence/convergence ability are based on complex neurological processes (Thiagarajan et al., 2011). If these are not developed properly or damage occurs, different ocular motor problems might be a result.

In the past years, the diagnosis of Cerebral Visual Impairment (CVI) has gained much attention in the field of visual impairments. CVI means that the brain is unable to process visual information which can lead to a spectre of vision problems, such as reduced visual field, low visual acuity, increased contrast sensitivity, and colour vision problems. In addition, there are often unstable fixation and other ocular motor problems. Children can also have difficulties with perceiving pictures, forms, and objects. This influences their eye-hand coordination and other motor activities. Children with CVI have often other disabilities, for example, intellectual disabilities (Zihl, 2021).

It is difficult to make any statement about a child's cognitive status if teachers don't know whether the child can visually perceive and process the information presented. Dinukumar et al. (2019) even advocate for a yearly comprehensive vision assessment for these children.

A paradigm change has occurred in some fields of visual sciences, namely, that some visual functions in severe visual impairments can be restored or developed through structured intervention (Sabel et al., 2011). The American researcher Christine Roman-Lantzy developed a programme of intervention particularly for children with CVI and multiple disabilities (Roman-Lantzy, 2018). Cyvin and Wilhelmsen (2008) showed that structured vision intervention improved vision in children with CVI. The effects of stimulation and training are similar to those of stroke patients (Poppelreuter, 1990; Zihl, 2000) and regular school children with vision disturbances (Sterner, 2004; Wilhelmsen & Felder, 2021a). These changes are probably due to the brain plasticity.

Children with severe intellectual disabilities must receive a comprehensive vision assessment. The authors feel very strongly that even though children with severe intellectual disabilities are difficult to assess for accommodation and convergence, these and other ocular motor functions should be part of any assessment. Gathering the assessment results and interpretation of the results is more time-consuming and requires input from teachers and parents and others on a multidisciplinary team. If not assessed, symptoms of accommodation and convergence problems such as avoidance of visual materials, blurred vision, visual fatigue, and transient vision (AOA, 2021) could be attributed to other visual causes and perhaps impact treatment and treatment choices.

It is crucial to understand vision challenges

Vision assessment and intervention in this population of children should be done by specialists who are experienced in vision and who know the group and their challenges. It is also important that someone who knows the children well and can communicate with them join the session. Parents and caregivers need to be made aware of the importance of vision for their children (Dinukumar et al., 2019). Schools and special education are a crucial factor in making sure that children's visual needs will be met:

> To meet the visual needs of children with disability, stronger links are needed between child development and community paediatric services, ophthalmology, and specialist education services for children with special needs.
>
> (Dinukumar et al., 2019, p. 11)

Vision develops through meaningful activities. This is especially important for children with intellectual disabilities. They need an environment rich in interactions with people and stimulating activities at their individual level. They need to be involved in literacy activities, in play, and in a range of activities fostering their visual capacities. Research has identified that direct instruction is an effective method of teaching children with intellectual disabilities (Çelik & Vuran, 2014). This also has to be taken into consideration when developing programmes for intervention. Improving children's vision may strengthen their verbal and non-verbal communication and their ability to use visual displays and aids, which can be of help during the assessment process. Children with intellectual disabilities may have refractive errors and may need glasses (Das et al., 2010). However, structured visual stimulation connected to ocular motor functions and visual sensory functions may be implemented as a first step (Daw, 2014). Baraka is a good example of such a stimulation programme.

Children with intellectual disabilities belong to the most vulnerable group of children. Assessments of their visual function should be part of their educational programme in order to provide them with the best learning opportunities possible – also in the area of visual functioning. Many professions might be involved in the assessment work – ophthalmologists, opticians, optometrists, and neuropsychologists – but teachers with insight into vision functions have to be responsible for the functional assessment and the education programme. Compensatory strategies such as large print or larger symbols and assistive technology may be helpful and needed but this should not replace interventions to improve visual functions and functional vision (Thiagarajan et al., 2013; Hussaindeen et al., 2018; Wilhelmsen & Felder, 2021a, 2021b).

Teachers with the knowledge and competence in vision assessment and training can design, plan, and implement the intervention for stimulation of better sensory vision and more precise ocular functions, and can improve the perceptual development. Baraka's example has shown that teachers can assess and stimulate children's vision so they reach their highest potential.

CONCLUSION

Children with intellectual disabilities are more likely to have vision problems than others. These problems are often connected to reduced visual acuity and different ocular motor disturbances including accommodation and convergence but overlooked and not dealt with in an educational setting. A thorough visual assessment is necessary for developing vision stimulation lessons as part of their education and total development.

REFERENCES

AAIDD. (2008). *Frequently Asked Questions on Intellectual Disability and the AAIDD Definition*. American Association on Intellectual and Developmental Disabilities.

AAIDD. (2010). *Intellectual Disability: Definition, Classification, and Systems of Supports* (11th ed.). American Association on Intellectual and Developmental Disabilities.

Alimović, S. (2017). Vision problems in children with intellectual disabilities. *Croatian Review of Rehabilitation Research*, *53*, 98–104.

AOA. (2021). *Accommodative Dysfunction*. American Optometric Association. https://www.aoa.org/healthy-eyes/eye-and-vision-conditions/accommodative-dysfunction?sso=y

Barraga, N. (1964). *Increased Visual Behavior in Low Vision Children*. American Foundation for the Blind.

Becker, R., Gräf, M., Hübsch, S., & Kaufmann, H. (2002). Examination of young children with Lea symbols. *British Journal of Ophthalmology*, *86*(5), 513–516. https://doi.org/10.1136/bjo.86.5.513

Black, S. A., McConnell, E. L., McKerr, L., McClelland, J. F., Little, J. A., Dillenburger, … & Saunders, K. J. (2019). In-school eyecare in special education settings has measurable benefits for children's vision and behaviour. *PLOS ONE*, *14*(8), Article e0222300. https://doi.org/10.1371/journal.pone.0220480

Cargan, L. (2007). *Doing Social Research*. Rowman & Littlefield.

CASH, Community Health. (2021). Distance vision testing (Lea symbols chart). *Government of Western Australia, Child and Adolescent Health Service*. https://cahs.health.wa.gov.au/~/media/HSPs/CAHS/Documents/Community-Health/CHM/Distance-vision-testing-Lea-Symbols-Chart.pdf?thn=0

Çelik, S., & Vuran, S. (2014). Comparison of direct instruction and simultaneous prompting procedure on teaching concepts to individuals with intellectual disability. *Education and Training in Autism and Developmental Disabilities*, *49*(1), 127–144. http://www.jstor.org/stable/23880660

Creswell, J. W., Vicki, L., & Clark, P. (2011). *Designing and Conducting Mixed Methods Research*. SAGE publications.

Cyvin, M., & Wilhelmsen, G. B. (2008). Et forbedret syn, grunnlag for motorisk, språklig og sosial utvikling. [An improved vision the basis for motor, language and social development.] *Spesialpedagogikk*, *3*, 28–34.

Das, M., Spowart, K., Crossley, S., & Dutton, G. N. (2010). Evidence that children with special needs all require visual assessment. *Arch Dis Child*., *95*(11), 888– 892. https://doi.org/10.1136/adc.2009.159053

Daw, N. W. (2014). Treatment of Amblyopia. In *Visual Development* (pp. 167–180). Springer. https://doi.org/10.1007/978-1-4614-9059-3_10

Dinukumar, A., Kalaiselvi, G., Fredrick, M., & Veena, K. (2019). Burden of visual disability in children with other disabilities. *Journal of Ophthalmic Science and Research*, *57*(1), 8–11.

Eisenbarth, W. (2018). Vision assessment in persons with intellectual disabilities. *Clinical and Experimental Optometry*, *101*(2), 267–271. https://doi.org/10.1111/cxo.12600

Felder, M., Wilhelmsen, G., & Schneiders, K. (2021). Developing "Vision-for-Learning" competencies among teachers in Tanzania—an innovative higher education initiative. *Creative Education*, *12*, 82–102. https://doi.org/10.4236/ce.2021.121007

Gogate, P., Soneji, F. R., Kharat, J., Dulera, H., Deshpande, M., & Gilbert, C. (2011). Ocular disorders in children with learning disabilities in special education schools of Pune, India. *Indian Journal of Ophthalmology*, *59*(3), 223–228. https://doi.org/10.4103/0301-4738.81036

Gogri, U., Al-Harby, S., & Khandekar, R. (2015). Visual function of children with visual and other disabilities in Oman: A case series. *Oman Journal of Ophthalmology*, *8*, 97–101.

Grauer, K. (2012). A case for case study research in education. In S. R. Klein (Ed.), *Action Research Methods* (pp. 69–79). Palgrave Macmillan. https://link.springer.com/chapter/10.1057/9781137046635_4

Griffiths, H., Carlton, J., & Mazzone, P. (2019). *Childhood vision screening in Europe*. Summary Report: Produced as part of Work Package 3. EUscreen, vision & hearing. University of Sheffield.

Harcourt, H., Perry, B., & Waller, T. (2011). *Researching Young Children's Perspectives. Debating the Ethics and Dilemmas of Educational Research with Children*. Taylor & Franscis.

Hussaindeen, J. R., Shah, P., Ramani, K. K., & Ramanujan, L. (2018). Efficacy of vision therapy in children with learning disability and associated binocular vision anomalies. *Journal of Optometry*, *11*(1), 40–48. https://doi.org/10.1016/j.optom.2017.02.002

Jackson, L. S. (2008). *Research Methods: A Modular Approach*. Cengage Learning.

Joshi, R. S., & Somani, A. A. (2013). Ocular disorder in children with mental retardation. *Indian Journal of Psychiatry*, *55*(2), 170–172. https://doi.org/10.4103/0019-5545.111457

Katoch, S., Devi, A., & Kulkarni, P. (2007). Ocular defects in cerebral palsy. *Indian Journal of Ophthalmology*, *55*(2), 154–156. https://doi.org/10.4103/0301-4738.30717

Kaur, G., Thomas, S., Jindal, M., & Bhatti, S. M. (2016). Visual function and ocular status in children with disabilities in special schools of Northern India. *Journal of Clinical and Diagnostic Research*, *10*(10), NC01–NC04. https://doi.org/10.7860/JCDR/2016/23615.8742

Koslowe, K., Glassman, T., Tzanani-Levi, C., & Shneor, E. (2010). Another look at Accommodative Amplitude Determination: Pull-away versus Push-up Method. *Optom Vis Dev*, *41*(1), 28–32.

Lane, K. A. (2005). *Developing Ocular Motor and Visual Perceptual Skills*. An Activity Workbook. Slack Icorporated.

LEATest.com (2021). *LEA SYMBOLS® CHART for vision rehabilitation*. https://leatest.com/catalog/distance-vision/lea-symbols%C2%AE-chart-vision-rehabilitation

Lövdén, M., Wenger, E., Mårtensson, J., Lindenberger, U., & Bäckman, L. (2013). Structural brain plasticity in adult learning and development. *Neuroscience and Biobehavioral Reviews*, *37*, 2296–2310. https://doi.org/10.1016/j.neubiorev.2013.02.014

MentalHealth.net (2021). *Intellectual Disability and Severity Codes*. https://www.mentalhelp.net/intellectual-disabilities/and-severity-codes/

Narayanasamy, S., Vincent, S. J., Sampson, G. P., & Wood, J. M. (2016). Visual demands in modern Australian primary school classrooms. *Clinical and Experimental Optometry*, *99*(3), 233–240. https://doi.org/10.1111/cxo.12365

O'Hara, J., McCarthy, J., & Bouras, N. (2010). *Intellectual Disability and Ill Health: A Review of the Evidence*. Cambridge University Press.

Ouellette-Kuntz, H. (2005). Understanding health disparities and inequities faced by individuals with Intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *18*, 113–121. https://doi.org/10.1111/j.1468-3148.2005.00240.x

Pellisier, H. (2016). Inside the preschooler's brain. *Great schools' org*. https://www.greatschools.org/gk/articles/preschooler-brain-development/

Poppelreuter, W. (1990). *Disturbances of Lower and Higher Visual Capasities Caused by Occipital Damage.* Oxford: History of Neuroscience series 2, Oxford Science publications.

Roman-Lantzy, C. (2018). *Cortical Visual Impairment: An Approach to Assessment and Intervention*. AFB Press.

Sabel, B. A., Henrich-Noack, P., Fedorov, A., & Gall, C. (2011). Vision restoration after brain and retina damage: The "residual vision activation theory". *Progress in Brain Research*, *192*, 199–262. https://doi.org/10.1016/B978-0-444-53355-5.00013-0

Scheiman, M., Gallaway, M., Frantz, K. A., Peters, R. J., Hatch, S., Cuff, M., & Mitchell, G. L. (2003). Nearpoint of convergence: Test procedure, target selection, and normative data. *Optometry and Vision Science*, *80*(3), 214–225.

Schiller, P. (2010). Early brain development research review and update. Brain Development. *Exchange*, Nov/Dec, 26–30.

Srebro, R. (1983). Fixation of normal and Amblyopic eyes. *Arch Ophthalmol.*, *101*(2), 214–217. https://doi.org/10.1001/archopht.1983.01040010216006

Sterner, B. (2004). *Ocular Accommodation: Studies of Amplitude, Insufficiency, and Facility Training in Young School Children*. Doctoral thesis, University of Gothenburg.

Stidwill, D., & Fletcher, R. (2012). *Normal Binocular Vision: Theory, Investigation and Practical Aspects*. J. Wiley and Sons.

Suhr, H., Müchler, B., Schiller, T., Karner, F., Kamp, M., El-Noshokaty, D., Ertl, V., & Kaiser, M. (2020). *Corona-Pandemie in Afrika: Mehr Armut, Krisen und Konflikte?* https://www.kas.de/de/web/tansania/publikationen/einzeltitel/-/content/corona-pandemie-in-afrika

Sutherland, G., Couch, M. A., & Iacono, T. (2002). Health issues for adults with developmental disability. *Research in Developmental Disabilities*, *23*, 422–445. https://doi.org/10.1016/s0891-4222(02)00143-9

Thiagarajan, P., Ciuffreda, K. J., & Ludlam, D. P. (2011). Vergence dysfunction in mild traumatic brain injury (mTBI): A review. *Ophthalmic and Physiological Optics*, *31*(5), 456–468. https://doi.org/10.1111/j.1475-1313.2011.00831.x

Thiagarajan, P., & Ciuffreda, K. J. (2013). Effect of oculomotor rehabilitation on vergence responsivity in mild traumatic brain injury. *Journal of Rehabilitation Research & Development*, *50*(9), 1223–124. https://doi.org/10.1682/JRRD.2012.12.0235

UNDP, United Nations Development Programme (2019). HDR 2019 Launch: Beyond income, beyond averages and beyond today. DECEMBER 31. https://www.undp.org/tanzania/news/hdr-2019-launch-beyond-income-beyond-averages-and-beyond-today

Voss, M. W, Erickson, K. I., Prakash, R. S., Chaddock, L., Kim, J. S., Alves, H., … & Kramer, F. (2013). Neurobiological markers of exercise-related brain plasticity in older adults. *Brain, Behavior, and Immunity*, 28, 90–99. https://doi.org/10.1016/j.bbi.2012.10.021

Wajuihian, S. (2016). Down syndrome: An overview. *African Vision and Eye Health*, *75*(1). https://doi.org/10.4102/aveh.v75i1.346

WHO. (2021). Blindness and visual impairments. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

Wilhelmsen, G. B. (2010). Kan det være synet? [Could it be the vision?]. Video. Mediesenteret, Høyskolen i Bergen. https://www.youtube.com/watch?v=CUErBuTQbew

Wilhelmsen, G. B. (2012). Children's functional vision. [*Barns funksjonelle syn. Gir synsvansker som ikke klassifiseresetter ICD-10 behov for tiltak*?] Høgskolen i Bergen. https://hvlopen.brage.unit.no/hvlopen-xmlui/handle/11250/2481338

Wilhelmsen, G. B., & Felder, M. (2021a). About the importance of vision screening by teachers in schools: A study from Tanzania. *Improving schools*, *25*(3), 1–18. https://doi.org/10.1177/13654802211004787

Wilhelmsen, G. B., & Felder, M. (2021b). Structured visual learning and stimulation in school: An intervention study. *Creative Education*, *12*, 757–797. https://doi.org/10.4236/ce.2021.124054

Wilhelmsen, G. B., & Knudsen, E. (2020). Reading starts as a vision process. In B. Hvidsten, I. Kuginyte-Arlauskiene, & G. Söderlund (Eds.). *Tilpasset Opplæring og Spesialpedagogikk i teori og praksis* [*Adapted training and special needs education in theory and practice*]. Fagbokforlaget.

Zihl, J. (2000). *Rehabilitation of Visual Disorders after Brain Injury. Neuropsychological Rehabilitation: A Modular Handbook*. Psychology Press Ltd.

Zihl, J. (2021). Zerebral bedingte Störungen der visuellen Wahrnehmung im Kindes-und Jugendalter (CVI) – eine mulitdisziplinäre Herausforderung für Diagnostik und Behandlung. *Blind-sehbehindert*, *141*(3), 231–235.