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Reading Profiles and Fatigue Ratings in Children with Hearing Loss

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INTRODUCTION

Children with hearing loss (CHL) demonstrate difficulties across many areas of academic achievement. The average reading ability of CHL is widely reported to be at a fourth grade level, and has remained relatively consistent across several decades (Karchmer, 2003). Even mild hearing loss is associated with lower reading outcomes as measured on standardized tests (Antia & Jones, 2009). To reduce the achievement gap between children with hearing loss (CHL) and hearing peers (CNH), researchers must examine potential contributors to poorer reading performance.

One possible reason that CHL score lower than CNH on tests of reading achievement is that CHL demonstrate higher levels of fatigue than their peers. Children with fatigue caused by cancer, sleep deprivation, rheumatic diseases, and chronic fatigue syndrome experience a variety of social and psycho-educational problems (Ravid et al., 2009; Hockenberry-Eaton et al., 1999). Information on **hearing-related fatigue**, however, is limited. Anecdotal reports, intuitive beliefs, pilot studies and parental/teacher reports have suggested that CHL do experience greater listening effort and subsequent hearing-related fatigue during the school day than CNH (Bess et al., 1998; Hicks & Tharpe, 2002; Hornsby et al., 2013).

The data presented herein comes from a larger study examining fatigue in CHL. Specifically, two questions are examined.
1. Do CHL **differ** from CNH on *WRMT* total scores or *WRMT* subtests?
2. Do CHL demonstrate **fatigue** effects on the *WRMT* when examining (a) change in performance and (b) association with subjective fatigue?

PARTICIPANTS

Participants were children age six to twelve years with normal hearing (n=33) or with hearing loss (n=28). All participants are monolingual speakers of English. Children with diagnoses such as cognitive impairment, autism, and other developmental disorders are excluded.

	Age* (months)	NVIQ* (TONI)	CELF*	Maternal Ed.	Race	Gender
CHL	124.04 (22.51)	102.15 (12.83)	88.69 (23.22)	4.8 "some college"	67.6% white	55.9% boys
CNH	108.04 (27.49)	108.71 (9.71)	108.76 (10.47)	5.0 "some college"	64.7% white	35.3% boys

	Age of Identification (years)	Age of Amplification (years)	Better Ear PTA (dB HL)
CHL	5.12 (3.38)	6.84 (3.18)	33.77 (13.77)

Tables 1 and 2. Demographics of CHL and CNH in the experimental sample. Asterisks indicate significant differences between groups.

METHODS

All children were participants in a larger study examining fatigue in CHL. Children were tested on two separate days. One visit occurred on a weekend morning (non-school day visit). Another visit occurred on a weekday afternoon after school (school day visit). The order of visits was counter-balanced, as were the forms for the reading measures. There were no significant differences in child performance due to order effects or form effects (p>.25). The average time between visits was 8.12 days.

The **Woodcock Reading Mastery Test** (WRMT-III, 2011) accounts for the diverse skills needed for reading. Subtests include Word Identification (reading vocabulary), Word Attack (decoding of nonsense words), Word Comprehension (synonyms, antonyms, analogies), Passage Comprehension (identification of missing words in a sentence or paragraph), and Oral Reading Fluency (efficiency x accuracy).

The **PedsQL Multidimensional Fatigue Scale** (PedsQL, 1998) measures subjective fatigue across multiple domains: general fatigue, sleep/rest fatigue, cognitive fatigue and an overall composite measure of fatigue. For the purpose of this study, the cognitive fatigue subscale was used.

RESULTS

Do CHL (n=28) differ from CNH (n=33) on *WRMT* total scores or *WRMT* subtests?

There were group differences between CHL and CNH on all subtests of the WRMT, even after statistically controlling for age and nonverbal IQ (Figure 1). There were group differences between CHL and the population sample (M=100; SD=15) for the Word Identification and Word Attack subtests (p<.01).
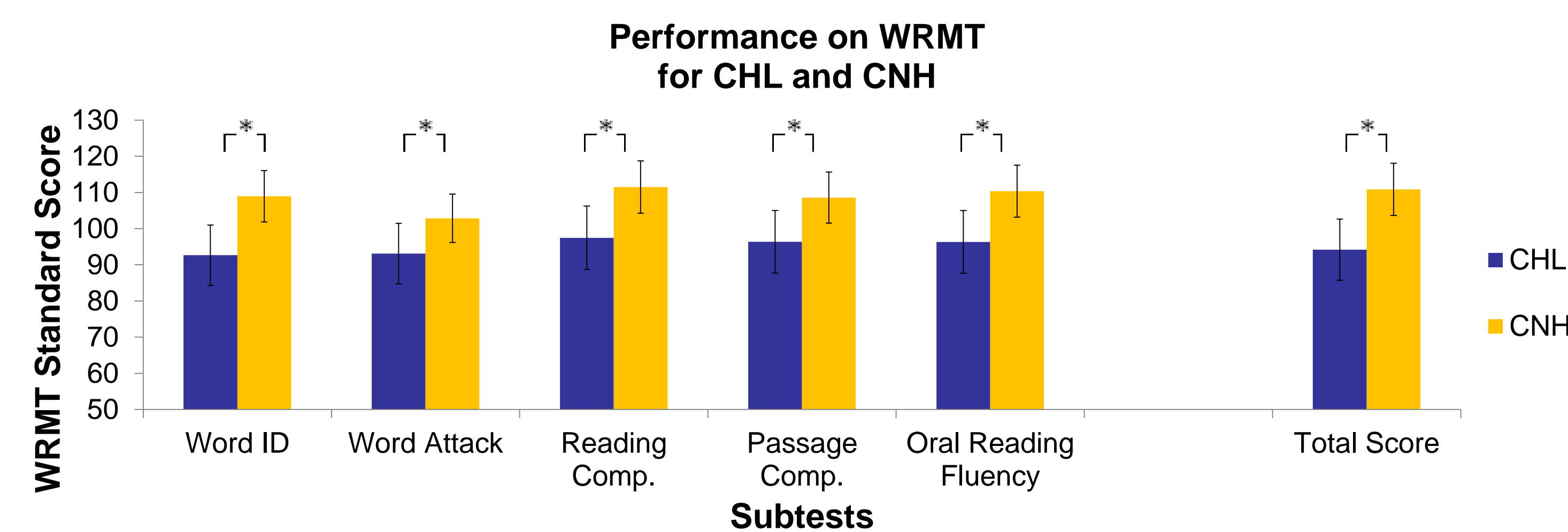

Figure 1. Differences between CHL and CNH on the WRMT, controlling for age and NVIQ.

Between Group Differences – Standard Scores						
	WI	WA	WC	PC	ORF	Total Score
CHL	92.64 (18.23)	93.07 (16.61)	97.46 (17.32)	96.36 (18.22)	96.32 (18.16)	94.18 (19.11)
CNH	108.94 (13.85)	102.85 (15.27)	111.50 (11.16)	108.58 (16.74)	110.35 (14.31)	110.84 (14.61)
F Test	14.83	8.21	13.26	9.06	9.44	14.91
P Value	.000	.000	.000	.000	.000	.000

Table 3. Differences between CHL and CNH on the WRMT, controlling for age and NVIQ.

Do CHL demonstrate fatigue effects on the *WRMT*?

There were no significant differences in how CHL performed on mornings of non-school days and afternoons of school days on standard or raw measures.

Repeated Measures Differences– Standard Scores						
	WI	WA	WC	PC	ORF	Total Score
F Test	1.07	1.59	.410	.505	.308	.488
P Value	.369	.202	.747	.680	.819	.692

Table 4. Differences between school day and non-school day testing for CHL.

RESULTS

CHL did demonstrate significant correlations between subjective fatigue ratings and performance on WRMT subtests and total scores. Children who rated themselves as "less fatigued" on the cognitive subtest of the PedsQL performed better on the WRMT, while children who rated themselves "more fatigued" performed poorly (r=.392).
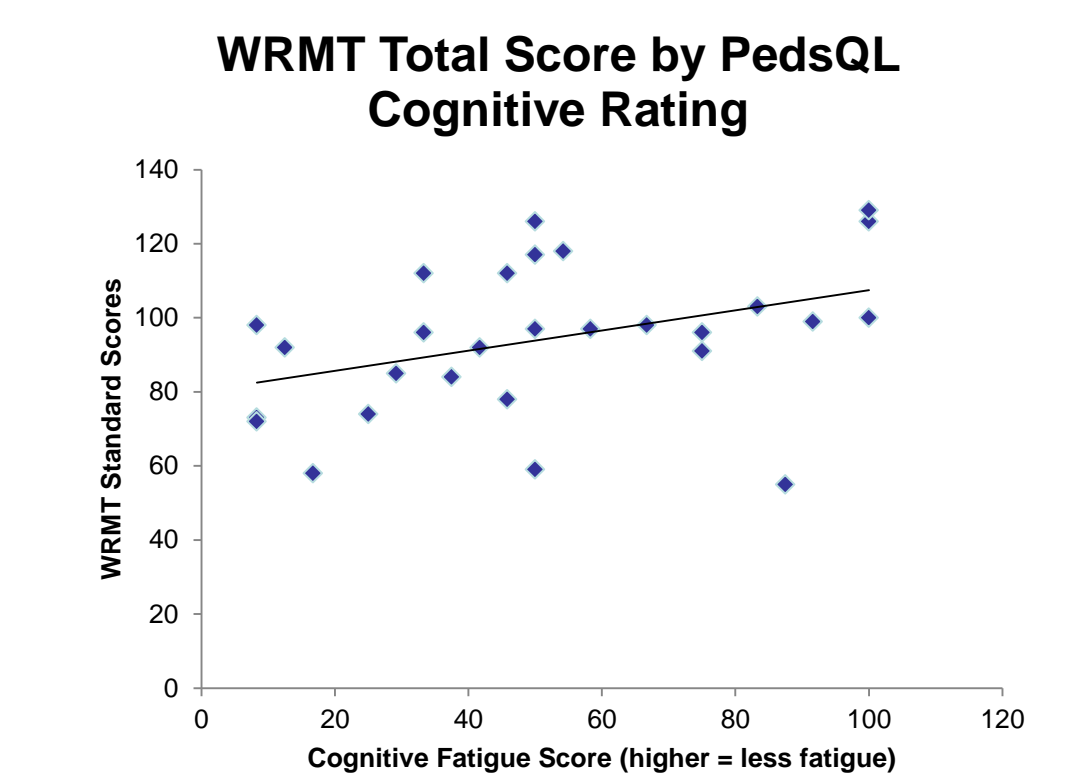

Figure 1. Correlations between subjective fatigue ratings and WRMT performance.

CHL	Age	NVIQ	CELF	Fatigue Rating	WRMT Total	Age ID	HA Use
Age	1						
NVIQ	-.220	1					
CELF	.068	.473*	1				
Fatigue Rating	-.259	.201	.462**	1			
WRMT Total	-.152	.629**	.867**	.392*	1		
Age ID	.269	.106	.100	.072	.034	1	
HA Use	-.310	.104	-.037	.085	-.037	-.076	1

Table 5. Correlation matrix for CHL. * p<.05, ** p<.01

DISCUSSION

CHL performed significantly below hearing peers on all subtests of the WRMT even when controlling for age and NVIQ. CHL demonstrate relative strengths in comprehension subtests and relative weaknesses in decoding subtests.

Fatigue effects in CHL do not appear to be captured using standardized measures of reading performance. However, children who subjectively rated themselves as being more fatigued also performed poorly on standardized reading measures (r = .392).

Who performed poorly on the WRMT?
Eight CHL were identified with WRMT total scores <85. On average, these children were later-identified (m = 6.81 years via parent report), had lower CELF scores (m = 64.38), and rated themselves 20 points more fatigued on a 100-point cognitive fatigue scale than their counterparts who also had hearing loss. Better ear PTA was not significantly different from the full CHL sample; however, all eight children fell into the "moderate" range of hearing loss.

ACKNOWLEDGEMENTS

References are available at
https://medschool.vanderbilt.edu/developmental-disabilities-lab/