Seeing the Problem: Understanding vision as the first step in providing support

Rachel Pilling, Consultant Paediatric Ophthalmologist, Bradford Teaching Hospitals NHS Foundation Trust, UK; Professor of Ophthalmology, University of Bradford, UK

This article describes early visual development, discusses what 'vision' is and highlights the causes and features of visual impairment in young children. The intention is to provide the reader with an appreciation of the importance of understanding both what and how a child sees in order to provide an appropriate environment for them to develop and learn in.
Keywords: ??

If we are to fully understand visual impairment in children, we need to take a step back and first ask, What do we mean by 'vision'?

When we think about 'vision', most of us default to our ability to see letters on a vision chart. In order to see letters on a chart, a clear focused image needs to pass through the layers of the eye to the retina, generating an electrical signal which transmits down the optic nerve to the vision part of our brain. Problems with the 'eye' affect acuity, contrast, colour and visual field. Examples of these in early childhood might commonly be refractive error (needing glasses) or squint, or rarely cataract or an optic nerve developmental anomaly. Children with untreatable severe visual developmental problems due to eye problems can be said to have Ocular Visual Impairment (OVI).

TABLE 1: ELEMENTS OF VISION

Easier to measure elements of vision	Harder to measure elements of vision
Acuity	Visuo-spatial orientation
Contrast	Visual search
Colour	Visual memory
Visual Field	Motion perception
	Visuo-motor coordination

Vision, however, is made up of many components (see Table 1). Each of these develops at a different age. Some are easier to measure than others, and in the main, only visual acuity is typically recorded at an eye assessment. Whilst formal testing of other elements (for example visual field) in young children is difficult, observational assessment can determine if a child has a preference for one side over another, or if there is an area of visual inattention – a place where objects seem 'unnoticeable'. A key visual skill is to have effective visual search – to be able to scan our visual world to 'notice' things, to pick out objects from a busy visual background – and then coordinate a motor response to reach, grab, move, avoid, or throw an object. The ability to track moving objects is important in motor function; without this, objects seem to 'disappear' and need to be sought out in their new location. The ability to store images of objects, letters, faces and places in our visual memory is essential in order to attach meaning, for recall or to match and learn. Finally, the ability to create a virtual 'map' in our mind of a space, to recall locations relative to one-another, to store and recognise routes, enables us to navigate a room, a house, a building, a street and so on. Children with difficulties in one of more of these areas of visual processing may have Cerebral Visual Impairment.

CEREBRAL VISUAL IMPAIRMENT – THE ROLE OF THE BRAIN IN VISION

Children with neurodevelopmental problems may be unable to interpret or process visual information as described above (see Table 2). In short, the eye is normal, but the brain is not. These children are said to have Cerebral Visual Impairment (CVI). There will be a subset of children who have both OVI and CVI.

Cerebral Visual Impairment is the most common cause of childhood visual impairment in the UK, and the developed world (Teoh, 2021). CVI is like a patchwork quilt: each child will have a unique combination of visual strengths and difficulties, with some having a single area of dysfunction and others having multiple combinations. The diagnosis of CVI is not well established and is complex. It is unlikely it can be achieved in a single clinic visit and may take a series of observations and assessments for the clinician to acquire sufficient information on visual function to be confident.

TABLE 2: NEURODEVELOPMENTAL CONDITIONS COMMONLY ASSOCIATED WITH CEREBRAL VISUAL IMPAIRMENT

Hypoxic ischaemic encephalopathy (HIE) – brain damage at birth
Prematurity
Cerebral palsy
Hydrocephalus
Meningitis

WHAT DO WE MEAN BY SIGHT IMPAIRMENT?

Diagnosing a child as being visually impaired is not straightforward. Terminology such as 'blind' or 'partially sighted' is now outdated. Definitions of visual impairment differ by country; however, it is worth noting that in all cases, they are based on mature, adult vision (see Table 3). As we have learnt, vision develops in the first few years of life (see Figure 1). It may not be apparent in the first years of life whether a child with slow or faltering visual development will continue to improve and achieve good vision or remain visually impaired. It is worth noting that evaluation of visual acuity is based on both eyes open, wearing any glasses correction. A child with good vision in one and poor in the other is not considered partially sighted as, with both eyes open, their vision is normal.

TABLE 3: INTERNATIONAL CLASSIFICATION OF DISEASES 11 (2018) CLASSIFIES VISUAL IMPAIRMENT AS:

- Mild –visual acuity worse than 6/12 to 6/18
- Moderate –visual acuity worse than 6/18 to 6/60
- Severe –visual acuity worse than 6/60 to 3/60
- Blindness –visual acuity worse than 3/60

N.B. A person with 6/12 vision can see at 6 metres what a person with normal vision can see at 12 metres.

FIGURE 1: DEVELOPMENT OF VISION IN INFANTS

Keen-eyed readers will notice that these definitions refer solely to visual acuity. As is a recurring theme of this article, there is inherent bias in the use of visual acuity as a measure of vision. This is only part of the story – to be able to help children with visual impairment, we need to understand 'HOW and WHAT I see'.

COORDINATING SUPPORT: THE ROLE OF QUALIFIED TEACHERS FOR THE VISUALLY IMPAIRED (QTVI)

Around 80% of learning is using our vision. For this reason, Qualified Teachers for the Visually Impaired (QTVI) are a critical member of the team around a child with visual impairment. In the UK, any child with significant visual developmental problems should be referred into education services by the healthcare team. There are no specific vision thresholds for accessing services, but it is important to understand that any problem with accessing visual information will impact on the child's development overall. Early Years Teams provide community services and support transition into schools, offering parents advice and guidance on the type of provision which might best suit their child. Many use the Developmental Journal for babies and young children with Visual Impairment (DJVI) as a framework to support the family in learning how to help their child learn, to set expectations and suggest activities which can enhance the sensory world for a child with visual impairment (Dale, 2019).

SEEING IS HARD WORK

Underpinning any strategy to support a child with visual impairment is the need to appreciate how effortful using vision can be. For infants, it is said that 50% of neurological processing is devoted to vision. For most people, vision is subconscious and effortless, but any time a child with visual impairment is required to use vision at its limit will 'spend' energy.

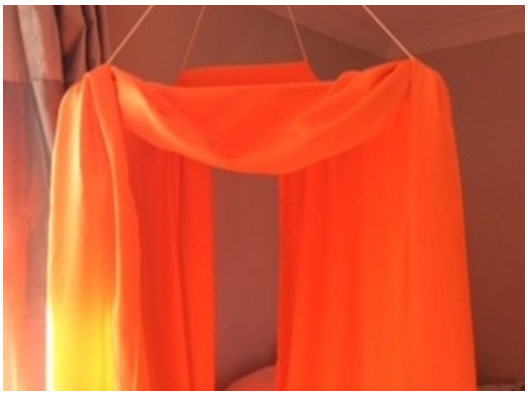
We can think of visual effort in terms of footwear. For most people, using vision is like wearing comfortable flat shoes or trainers. Tasks are effortless and can be done for long periods without trouble. However, for children with visual impairment, using their vision is like wearing stiletto heels - they can do just about anything you can do in flat shoes, but it is much harder work. You need regular rests to give you feet a break; you will get slower and more wobbly as the day goes on, and the effort can make you feel quite bad tempered! Anything we can do to make it easier for the child to see, so they aren't at the limit of their vision, can increase the accuracy and stamina of their vision. Breaking vision tasks down into smaller chunks, doing tasks early in the day, not late at night, and noticing when the child needs a break can have a big impact on the overall quality of learning he or she can achieve.

HOW CAN WE HELP CHILDREN WITH UNTREATABLE VISUAL IMPAIRMENT 'SEE' BETTER?

Parents are the most powerful advocates for their child. The parents who are most effective in this role are those who understand 'how' and 'what' their child sees. The diagnosis alone tells us little about how the child functions in a visual world. Medical reports tend to provide technical measurements which mean little in real life. Caregivers who can communicate to members of education and health care teams what size objects the child can see, in which location and for how long at a time, will facilitate professionals in providing appropriate interactions and interventions. The unique nature of each child's visual dysfunction makes developing standardised treatment approaches invalid and clinicians cannot simply apply the strategies which work for one child to another.

Children with profoundly reduced vision find it difficult to learn by experimentation. The world is too big and limitless to begin to understand or explore. Lil[illegible]lson (1[illegible]) describes how providing a sm[illegible], confined world with tactile boundaries allows a safe place in which to gain skills. 'The Little Room' is a place – a box, a corner of a room or even behind a sofa - which is large enough for the child to sit or lie inside. Similar to a baby's gym, objects can be hung from the walls of the box, allowing the child to learn by touch. Regularly changing the elements inside the box encourages curiosity.

One intervention which is gaining popularity is the Colour Tent (Pilling, 2019). A colour tent is a single-coloured fabric dome or curtain in which a child can sit or lie for 20 minutes each day. By reducing all other background clutter and providing a simplified visual stimulus, the child's visual system is able to access the visual input. Over a period of time, children who have previously shown no visual awareness begin to demonstrate visual responses to the colour tent. Single objects can then be introduced to the tent to allow the child to further develop their visual attention. Over time, some children are then able to access their visual attention outside the tent and use vision for learning. A similar approach has been found to be helpful for children with Autism Spectrum Disorder;



COLOUR TENT

using a black or dark coloured tent to reduce visual stimulation from bright colours or lights, enables the child to access visual information.

Amongst the complex and overwhelming information parents and caregivers may receive or read, there is a simple phrase to hold in mind:

MAKE IT EASIER TO SEE

Any action they can take which reduces visual effort will help the child see (see Box 2). Some of these principles have been used intuitively by parents with rewarding result as in the case studies below.

BOX 2: SIMPLY THINK: HOW CAN I MAKE IT EASIER TO SEE? (PILLING, 2022)

Bigger and brighter	Reduce other sensory input	Allow more time
Where I see best	Simplify background	Regular breaks
Higher contrast	Keep it still	One thing at a time

CASE STUDY: ISABELLE

Isabelle was diagnosed with nystagmus and cone dystrophy at age one. Her mum understood that seeing objects with poor contrast was challenging for Isabelle. Her visual acuity was very limited for distance even with her glasses on. Isabelle was struggling to join in her baby ballet class as she couldn't see the teacher's hands and feet well. Isabelle's mum asked the teacher to wear fluorescent yellow gloves and leg warmers so Isabelle could pick them out from the background and was able to copy her movements.

CASE STUDY: DYLAN

Dylan was diagnosed with autistic spectrum disorder and cerebral visual impairment before the age of three. He was unable to communicate verbally. He could see small objects very well but was unable to recognise faces. In the playground, he would not be able to find his mum. He would walk up to any adult looking like his mum and take their hand when he wanted to go home. Dylan's mum understood that seeing faces was a challenge for Dylan and began to wear red framed glasses to help him 'find' her. These frames were also worn by Dylan's nursery teacher so Dylan could 'find' her amongst the many people in the room, and by family members when they took Dylan to the park.

CASE STUDY: HASNAIN

Hasnain was diagnosed with cerebral palsy, was in a support chair all day and had a right sided visual field inattention. Hasnain's parents had noticed that sometimes he

wasn't interested in mealtimes at home. At pre-school, the teachers had commented that sometimes he was interested in joining activities, but not at other times. By understanding that Hasnain could only use the left side of his vision, his mum realised that when they were feeding him from the right side, he could not see the spoon. When his wheelchair was placed so his left side was facing into the room or the group, Hasnain could see what was going on and participate.

CASE STUDY: CHARLIE

Many children with visual impairment struggle at mealtimes if they cannot clearly see the food they are eating. Charlie's foster carer noticed that when he was given pasta, rice or mashed potato on a white plate, he had to use his hand to feel for them, and when the plate was on a white table, he pushed food off the edge of the plate. By using a bright blue plate, food was easier to see and mealtimes became quicker and less messy.

SUMMARY

This article has highlighted the changing landscape of visual impairment in children, demonstrating the importance of understanding the child's experience of vision in order to provide support. We have introduced readers to the concept of 'visual effort' and how tiring vision will be for children with visual impairment. The role of parent as advocate in describing the child's visual dysfunction, along with trying simple changes to 'make it easier to see', is apparent. Finally, the involvement of Teachers for the Visually Impaired in planning the child's educational provision should not be overlooked.

PRACTICE POINTS

- We see with our brain, not our eyes.
- Vision at birth is poor and develops rapidly in the first year of life. Most children achieve normal vision by age four years.
- Over half of childhood visual impairment is due to Cerebral Visual Impairment – the eye is normal, but the brain is unable to process the information it receives.
- Understanding HOW and WHAT a child sees is essential in order to provide strategies to support development.
- The involvement of Teachers for the Visually Impaired can support and guide parents and caregivers.

REFERENCES

Dale, N.J., Sakkalou, E., O'Reilly, M.A.O., Springall, C., Sakki, H. et al. (2019) Home-based early intervention in infants and young children with visual impairment using the Developmental Journal: Longitudinal cohort study. Developmental Medicine and Child Neurology, 61:697-709.

[illegible]one, J.F., Mitchell, P., Kifley, A., Rose, K.A. (2014) [illegible]ative visual acuity in infants and pre-school aged children in Sydney. Acta Ophthalmologica, 92:e521-9.

Pilling, R.F. (2022) Make it easier: 3-word strategies to help children with Cerebral Visual Impairment use their vision more effectively. Eye. DOI: 10.1038/s41433-021-01920-4.

Pilling, R.F., Little, S.M. (2019) Evaluation of the role of colour tent in vision stimulation for children with complex disabilities and cerebral visual impairment: A feasibility study. British Journal of Visual Impairment, 38(1):104-114.

Teoh, L.J., Solebo, A.L., Rahi, J.S. (2021) British Childhood Visual Impairment and Blindness Study Interest Group: Visual impairment, severe visual impairment, and blindness in children in Britain (BCVIS2) - A national observational study. Lancet Child and Adolescent Health, 5(3):190-200.

Williams, C., Pease, A., Warnes, P., Harrison, S., Pilon, F. et al. (2021) Cerebral Visual Impairment-related vision problems in primary school children: A cross-sectional survey. Developmental Medicine & Child Neurology, 63:683-689.