Maximum Available Desk-to-Eye Distance for Students in Grades One and Two: Regional Norms and Statistical Comparison to Distance Used for Near Point Screening

Chapter I

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Introduction:

There is increasing national and statewide interest in vision screening of school-age children. The belief that vision is a main avenue of learning has led to concern about school children receiving evaluation of their vision by means of vision screening *(Petrie, Tumblin, and Miller 1979)* . Research has produced data which indicate that it is not so much the mildly to moderately myopic child who demonstrates problems in reading as it is the child who is mildly to moderately hyperopic *(Francis 1973)* .

Target distances used for screening near vision are based on research findings and conclusions of specialists in the eye care field over the past 100 years or more. Reading and vision researchers have often used these same distances of 14 to 16 inches (33.02 to 40.64 cm) as physical or optical distances created by the use of lens *(Bayle 1942) (Gonzalez 1983) (Kruger 1977)* . In the United States, these same distances are used as target distances for screening near vision *(Petrie, Tumblin, and Miller 1979) (Sloan 1959)* . Some vision experts argue, however, not to screen near vision, but to employ only plus or convex lens at far distance to screen for hyperopia. They indicate that the ability of the student to see clearly through the fogging lens is a better indicator of likely difficulty the student will experience in seeing well or comfortably at near work distance *(American Association of Ophthalmology 1971) (Committee on School Health 1977) (Doster 1971)* .

Information about vision screening practices in the United States has been only summative and is expressed in terms of the areas screened and the names of tests or screening machines used. There has been no inclusion of the near target distances or the plus lens power *(Belloc 1962)* *(Bromberg et al 1984)*.

The unit used to measure eye accommodation is the diopter. A target's linear distance from the eye and the dioptric power of accommodation are reciprocal. When one is known, the other may be calculated by using the formula:

Diopter = 1.00 m/metric target distance
or
Metric Target Distance = 1.00 m/diopter *(Borish 1970).*

Metric target distance is converted to inches by dividing by .0254 m. Because of reciprocity, the necessary accommodation increases as the target distance decreases. The range of clear vision for a given greater diopter also decreases. Normal vision may be thought of as the refractive status which is most commonly found in a population. Emmetropic vision for an individual is the refractive status in which there is present the

theoretically perfect relationship between convergence and accommodation for best vision at varying distances. Normal vision at different ages is not necessarily emmetropic.

An emmetrope's linear range of clear vision for the one-diopter difference between +1 D and +2 D is 19.685 inches (50 cm); whereas, the linear range of clear vision for the one-diopter difference between +10 D and +11 D is less than 1/2 inch (0.91 cm). Maximum available nearpoint distance is finite and is limited by four factors:

1. the physical build of the child,
2. the style of the desk being used,
3. the height at which the desk is set, and
4. the height of the chair seat.

Posture changes can only shorten the maximum available desk-to-eye distance. A shorter distance increases the power of accommodation which is necessary for the student to continue to see the near stimulus clearly.

Hurst *(Hurst 1964)* expressed concern that adult viewing distance criteria or norms were being used to screen or test children's vision. Several investigators in the field of eye care *(Hurst 1964) (Rouse, Hutter, and Shiftlett 1984) (Sheridan 1979)* have found that the working distances of primary-age children are often shorter than those of adults. They also found that there may be a range of near work distances, both across their research sample and for a single subject during a sustained time on a single near task.

The Problem

No standards for nearpoint desk-to-eye distance have been found for primary-age children (Grades 1 and 2) which can be used as criteria for comparing the distances used for screening vision or the distances used in research in fields of reading and the vision of primary-age children. Research in these areas has not included data which indicate that the distances used are related to distances available to children during nearpoint tasks in a classroom. Without criteria for available distance while children are seated at classroom furniture, it is difficult to assess the appropriateness of generalizing research findings or pass/fail of vision screening to the classroom situation.

Purposes of the Study

The main purpose of this study was to establish norms for the maximum available desk-to-eye distance (MA-DED) for students in Grades 1 and 2 while seated to write at each of two styles of desks. The second purpose of the study was to test for significant differences. The tests were between means of the Side and Across MA-DEDs and the standards of target distances used for nearpoint vision screening (TDNPVS) as reported by the states and the District of Columbia (the states), and between the dioptric equivalent of the means of the Side and Across MA-DEDs (D_S and D_A) and the standards created (D_{SFL} and D_{AFL}) by adding each dioptric plus power fogging lens reported by the states as being used to screen for hyperopia (D_{FL}) and each D_S and D_A. The diopter is the unit used to measure power of accommodation.

The third purpose of the study was to test for significant differences between the remeasure/measure means

of the Side and Across MA-DEDs. The remeasure was done the semester immediately following the measure, fall to spring (Time 1, 4 months) for Grades 1^1 and 2^1, and spring to fall (Time 2, 8 months) Grade 1^2.

Statement of Hypotheses

The following research hypotheses were tested in this study:

- **H1:** There is a significant difference between the mean of the MA-DED for each cell as described and each standard distance used as target distance for nearpoint vision screening (TDNPVS).
- **H2:** There is a significant difference between the mean MA-DED diopters (the mean of the MA-DED for each cell as described when converted to plus diopters of accomodation [D_S, D_A]) and the summed diopters (D_{SFL}, D_{AFL}) of the given plus diopters fogging lens and MA-DED diopters for a given cell.
- **H3:** There is a significant difference between the remeasure/measure means of the MA-DED across time for the children in Time 1, Grades 1^1 and 2^1 and Time 2, Grade 1^2.

Limitations

The limitations for this study were:

1. the geographic area within Education Service Center Region X of the State of Texas (Collin, Dallas, Ellis, Fannin, Grayson, Hunt, Kaufman, and Rockwall counties);
2. the decision of a district's administrators as to which schools within that district would participate;
3. the number of children enrolled in Grades 1 and 2 who were present the day of measurement and whose parents had given permission for participation;
4. the ethnicity, sex, and grade level of the participating children under age 10 who were present the day of measurement;
5. the response of the administrators, the number of subjects enrolled in the same school at the time of remeasurement, the response of the parents to the request for remeasurement, and the subjects' presence on the day of remeasurement;
6. the time period in which the study was conducted (three consecutive semesters);
7. the standards used for MA-DED comparisons were near point distances utilized by the individual states in their vision screening methods; and
8. the standards used for D_{SFL} and D_{AFL} comparisons utilized the plus diopters reported by the states as being used to screen for hyperopia and the plus diopters suggested in the literature.

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