DIGITAL VS HARD COPY: DIFFERENCES IN READING 3/3

DIGITAL VS HARD COPY. AN OVERVIEW OF SCHOOLS' VISUAL NEEDS, READING, AND DIFFERENCES IN LEARNING AND READING BETWEEN DIGITAL VS. HARD COPY FROM AN OPTOMETRIST´S PERSPECTIVE.

In this third and final part of our series, we dissect some possible solutions to minimize the potential visual problems linked to the continued use of digital devices at school. We discuss certain issues related to prescribing ametropias and diagnosing Binocular Dysfunctions and Non-Strabismic Accommodation in this said environment, and we will present our conclusions.

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ACRONYMS USED

- **FVA** – Far visual acuity
- **P/NRA** – Positive/negative Relative Accommodation
- **VA** – Visual acuity
- **NVA** – Near visual acuity
- **AA** – Accommodative amplitude
- **ANSBDs** – Accommodative and Non-Strabismic Binocular Dysfunctions
- **DES** – Digital Eye Strain
- **URE** – Uncorrected refractive error

KEY WORDS:
Visual hygiene, prescription protocols, symptoms, accommodation, farsightedness

Our optometric perspective on the digitization of schools.

Prescribing for ametropia in the digital age

The use of all kinds of digital devices is ubiquitous. People of all ages use them for all kinds of activities. And the hours we spend on them are only increasing. If we add learning and educational activities to the list of uses, we can deduce that- not only is a large percentage of the population at risk of developing symptoms associated with **Digital Eye Strain (**DES), as some authors mention (9)- but a large part of these new patients will be school-aged children who will also have poorer school performance. We are not trying to be sensational. To justify ourselves, we will answer our initial questions. We saw in the prior articles that **format can change reading and cognitive performance,** as proven by the clinical studies. We also saw that **there can be implications for the visual system caused by digitization,** which is vital to school performance**.** Additionally, research and epidemiological studies suggest **there will likely be an increase in DES in the school-aged population** over the next years. The last question remains: what can we do to prevent the associated problems?

We sincerely believe that we can break this chain of events. There are the non-visual factors related to the use of digital devices, such as: cultural gaps, individual psychological factors, technological advances, adjustment of the content to the format, and pedagogical aspects. We think these obstacles can be overcome. There are many options in terms of visual health.

Regarding the behavioural aspect relating to the use of digital devices, time and intensity of work (in

addition to working distance), are the factors with the highest prevalence of symptoms and complaints (both visual and asthenopic) (2, 3, 4, 5). As a first measure, we **need appropriate usage protocols that are adapted to the school age.** They must include regular pauses in near vision activities, limits on the time period of use, and adequate working distances (over 30cm). The last measure is also essential to preventing myopia (6).

Within these usage protocols, we also must consider **environmental conditions. Ventilation** and lighting are both positively correlated with improved school performance (7). There is a wide consensus that **appropriate classroom lighting** (or any workspace, for that matter) improves performance and academic achievements, and prevents distraction while studying (7, 8). If we consider this as key during the use of digital devices, it becomes even more important. Reflections, glares, and difficulty adapting to light are all conditions that cause discomfort, visual fatigue and compensatory postural adjustments (9, 10). Additionally, these factors have an impact on the legibility of the text. The most obvious conclusion is that classrooms need an ergonomic makeover. Speaking colloquially, we cannot just "drop" some tablets in the hands of children without considering the environment (lighting, in our case) in which they will be used.

With respect to the visual skills and refractive errors, the conclusions speak for themselves. We should redefine and launch more selective visual screenings in which we assess near and distance visual acuity and add some type of binocular and accommodative testing. The near point of convergence and amplitude of accommodation are sensitive enough, but above all, the cost of the equipment and speedy execution more than fit within the needs of the screening. We believe that the **detection of any visual or ametropic anomaly** is fundamental and key both in the **prevention of DES** and in aspects inherent to eye health and **visual development**, like the **academic process.**

These measures are not sensationalist, they are genuine. If any part of this is most valuable and original, we believe it is the view from a multi-factorial and interdisciplinary perspective.

On the other hand, and directly related to the visual capacities of paediatric patients suffering from symptoms related to the use of digital devices (whether or not they have Uncorrected Refractive Errors (URE) or Accommodative and Non-Strabismic Binocular Dysfunctions (ANSBDs), we have come to various conclusions—fundamentally based on our own clinical experience—on the visual needs of the "digital era" and on the management of paediatric patients immersed in digitization.

First, we had to ask if the parameters under which we categorized and classified the binocular conditions- mainly the accommodative ones- were the right ones.

The main reason was we often met paediatric patients with asthenopic symptoms- both visual and ocular- which were unequivocally related to URE in that the accommodation amplitude values (AA) /P/NRA were right, based on Hofsetter and Sheard's criterion. It was particularly bad for children in the age range of 7 to 10, as reading requirements increased. We saw a greater volume of visits in older children patients (from 10 to 12, meaning the older the child, the greater the prevalence), with the added fact that the intensity of the symptoms are usually greater.

These findings in our clinical practice are consistent, to a certain degree, with the findings of the clinical studies like Rosenfield & Benzoni (11), which found that "the clinical measurements of amplitude of accommodation showed a marked reduction between 5 and 10 years of age," although the amplitude values obtained were greater than expected. Other studies had different findings with regard to the accommodation that we can tie into our experience. Indeed, Anderson et al (12) found that, despite what they expected to find regarding amplitude of accommodation, the average values were only slightly higher than 7D, objectively measured from 3 years until adolescence, and were relatively stable during this time period.

This suggests that while the AA seems to be an essential test in our routine examinations, maybe its value—or measure—is not specific enough to allow us to diagnose or treat based on which cases and the type of patients that we mentioned above. We need to always bear in mind that it is not only about having an adequate AA, but that within the context of demanding up close visual work which takes place in the reading activities in primary school children, the sustained accommodation and its flexibility are crucial to comfortably performing close up visual tasks

In these kinds of patients—the infant and young population who are likely to receive their education digitally, we found it very useful, when diagnosing and implementing solutions, **to measure accommodative flexibility and the associated vergence flexibility** that we think provides more accurate information on the real capacities, or the behavior, of the individual when performing close-up activities.

That said, we believe it is important to address another question on how we approach these patients, and the way in which we obtain our clinical data. Traditionally, these data were collected—at a near distance—from 33 or 40 cm, depending on the test. But various studies concluded that the usual working distances for school age children are substantially shorter—for example, Drobe et al. (18) found reading distances to be around 10 cm below our average distance, which led some researchers and practitioners to suggest (Weng at al (19), for example) that **close up tests should be done at 25 cm** to have a real idea of the accommodative and vergence capacities of the infant population. **We agree with this sentiment entirely.**

With regard to the symptoms listed above, which still do not have a completely standardized case study (remember that we are speaking of a clinical practice and not clinical trials), we can confirm that the complaints that we most often see are:

Blurred distance vision when changing the position of the gaze while doing school work.
Blurred distance vision after performing school work.
Ocular fatigue or tiredness after the reading day.
Headache after the school day.

More common symptoms mentioned by young children in our clinics.

The symptoms are rather similar—even if in another order—to those found in clinical studies that followed strict protocol, like those found in García Muñoz et al's (13) protocol for the symptoms related to ANSBDs. This led us to give them the same treatment that we usually give to patients with ANSBDs, which offers them significant relief from the symptoms. On these questions in particular, we refer to our experiences and work methodology: visual therapy and prescription of help for close-up vision, mainly and by its features, with ophthalmic lenses with variable near vision support.

We don't want to dive too deep into these types of questions, which go beyond the scope of this article. However, we would like to call attention to the **prescription patterns in a paediatric population.** We believe this is an aspect that needs to be revised in terms of the current visual needs, and (always bearing in mind the debate we are now involved in) from the point of view of the possible symptoms associated with continuous visual effort that most digital reading activities require.

In this sense, we feel very close to the criteria listed by Shneor et al. (14) in which the **presence of symptoms, more than the magnitude of the refractive error, determines the prescription of a visual correction.** We can make the same consideration with regards to VA. If we use the possible increase or decrease of VA as the sole prescribing criterion in children or young patients, it is hard to find a clinical justification that warrants the need to prescribe refractive errors, fundamentally hypermetropic or astigmatic, which is low or even moderate in patients who still see rather well—when referring to the "quantity" or "functionality" that you have. We believe this is fundamental—the symptoms connected to visual activities—like those done at school and related to long-lasting tasks using digital devices.

As most guides and studies suggest on the prescription criteria, age could be fundamental if we have doubts on the idea of prescribing an optical correction. From our perspective, this reasoning—also applicable to VA—is completely logical for treating the said common patterns, and the treatment protocols in patients with high to moderate refractive errors in terms of preventing amblyogenic factors and/or those that generate strabismus. However, when treating specific cases in our daily clinical practice with refractive defects or light ANSBDs, we believe that the activities and **possible symptoms that are associated with it, are much more important than** merely the **demographic** (age, most of all) **or visual** (VA) **criteria.**

Symptoms, ametropic value, age, and lifestyle (including leisure, work, and school), **are all factors that could be interrelated to establish prescription criteria in cases of low-range ametropia.** We can give examples from the previous study (14): a large number of optometrists do not correct prescriptions as low as + 0.75 in children from 4 to 6 when there are symptoms. But close to half of those surveyed would do it if the age range is 6 to 10. These data are similar to those from other methodological revisions, like that of O'Leary & Evans (15), in which they found that most optometrists would correct symptomatic patients (for non-presbyope populations) low hypermetropia, from +1.00sph and astigmatisms of -0.75cyl. Our clinical practice is consistent with these criteria: we believe that in an environment with a high requirement for up-close work- as is school- and even more so in **an increasingly digital environment**, **the diagnosis in** school-aged patients with **low hypermetropia and astigmatism** (around +/- 0.75) should not be seen as unusual.

Final thoughts

We go back to our initial question: paper vs digital. In this series of articles, we journeyed over a number of questions (school and its visual requirements, the differences between formats, the implication of ocular movements, etc.) that in one way or another are related to the questions that we ask regularly. We believe some have been answered, while others remain open to debate, but independently, there is a final reflection to be made.

We do not think asking whether paper or digital is better, is the right approach. This should not be a matter of excluding one over the other, or a debate between advocates of one format or another. What is important is whether- regardless of the media- the students can learn and fully develop their intellectual capacities, without visual issues (which is our area of work) stopping them from doing so. We must also take advantage of all the educational benefits that digital devices undoubtedly offer.
We agree with Liu Z (16) that in our increasingly digital current environment, "readers (especially younger readers) are likely to gradually develop screen-based reading behaviour". Thinking the contrary denies the evidence. Another question is whether reading for studying could co-exist with its print counterpart. We think it can.

To conclude, we look at the literature. In his work, *The Coming of Post-Industrial Society*, Daniel Bell (17)

made the following remarks on the limitations of technological profusion in society: "***there are limits to nature,*** *(…)* ***customs, habits*** *and institutions."* We found other paragraphs in his book interesting as well: "***…the expansion of a new invention*** *or product does not* ***depend*** *only on its technical efficacy but also its cost, its attractiveness to consumers, its social costs (…) and the values and* ***social attitudes of the customers.***" Changing genres entirely, we move from sociology to science fiction. There is a quote in Frank Herbet's *Dune* which we think is relevant: "*The mind can go either direction under stress—toward positive or toward negative: on or off. Think of it as a spectrum whose extremes are unconsciousness at the negative end and hyperconsciousness at the positive end. The way the mind will lean under stress is strongly influenced by training.*" We believe this is the right thought process. It helps us extrapolate the problem and have a good idea on the questions that we have brought up in this article. Habits- such as our long-standing cultural partiality to the physical (and, excuse the personal reflection, but ***wonderful***) format of a book in hand- and prejudices (including fear) around technology can (and we think have) affected the perspective on the use of digital devices. On the other hand, digital devices do come with some side effects that impact our eye health. But we do not think these are insurmountable. In fact, we think they are preventable.

KEY TAKEAWAYS:

- The practically continuous use of all kinds of digital devices is part of the lives of boys and girls of all ages – both for leisure and for school work. It is essential to adopt protocols for the proper use of these devices, especially in the academic environment.
- We must all face the new digital era with specific clinic protocols to prevent digital eye strain and binocular and accommodative disorders related to screen use.
- The presence of symptoms and lifestyles may determine the prescription or treatment, more than the magnitude of the refractive error or the magnitude of binocular and accommodative abilities.
- The key question is not which format is better for learning: printed or digital format, but what is important is that, regardless of the media, the students can learn and fully develop their skills without having any visual issue.

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