

I CAN'T BELIEVE MY EYES! SCREEN TIME AND ITS RELATIONSHIP TO VISION FUNCTION IN YOUNG LEARNERS

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Research has increasingly shown that vision, a crucial way in which we process the world around us, is much more complex than traditionally understood. Conventional vision examinations do not capture this complexity, and as a result, many problems often remain undetected. In addition to these undetected problems, the connection between vision and learning is not widely understood. The vast majority of learning relies heavily on a well-developed and diverse set of visual processing skills – examples include reading, copying from the board, or playing games that require hand-eye coordination. Children who struggle with vision problems often exhibit symptoms such as short attention spans, poor coordination, difficulty reading, writing and/or sitting still, which are frequently misdiagnosed due to their similarity to other learning difficulties such as Attention Deficit Disorder (ADD) and dyslexia. Anecdotal evidence from practitioners seeing a relatively rapid increase in vision problems suggests that this is driven by a change in children's environments. Although the reasons are bound to be multifaceted, a worldwide increase in screen time among children raises questions about the extent to which this is a significant cause of poor vision function. This paper first outlines the basic 'functional' vision skills, which are vital for accurate and efficient visual processing but are not measured by conventional vision screening examinations. Two case studies are presented that illustrate how vision dysfunction can manifest itself in student behavior and work. The relationship between screen time and vision function is explored, using a data set from a behavioral optometry practice based in Kuala Lumpur, Malaysia.

Keywords: Screen time, vision function, young learners

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In addition to these undetected problems, the connection between vision and learning is not widely understood. The vast majority of learning relies heavily on a well-developed and diverse set of visual processing skills – examples include reading, copying from the board, or playing games requiring hand-eye coordination (American Optometric Association, 2008). Children who struggle with vision problems often exhibit symptoms such as short attention spans, poor coordination, difficulty reading, writing and/or sitting still (American Optometric Association, 2008), which are frequently misdiagnosed due to their similarity to other learning difficulties such as Attention Deficit Disorder (ADD) and dyslexia.

Anecdotal evidence from practitioners seeing a relatively rapid increase in vision problems suggests that this trend is driven by a change in children's environments. Although the reasons are bound to be multifaceted, a worldwide increase in screen time among children raises questions about the extent to which this is a significant cause of poor vision function.

This paper comprises two parts. Part 1 outlines the basic 'functional' vision skills, which are vital for accurate and efficient visual processing but are not measured by conventional vision screening examinations. Two case studies are presented that illustrate how vision dysfunction can manifest itself in student behavior and work. Part 2 of the paper explores the relationship between screen time and vision function, using a data set from a behavioral optometry practice based in Kuala Lumpur, Malaysia. Using linear regression, the relationships between television and electronic device screen viewing habits and four different aspects of vision function were examined. Some results indicate potential links, particularly between device viewing time and vision function; overall however, the small sample size resulted in few statistically significant findings. Moving forward, further research is required, replicating this type of study with larger sample sizes.

TOWARD A BROADER VIEW OF VISION

What is Vision Function?

General awareness of the need for eye examinations is high in Kuala Lumpur, with eye health care provided by all major public hospitals, private care providers accessible throughout the city as well as a concentration of specialist care providers in urban areas (Patel et al., 2011). However, the emphasis in policy and research is strongly skewed toward blindness and visual impairment, with

little recognition of the importance of broader vision functions. The 1996 National Eye Survey, for example, makes no reference to alignment, focus, peripheral vision or eye movement issues, collecting data only on visual acuity measures and eye conditions related to blindness (Zainal et al., 2002), and the National Eye Database does not collect any information relating to vision function (Goh et al., 2008). Furthermore, the 2014 National Eye Survey sample consists only of individuals beyond the age of 50 years, resulting in a lack of up to date nationally representative data on the eye health of Malaysian children (Ministry of Health, 2014).

Learning related vision problems fall into two broad categories: visual efficiency and visual information processing (American Optometric Association, 2008). Visual efficiency (or vision function) refers to basic visual physiological processes (American Optometric Association, 2008). Visual information processing on the other hand involves higher brain functions, including the non-motor aspects of visual perception and cognition, and their integration with motor, auditory, language, and attention systems (American Optometric Association, 2008). These aspects of vision are not the focus of this paper.

In the following section, five broad categories of vision function are described: (a) Central vision¹, (b) Eye movement², (c) Alignment³, (d) Focus; and (e) Peripheral vision. The descriptions provided here are not intended to be read as technical ophthalmological definitions; rather, they are composite measures grouped under broad categories of vision function that are accessible for parents and practitioners alike.

Central Vision

Central vision, also known as visual acuity, refers to the detailed vision that requires fine, sharp, straight-ahead vision essential for activities such as reading or driving. Central vision is typically measured in general eye screenings with the commonly used 20/20 vision examination, which measures the clarity or sharpness of an image seen from a 20-foot distance. Issues that can be detected with the 20/20 vision examination include well known conditions such as myopia (nearsightedness) and astigmatism.

¹ Includes conditions such as myopia (nearsightedness), hyperopia (farsightedness) and astigmatism.

² Includes saccades movements (fast eye movements used to change the direction of fixation rapidly); vergence eye movements (to change fixation from a far to a close target); and combined movements (used when looking at objects in the space needing a shift of gaze both in direction and in depth).

³ Includes issues such as strabismus; insufficient convergence and divergence recovery.

Eye Movement

Eye movement refers to the ability of the eyes to perform functions such as fixating, tracking, shifting gaze and scanning. Fixation refers to the ability to direct a gaze and hold an object steadily in view. Tracking refers to the ability to use the eyes to follow an object, a skill used, for instance, when throwing and catching a ball. Shifting gaze is the ability to fixate on an object, shift visual attention to another object, and then return to the first object. This skill is necessary when copying notes from one source to another, or shifting from one line to another while reading. Scanning is used to search for materials, for instance, to look for information on a page or locate a book on a shelf. A child experiencing difficulty with eye movement may demonstrate excessive head movements when engaged in visual activities.

Alignment

All visual activity involves each eye sending a separate, slightly different image to the brain, where the images are combined into a single image. Eye alignment, also known as eye teaming, allows binocular vision that enables both eyes to work together in a precise and coordinated way. Dysfunctional eye alignment can cause double vision, and negatively affects depth perception. Children with difficulty focusing may squint, blink excessively or move forwards and backwards as they read or look at a screen.

Focus

The ability to focus enables the eyes to maintain a clear image of an object as its distance varies, or adjust as the eyes shift from a point close by to one further away. This process is also known as accommodation. An inability to focus can result in a blurred image, a time lag before the image becomes sharp, or an image that moves in and out of focus. It is common for the ability to focus to reduce with age, and it can also be negatively affected by fatigue. However, difficulty focusing observed in children indicates vision dysfunction. Children with difficulty focusing may demonstrate similar symptoms to that of poor eye alignment.

Peripheral Vision

Peripheral vision refers to side vision, or all that is seen by the eye outside of the central area of focus. Symptoms of peripheral vision loss include the sensation of seeing through a narrow tube, or 'tunnel vision', decreased ability to see in dim light and/or difficulty in navigating while walking or driving. Children who lack peripheral vision often fail to respond to their name being

called, are exceedingly startled when interrupted, or are described as ‘lost in their own world’.

Apart from central vision, these aspects of vision function provide a basic glimpse of the complexity and nuances in the process of ‘seeing’. Most vision function deficiencies do not occur in isolation, as a majority of patients have difficulty in multiple areas (American Optometric Association, 2008). The different vision functions can also be interrelated, often complicating a clear cut diagnosis (American Optometric Association, 1998). For instance, a child struggling with poor eye alignment may be using a high level of effort and energy to read, which then results in eye fatigue and an inability to focus as the eyes become worn out. In this case, poor alignment has resulted in poor focus. Another situation might result in the opposite effect: poor alignment, for instance, may lead to heightened eye movement and focusing performance as the eyes compensate for the reduced eye coordination.

The importance of vision function to learning is widely documented in the literature particularly as it relates to reading performance (Grisham et al., 2007; Kulp & Schmidt, 1996; Young et al., 1994). A study of children aged 5 to 7 years showed a relationship between accommodative function, depth perception and reading test scores (Kulp & Schmidt, 1996). Several studies have found that children with dyslexia demonstrate vision skills deficiencies in eye movement compared to neurotypical children (Bucci et al., 2009; Tiadi et al., 2016), and other research has found that large proportions of poor readers have some kind of vision skill deficiency (Grisham et al., 2007).

At least 20 percent of individuals with learning difficulties have vision function issues (American Optometric Association, 2008). A study comparing students on Individual Education Plans (IEPs) (individualized learning goals for students with learning difficulties) to students without such plans found that the IEP group had significantly poorer vision function (Quaid & Simpson, 2013). A study of children with learning difficulties in Malaysia resulted in a similar finding; nearly 30% of the children in the sample displayed vision skills deficiencies including poor alignment and focus (Muzaliha et al., 2012). Additionally, there is an overlap between the symptoms of poor vision function and attention deficit disorder (Granet et al., 2005), creating the possibility of misdiagnosis if vision issues remain undetected.

There remains considerable debate as to whether these vision problems are a cause or symptom of learning difficulties (American Academy of Pediatrics, 2009). However, it is evident that good vision function encompasses far more than the 20/20 test. Also, the recognition and diagnosis of vision issues is far more complex and challenging than traditionally believed; particularly in the case of students with learning difficulties, broader eye examinations can shed light on the challenges faced. The following case studies provide real life examples of vision dysfunction as seen in student work and behavior.

Case Study 1: Vision is Connected to Academic Performance

Stewart was a cheerful 12-year old student who complained that the words were moving around the page, often skipped lines and lost his place when reading, and had difficulty copying from the board. At his desk, he would often place his forearm on the table and rest his head on it, reading or writing extremely close to the book or paper.

The first work sample here shows that Stewart struggles to keep his letters and numbers at a uniform size. His spatial awareness of the page is also limited – for instance, he does not write his answers in the space allocated by his teacher and completely ignores the lines on the page. He writes his second answer inside the margins, and the periods are also unusually large and pronounced.

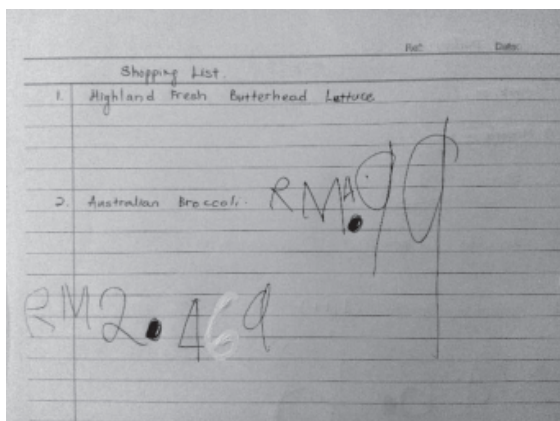


Figure 1. Writing sample from a child with vision dysfunction.

The second work sample shows an exercise where Stewart was required to find and mark the appropriate coordinate, and then write the corresponding letter next to it. Although gridlines are provided for guidance, Stewart needs to draw darker lines in order to successfully mark the coordinate. Even after drawing these lines, some of the coordinates, for instance, points 'f' and 'g', are not marked accurately. A number of eraser marks point to a struggle to successfully complete the task, rather than a lack of interest or effort that is often attributed to children with visual difficulty.

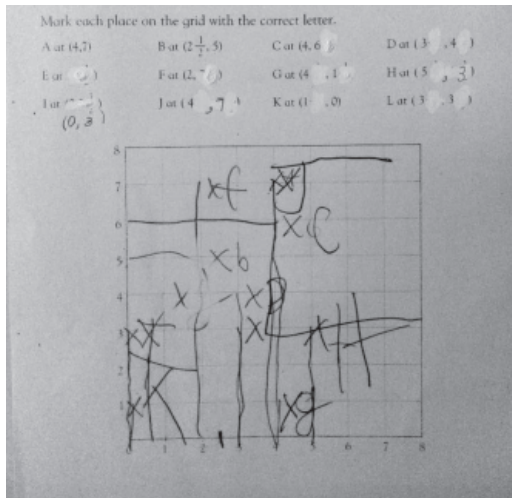


Figure 2. Coordinate mapping exercise reveals symptoms of vision dysfunction.

Stewart's vision assessment indicated that he was having considerable difficulty in alignment and eye movement, resulting in eye fatigue. One eye was also considerably stronger than the other, resulting in heavier reliance on the dominant eye and underdevelopment of the weaker eye.

Case Study 2: The Complexity of Vision

Amy was a 19-year old student who had struggled through school and successfully completed her O-Level examinations. She had an excellent memory, was able to read and write in full sentences, and could use relatively sophisticated vocabulary. Her handwriting was neat and she was highly conscientious.

Although she had managed to pass her examinations, Amy had significant gaps in her life skills. For example, she was unable to tie her own shoelaces or locate ingredients she needed in a kitchen cabinet. When packing away grocery purchases, she could not figure out how to rearrange the existing ingredients in the refrigerator to make space for her purchases. Once, when asked to cut strawberries for a baking activity, Amy tried to cut the strawberries with the blunt side of the knife. For most of her life, Amy had received assistance in performing most of her daily tasks from a helper or parent.

Often, when asked to draw, Amy would resist, saying 'I'm not good at art.' On one occasion when asked to draw a girl, she muttered as she began to draw, saying, 'Eyebrows first, then eyes, then nose, then mouth.' During a reading comprehension exercise, I once asked Amy to draw a girl in a 'pretty princess

dress', as was described in the passage. Amy was extremely reluctant, but I encouraged her to continue.

When she finished, I requested that she label the different parts of her drawing, which is shown in the following Figure 3. Her drawing ability is at a drastically different level from her writing ability, and is far below what would be expected of a student her age. Several clues in her drawing indicate abnormal vision or visual processing. The arm is placed in what would appear to be the lower half of the body, and the face is placed at the bottom of the drawing. The shoe is drawn as a long, vertical rectangle, and there is only one shoe drawn. The eraser marks indicate that this is more than a mere haphazard attempt; there has been considerable effort and energy spent in producing this drawing.

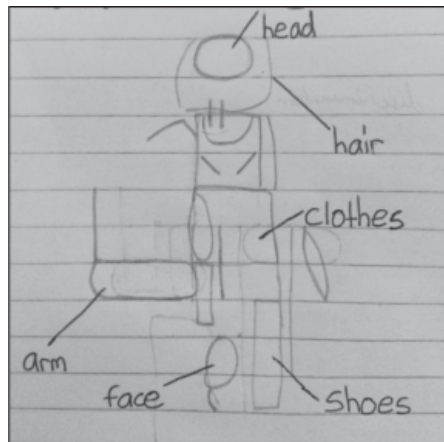


Figure 3. Labeled drawing demonstrating the complexity of vision dysfunction issues.

Amy's profile provides an example of the complexity and nuance in vision dysfunction issues. Several interesting observations emerge from her profile:

1) *Vision is multifaceted*

A fascinating observation from this work sample is the fact that Amy's letter recognition, replication and overall handwriting is extremely neat. This is a powerful illustration of the multifaceted nature of vision and visual skills. Amy has been able to successfully master the skill of reading and writing, but struggles immensely with visual literacy and interpreting the visual cues in her environment.

2) *Coping strategies are common to compensate for visual issues*

Amy has a powerful memory, and uses it to compensate in areas where her vision is failing. She has clearly devised a way to ‘remember’ how to draw a face, as evidenced by her statements when asked to draw. Another coping strategy she employs is avoidance; Amy has become highly accustomed to evading activities involving drawing and sketching, claiming that she is ‘not good in art’.

3) *Many unique individual factors compound visual issues*

Amy struggles with life skills not only due to her poor vision skills, but also, underdeveloped motor skills. Often, the impact of poor vision cannot be viewed in isolation; it is likely that Amy’s lack of success with life skills has significantly reduced her confidence levels, compounding the anxiety she experiences and magnifying the vision problems she experiences in these situations. Amy also grew up in a home where her independence and ability to perform these skills were not prioritized; rather, she received constant support from a helper or a family member, so that her schoolwork would not be interrupted. All these factors – poor motor skills, lack of confidence and a lack of practice – can magnify the effect of the visual problems faced.

EXPLORING THE RELATIONSHIP BETWEEN VISION AND SCREEN TIME

There is clearly more to vision than meets the eye. As discussed before, there is growing evidence to indicate that vision function issues are much more widespread than previously thought, particularly among children who struggle at school. Little information is available on the historical trends, apart from anecdotal evidence from practitioners indicating that vision function issues are on the rise. Despite this lack of information, it is important to explore the potential impact of environmental factors. If there is indeed a rapid change in the prevalence of vision function issues, this would point toward environmental rather than genetic drivers. One potential factor still insufficiently understood is the rapid increase in screen time seen across the world, and its impact on vision. This section of the paper presents a preliminary exploration of the relationship between screen time and vision function.

Screen Time and Vision

The rapid evolution of technology has resulted in dramatic lifestyle shifts around the world, as screen time and technology use increase to unprecedented levels. For example, 90% of Americans use digital devices for two or more hours each day (The Vision Council, 2016), and a 2016 survey of Malaysians adults

indicates that they spend an average of 4.1 hours daily on the Internet for non-work purposes (AIA Healthy Living Index, 2016).

This increase in screen time is also evident in the lifestyle of children today. While the American Academy of Pediatrics recommends screen time of no more than two hours per day (American Academy of Pediatrics, 2016), the average American child spends seven hours per day on entertainment media such as television, computers and other digital devices. In a large, nationally representative sample of Malaysian children aged 7 to 12 years, 68.4% of children studied exceeded this recommendation, with an average of 3.1 hours of screen time per day (Lee et al., 2015), a higher proportion than in the United States (65%) (The Vision Council, 2016) and Australia (25-37%) (Australian Institute of Family Studies, 2016). Some 50% of parent respondents to the AIA Healthy Living Index Survey (2016) indicated that they felt their children were exposed to an excessive amount of screen time.

Evidence indicates that where screen time is concerned, parents and education practitioners should proceed with caution. Studies tracking children over extended periods have consistently linked television viewing time to childhood obesity (Danner, 2008; O'Brien et al., 2007; Rey-Lopez et al., 2008), due to the associated increase in sedentary behavior, and several longitudinal studies have even linked childhood television watching with obesity in adulthood (Landhuis et al., 2008; Parsons et al., 2008).

Additionally, the high-energy visible or blue light emitted by electronics has been shown to disrupt sleep by suppressing the natural release of melatonin, a hormone that regulates sleep function (Harvard School of Public Health, 2012; Hysing et al., 2015). Evidence exists that in the longer term, consistent exposure to blue light can contribute to age-related vision issues, such as macular degeneration, an eye condition that affects central vision and can eventually cause blindness, and cataracts (Algvere, 2006; Dillon et al., 2004).

From an evolutionary perspective, vision has historically involved viewing objects near and far, many of which were in an outdoor environment, in natural light. The worldwide increase in screen time has changed the way we use our eyes; screen users often spending hours at a time looking at two dimensional images on a screen in relatively close proximity, which can cause eye fatigue and symptoms known as Digital Eye Strain (American Optometric Association, 2008; The Vision Council, 2016). Devices held extremely close (8-12 inches) can reduce blinking rates, causing irritation and dry eyes (The Vision Council, 2016), and some studies have linked the increase in screen time with a higher occurrence of myopia, due to the reduced number of hours spent outdoors (Dolgin, 2015; Rose et al., 2008).

Thus far, however, research studying the impact of screen time on vision has focused primarily on central vision. There has been little research exploring the direct impact of screen time on other aspects of vision efficiency. Apart from a few isolated studies, this remains a significant gap in the literature, and as such, this was a primary rationale for conducting the study.

METHODOLOGY

The data set for this research was drawn from the database of a behavioral optometry practice based in Kuala Lumpur. The sample comprised 41 children aged between 6-10 years living in the Klang Valley area, who were seeking optometric vision therapy for various vision skills issues in the 12-month period between September 2015 and September 2016. Each child was tested in five different vision function areas: central vision, eye movement, alignment, focus and peripheral vision, using a neuro-developmental vision evaluation. Each vision function area was scored on a scale of 0-5 where 0 indicates full functionality, and 5 indicates underperformance relative to age group. Thus, a higher score indicates increased severity of vision dysfunction.

A parental survey was conducted for each child to gather information on the frequency, length and proximity of television and electronic device screen viewing habits. The survey was administered via email, at the point of assessment.

Following this, a regression analysis was conducted to explore the relationship between screen time and vision function. Using linear regression, the relationships between television and electronic device screen viewing habits and the four different aspects of vision function (excluding central vision: focus, alignment, eye movement and peripheral vision) were examined.

RESULTS

The data set comprises 41 children, 12 of whom were female. The mean age of the children was 7.9 years ± 1.3 , and the ages ranged from 6 to 10 years. The following Table 1 provides a description of the score profile as well as the screen viewing habits of children in the sample.

It is worth noting that the mean score for central vision is 0.14, implying that by visual acuity measures alone, the children in this sample would be classified as having relatively healthy vision. All but six of the children had perfect central vision scores, none of which exceeded 2.00. This mirrors the findings of research conducted in a Malaysian sample of children where the majority of children identified as having reduced visual function had satisfactory visual acuity (Muzaliha et al., 2012). The most severe vision dysfunction for the group was in eye movement, with an average score of 3.97.

The average combined screen viewing time per day is 3.15 hours, exceeding the recommended limit of two hours per day. The sample mean is comparable to a larger survey of Malaysian children that found an average screen time of 3.1 hours per day (Lee et al., 2015). On average, time spent on devices is higher than time spent on television.

Table 1

Vision Function Scores and Screen Viewing Habits by Gender

	Boys		Girls		Total	
	Mean	SD	Mean	SD	Mean	SD
Vision Function Scores						
Central Vision	0.14	0.35	0.25	0.62	0.17	0.44
Composite	3.30	0.70	3.10	0.67	3.24	0.69
Eye Movement	3.97	0.91	3.08	1.38	3.71	1.12
Alignment	2.93	0.84	3.08	1.00	2.98	0.88
Focus	3.38	1.15	3.33	1.07	3.37	1.11
Peripheral Vision	2.93	0.88	2.92	1.08	2.93	0.93
Screen Viewing Habits						
TV Duration (Hours)	2.36	1.39	1.55	1.36	2.10	1.41
TV Frequency (times per week)	5.10	2.26	4.80	1.93	5.00	2.13
TV Distance (ft)	8.60	3.58	9.85	3.06	9.00	3.42
Device Duration (hours)	2.89	1.59	2.23	1.64	2.66	1.62
Device Frequency (times per week)	4.58	2.63	3.90	2.69	4.34	2.62
Device Distance (ft)	1.61	0.90	1.35	0.34	1.52	0.76

Composite score is defined as the average of eye movement, alignment, focus and peripheral vision scores.

As indicated in Table 2, the duration of time spent viewing electronic devices is positively associated with the composite, eye movement and focus scores. An additional hour of device viewing is associated with an increase of 1.00 in the composite score, a 1.55 increase in the eye movement score and a 1.3 increase in the focus score.

Electronic device viewing distance is negatively associated with alignment scores. A one foot increase in viewing distance is associated with a decrease of 1.15 in alignment scores. Television viewing distance on the other hand, is positively associated with focus scores. A one foot increase in viewing distance is associated with a 0.55 increase in focus scores. The frequency of television viewing is positively associated with peripheral vision scores; one extra weekly occurrence of television viewing is associated with a 0.95 increase in peripheral vision scores.

Table 2
Results of Linear Regression Analysis of Vision Function Scores on Television and Device Viewing Variables

	TV Duration (hours)		TV Frequency (times per week)		TV Distance (ft)		Device Duration (hours)		Device Frequency (times per week)		Device Distance (ft)	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Composite Score	0.10	0.77	0.12	0.07	0.03	0.04	0.20*	0.74	-0.05	0.05	-0.03	0.08
Eye Movement	0.27	0.14	0.07	0.12	-0.08	0.07	0.31*	0.13	-0.04	0.09	0.07	0.20
Alignment	-0.18	0.12	0.05	0.10	0.07	0.05	0.16	0.10	-0.02	0.56	-0.23*	0.09
Focus	0.09	0.10	0.15	0.10	0.11*	0.05	0.26*	0.12	-0.11	0.77	0.10	0.18
Peripheral Vision	0.21	0.13	0.19*	0.09	0.26	0.05	0.07	0.13	-0.04	0.07	-0.05	0.13

Composite score is defined as the average of eye movement, alignment, focus and peripheral vision scores; Significant coefficient at $*p < 0.05$

DISCUSSION

In this study, device viewing time was positively correlated with composite, focus and eye movement scores. This corresponds with the growing recognition of the impact of device viewing time on eyesight; Digital Eye Strain, also known as Computer Vision Syndrome, is now recognized as a problem resulting from prolonged device use (American Optometric Association, 2016). One of the most common symptoms associated with this condition is blurred vision, which is frequently temporary, but can sometimes last beyond the period of device usage (American Optometric Association, 2016). Although no significant correlation existed between alignment and screen viewing duration, a small scale research study in Korea also found a potential link between excessive smartphone usage and a type of eye alignment dysfunction (Lee et al., 2016), as well as an improvement in the condition upon reduced smartphone usage (Lee et al., 2016). As such, this relationship is worth exploring further.

A significant association was found between alignment and device viewing distance – a closer viewing distance is associated with higher alignment scores. However, there is a positive correlation between focus scores and television viewing distance, which is a surprising result. A greater viewing distance is

associated with higher focus scores, but the converse is true for alignment scores. This seemingly contradictory trend could be attributed to children with vision dysfunction issues compensating for their difficulty by adjusting their viewing distance upwards or downwards. This implies that the viewing distance measure may not be an accurate indicator, since even a greater viewing distance can be a symptom of vision dysfunction. An alternative measure, such as the average deviation from the recommended or normal viewing distance, may yield more insight.

In exploring these relationships, it should be noted that several potentially important mediating factors were not examined in this study. Firstly, it is unclear whether screen time itself is impacting vision, or whether screen time is actually a proxy for reduced outdoor time. Research has shown a connection between the level of children's outdoor play with prevalence of myopia (Dolgin, 2015; Rose et al., 2008; Wu et al. 2013), and some studies have even found that increasing time spent outside can reduce myopia rates (Dolgin, 2015; Wu et al., 2013). It is possible that the increased exposure to natural light, or the increased variety in viewing distance provided by an outdoor play setting is a factor impacting vision function, and future research should take this into consideration.

Secondly, screen time has been shown to impact sleep by suppressing the body's release of melatonin. Additionally, the sleep patterns of many children are changing as technology advances, with a well-documented association between engagement with technology, particularly at night, with a lack of sleep and increased level of tiredness (Eggermont et al., 2006; Shochat et al., 2010; Van den Bulck, 2007). Some research has also found a link between sleep deprivation and increased tunnel vision (Jackson et al., 2008). Further research is required to document the impact of milder, longer term sleep deprivation (possibly caused by screen time) on vision among children.

LIMITATIONS

While these results are an important preliminary step toward better understanding the screen time-vision function relationship, they must be interpreted with caution. Firstly, the sample size was small, considerably limiting the statistical significance of some results obtained. A larger sample was not immediately available as all patients in the relevant age group assessed over the past 12 months had already been included in the data set. At the time of writing, we did not have access to any other behavioral optometry practices in Malaysia which would be able to provide further vision function data. Further research utilizing a larger sample size is therefore necessary.

It is likely that the parental survey data is not entirely accurate. Answers were based on parents' memory of their children's screen viewing habits, and could be inaccurate for various reasons. Firstly, memory about time and distance of viewing is often an estimation. Secondly, parents who are not at home all the time may be relying on second hand reports from helpers or caregivers, who may have the incentive to report a lower screen time. Parents may also be hesitant to reveal the extent of their children's viewing time when answering a questionnaire administered by a medical professional. Besides that, some measures of screen viewing habits used are also problematic. For instance, children may vary their viewing distance as their eyes become fatigued, moving closer to the screen. When asked to provide their child's screen viewing distance, some parents described an intermittent pattern of moving forwards and backwards, resulting in varying viewing distance. In these cases, an average distance was used. Screen size is also a factor influencing viewing distance, but this measure was not collected in the parental survey.

CONCLUSION

The complexity of visual issues, and their far reaching implications for learning, warrants a broader and more comprehensive approach to assessing vision in young children. To date, there is limited research on the factors contributing to reduced vision function in young learners. However, given the rapid increase in screen time among young children, it is important to explore the impact of this trend on vision function.

A preliminary examination of the relationship between screen viewing habits and vision function revealed several significant associations, particularly relating to duration of device viewing time. Because of the limited sample size, however, these results are largely exploratory and should be viewed as a preliminary step in understanding this relationship. Given the potential implications for overall vision health, further research is imperative to deepen knowledge in the field, besides providing better informed guidelines to parents and practitioners who work with young children.

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