

**AMETROPIA, PRESCHOOLERS'
COGNITIVE ABILITIES,
AND EFFECTS OF SPECTACLE
CORRECTION**

ANNE-CATHERINE ROCH-LEVECQ, PHD;
BARBARA L. BRODY, MPH; RONALD G. THOMAS,
PHD; STUART I. BROWN, MD

ARCH OPHTHALMOL /VOL 126
(NO. 2), FEB 2008

THE PURPOSE OF THE STUDY:

To test the cognitive abilities of 3-5 y.o ametropic children.

INCLUSION CRITERIA


Ametropia:

BE uncorrected hyperopia ≥ 4.00 D (3- 5yo);
Astigmatism ≥ 2.00 D (3yo); ≥ 1.50 D (4- 5yo)
or a combination of both.

Emmetropia:

BE refractive error of sphere ≤ 2.00 D
BE Astigmatism ≤ 1.00

ADDITIONAL INCLUSION CRITERIA:

- (1) No other eye abnormalities (strabismus, amblyopia, cataract, glaucoma, did not previously wear glasses);
 - (2) Had no developmental problems (autism, hearing loss, cerebral palsy, or mental retardation on preschool health records);
 - (3) Age 3- 5 y o;
 - (4) English / Spanish - a primary language.
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METHODS

70 children enrolled (35 in each group),

Between 2003 & 2006,

The mobile eye clinic of the University of California,
San Diego.

The children were checked at baseline and 6
weeks after optical correction.



THE CHILDREN WERE TESTED FOR:

➤ **The Beery-Buktenica Developmental Test of Visual-Motor Integration¹⁰ (VMI),**

A nonverbal, standardized, age-normed test

Assessment of visual perception and eye-hand coordination.

Copying geometric figures in a sequence of increasing difficulty.

➤ **The Wechsler Preschool and Primary Scale of Intelligence– Revised (WPPSI),**

A standardized, age normed developmental test of cognitive abilities.

Allows for comparison of children's scores at different Ages.

strongly correlated with intellectual abilities and academic achievement, especially reading abilities.

The Child Behavior Checklist (CBCL).

Completed by parents

Used to assess behavioral problems

Table 2. Demographic and Health Characteristics of Corrected Ametropic and Emmetropic Groups

Characteristic	Ametropic Group (n=35)	Emmetropic Group (n=35)	P Value
Age, y			
Mean (SD)	4.6 (0.6)	4.7 (0.5)	.31
Median (range)	4.7 (3.1-5.8)	4.8 (3.1-6.0)	
Sex, No. (%)			
Female	22 (62.9)	20 (57.1)	.81
Male	13 (37.1)	12 (42.9)	
Ethnicity, No. (%)			
Hispanic	29 (82.9)	31 (88.6)	.73
Other	6 (17.1)	4 (11.4)	
Primary language, No. (%)			
English	15 (42.9)	19 (54.3)	.47
Spanish	20 (57.1)	16 (45.7)	
Current health problems, No. (%)			
No	33 (94.3)	31 (88.6)	.67
Yes	2 (5.7)	4 (11.4)	
Birth weight, kg			
Mean (SD)	3.0 (0.6)	3.3 (0.5)	.09
Median (range)	3.1 (1.4-4.2)	3.3 (2.2-4.4)	
Parents at home, No. (%)			
Mother	30 (85.7)	32 (91.4)	.71
Father	25 (71.4)	21 (60.0)	.45
Both	20 (57.1)	18 (51.4)	.81
Mother's education, No. (%)			
< High school	16 (45.7)	13 (37.1)	.63
≥ High school	19 (54.3)	22 (62.9)	
Father's education, No. (%)			
< High school	12 (34.3)	16 (45.7)	.46
≥ High school	23 (65.7)	19 (54.3)	
Range of household income, No. (%)			
\$0-\$25 000	25 (71.4)	23 (65.7)	.80
\$25 000-\$45 000	10 (28.5)	12 (34.3)	
No. of children at home, No. (%)			
≤ 2	16 (45.7)	21 (60.0)	.34
≥ 3	19 (54.3)	14 (40.0)	

Table 3. Comparison of Clinical Characteristics of Ametropic vs Emmetropic Groups

Clinical Characteristic	Ametropic Group (n=35)	Emmetropic Group (n=35)
Right eye		
Refractive error, mean (SD)	+4.05-1.94 × 1 (+2.81-1.42 × 10)	+1.23-0.13 × 145 (+0.74-0.34 × 38)
Spherical equivalents		
Mean (SD)	3.10 (2.10)	1.20 (0.57)
Median (range)	3.50 (-1.00 to 8.25)	1.13 (0.25 to 2.75)
Spherocylindrical power vector		
Mean (SD)	3.57 (1.60)	1.20 (0.60)
Median (range)	4.60 (1.00 to 8.27)	1.20 (0.35 to 2.75)
LogMAR visual acuity		
Mean (SD)	0.50 (0.25)	0.20 (0.09)
Median (range)	0.50 (0.00 to 1.00)	0.18 (0.00 to 0.30)
Left eye		
Refractive error, mean (SD)	+4.19-2.12 × 179 (+2.96-1.56 × 9)	1.28-0.09 × 126 (+0.83-0.45 × 41)
Spherical equivalents		
Mean (SD)	3.10 (2.20)	1.24 (0.60)
Median (range)	3.00 (-1.25 to 7.50)	1.14 (0.00 to 2.50)
Spherocylindrical power vector		
Mean (SD)	3.70 (1.60)	1.20 (0.60)
Median (range)	3.20 (1.25 to 7.50)	1.10 (0.00 to 2.53)
LogMAR visual acuity		
Mean (SD)	0.54 (0.28)	0.18 (0.11)
Median (range)	0.54 (0.00 to 1.00)	0.18 (0.00 to 0.30)

Table 4. Clinical Characteristics by Refractive Condition

Clinical Characteristic	Subjects With Compound Hyperopia and Astigmatism (n=23)	Subjects With Hyperopia (n=5)	Subjects With Mixed Hyperopia and Astigmatism (n=7)
Right eye			
Refractive error, mean (SD)	+4.60-1.96 × 1 (+2.23-1.27 × 1)	+4.90-0.13 × 170 (+1.17-0.23 × 14)	+1.66-3.17 × 2 (+1.31-1.10 × 5)
Spherical equivalents			
Mean (SD)	3.60 (1.60)	4.90 (1.06)	0.07 (0.76)
Median (range)	3.75 (1.13 to 8.25)	5.00 (3.75 to 6.50)	0.00 (-1.00 to 1.00)
Spherocylindrical power vector			
Mean (SD)	3.80 (1.50)	4.90 (1.06)	1.76 (0.45)
Median (range)	3.80 (2.10 to 8.30)	5.00 (3.75 to 6.50)	1.80 (1.00 to 2.20)
LogMAR visual acuity			
Mean (SD)	0.55 (0.27)	0.30 (0.11)	0.45 (0.15)
Median (range)	0.54 (0.00 to 1.00)	0.30 (0.20 to 0.40)	0.48 (0.20 to 0.70)
Left eye			
Refractive error, mean (SD)	+4.74-2.28 × 178 (+2.14-1.23 × 10)	+5.40-0.20 × 177 (+1.50-0.20 × 1)	+1.73-3.55 × 2 (+1.50-1.60 × 9)
Spherical equivalents			
Mean (SD)	3.60 (1.53)	5.30 (1.37)	-0.04 (0.73)
Median (range)	3.38 (1.63 to 7.38)	4.60 (4.13 to 7.50)	0.00 (-1.25 to 0.75)
Spherocylindrical power vector			
Mean (SD)	3.90 (1.45)	5.30 (1.40)	1.97 (0.56)
Median (range)	3.50 (2.10 to 7.40)	4.60 (4.10 to 7.50)	1.90 (1.00 to 2.90)
LogMAR visual acuity			
Mean (SD)	0.59 (0.29)	0.30 (0.13)	0.53 (0.25)
Median (range)	0.54 (0.00 to 1.00)	0.30 (0.20 to 0.50)	0.54 (0.20 to 1.00)

Abbreviation: LogMAR, logarithm of the minimum angle of resolution.

Table 5. Scores on Outcome Variables for Ametropic and Emmetropic Groups at Baseline and 6 Weeks

Variable	Mean (SD) Score			
	Baseline Assessment		6-wk Assessment	
	Ametropic Group Before Correction (n=35)	Emmetropic Group (n=35)	Ametropic Group After Correction (n=35)	Emmetropic Group (n=35)
VMI ^a	94.1 (13.7)	102.7 (11.0)	100.1 (12.0)	102.7 (10.7)
WPPSI-R				
Full scale	89.9 (9.2)	92.4 (7.5)	95.1 (9.9)	96.4 (9.2)
Performance scale	99.3 (11.9)	106.3 (10.2)	107.0 (13.4)	111.4 (11.4)
Object assembly	9.2 (3.0)	10.9 (2.7)	11.2 (3.4)	11.7 (3.0)
Geometric design	9.2 (2.6)	9.9 (1.7)	9.5 (2.5)	9.6 (2.2)
Block design	9.9 (2.6)	11.0 (2.1)	11.3 (2.3)	11.8 (2.6)
Mazes	9.5 (2.3)	9.8 (2.5)	10.0 (2.5)	11.4 (2.6)
Picture completion	12.3 (2.9)	13.1 (2.2)	13.1 (2.5)	13.9 (2.0)
Animal pegs	8.9 (3.4)	11.2 (2.4)	10.7 (2.6)	11.7 (2.1)
Verbal Scale	83.7 (9.6)	82.5 (8.2)	86.3 (9.6)	84.7 (11.9)
Information	6.6 (2.4)	6.5 (1.9)	7.2 (2.6)	6.9 (2.5)
Comprehension	6.6 (2.4)	6.5 (2.0)	7.6 (2.0)	6.5 (2.6)
Arithmetic	8.3 (1.7)	8.1 (2.4)	8.6 (2.0)	8.3 (2.6)
Vocabulary	7.0 (2.8)	6.5 (2.0)	7.3 (2.6)	7.8 (3.0)
Similarities	7.9 (2.1)	7.9 (1.7)	8.0 (2.1)	8.2 (2.1)
Sentences	5.0 (2.8)	5.8 (2.3)	5.8 (3.1)	6.1 (2.5)
CBCL	48.6 (10.3)	48.6 (11.6)	47.3 (9.6)	47.2 (12.1)

DISCUSSION

Possible reasons for reduced performance in baseline VMI :

- Uncorrected refraction caused vision problem of testing materials- unlikely
- Ametropia is a risk factor for neural alteration not yet understood- ?
- Ametropia make near tasks uncomfortable --> interfere with VM skills

CONCLUSION:

‘Early identification and correction of refractive errors could optimize cognitive development and learning abilities’.

