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Short Communication Open Access

Analogue Computer Model of Progressive Myopia-Refraction Stability Response to Reading Glasses

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Brief Communication

A tendency of the eye to become myopic with long hours focusing at a near distance has been reported often [1-8]. Myopia development, as any refractive development, is described by a first order feedback system. A first order feedback system is defined by its transfer function F(s) = 1/(1+ks) [1,2]. This function anticipates an exponential development of refractive state and the effect of lenses. Near work is myopizing, as it is equivalent to wearing a negative lens.

Using a digital computer, first-order equations have been solved previously to describe and predict myopia progression [1,3]. An analogue circuit can simulate myopia progression vs. time R(t) because the response of the feedback system is the same as the capacitor voltage in a R-C (Resistor-Capacitor) circuit, as shown in Figure 1. When near work is involved a negative square-wave represents the daily accommodative demand as represented in the inset in Figure1[3]. The R-C circuit solves the problem without any computations.

The system exhibits an exponential progression of myopia [1,3].

$$R(t) = -5.00 - 3\,[1 - \exp(-t/\tau)] \qquad \textbf{(1)}$$

where t is time, τ is the time constant and R is either refraction or voltage. This equation applies initially when the square wave is at -3, and then exponentials alternating with the square wave apply as described in [3].

This electrical circuit simulates myopia progression vs. time as the voltage at the capacitor, where Volts (V) represent Diopters (D), when we initialize the subject's myopia to -5 D and a negative square-wave representing the daily accommodative demand due to near work is applied. The switch selects the subject's myopia. We use -5 and -2 as a typical example.

Reading glasses will cancel the -3 diopter demand. Any type of reading glasses have the capability to optically shift a book or computer screen from a typical reading distance of 1/3 meter (14-inches) to infinity, reducing accommodative demand on the visual system. Plus-add glasses, bifocals, and progressive addition lenses (PALs) have therefore the potential to stabilize-myopia [4-8]. The use of electrical circuits as models of myopia may enlighten the understanding of this condition and its progression among those literate in the engineering field.

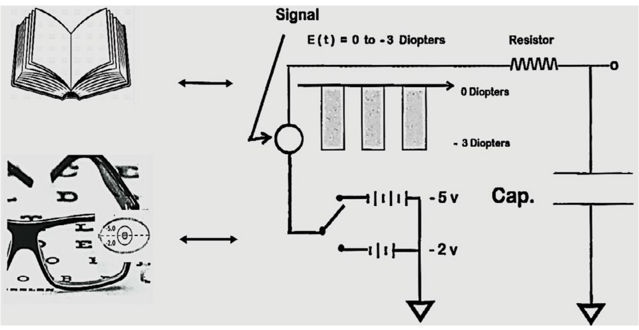

Figure 1: This schematic shows a -5 diopter eye, with a +3 diopter (decreased strength) lens used for a typical reading distance of 1/3 meter (14 – inches).

Conflict of Interest Statement

The authors have no proprietary or financial conflicts of interest.

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