Measuring Fatigue in School-Age Children with Hearing loss

Fred H. Bess, Benjamin Hornsby, Stephen Camarata & Krystal Werfel

Department of Hearing and Speech Sciences
National Center for Childhood Deafness
Vanderbilt Bill Wilkerson Center

Measuring Fatigue in School-Age Children with Hearing loss

Institute for Educational Sciences

Goal 1

Identification

IES Goal 1

"Conduct small-scale descriptive studies using primary data collection to identify existing programs and practices that may be associated with better academic outcomes, and examine factors and conditions that may mediate or moderate the effects of these programs and practices."

IES Funding "Goals"

- Goal 1
  - Identification Projects
- Goal 2
  - Development Projects
- Goal 3
  - Efficacy and Replication Trials
- Goal 4
  - Scale-up Evaluations
- Goal 5
  - Measurement Projects

A Clinical Study on

Fatigue in CHL

VANDERBILT
UNIVERSITY

"..... I can attest to the **FATIGUE** caused by prolonged intensive listening in noise through hearing aids.....so much effort was being devoted to getting the signal that I sometimes missed part of the message".

Mark Ross, 2006, 2012
Pediatric Audiologist

HEARING LOSS AND FATIGUE

Fatigue is a common sequelae of hearing loss and significantly impacts quality of life

Listening is exhausting!!!

"…since I lost most of my hearing…, I've had periodic bouts of tiredness that are deeper and of a different quality than I ever experienced before."

Copithorne, 2006

Description of Fatigue

"When you are hard of hearing you struggle

to hear; when you struggle to hear you get

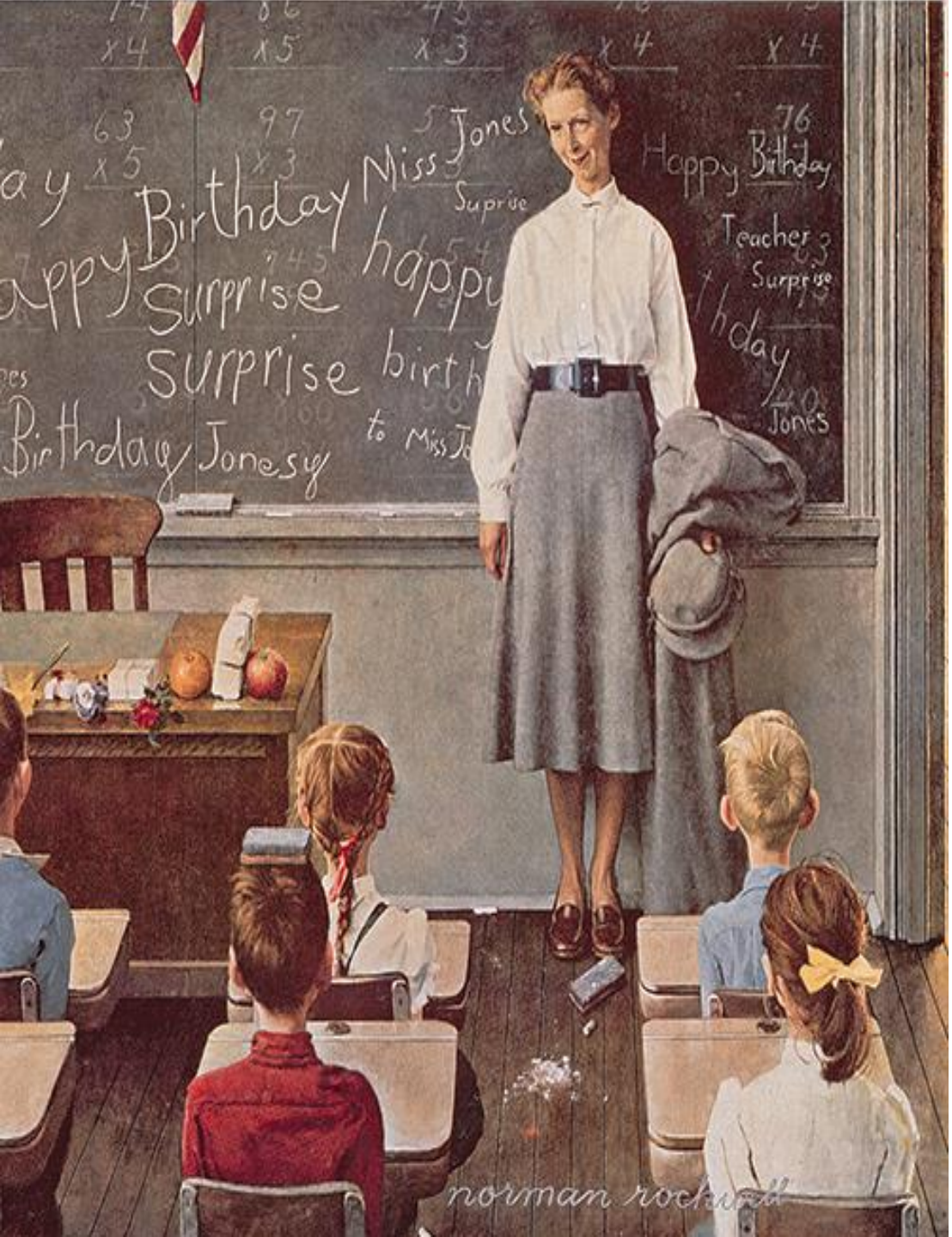
TIRED;

when you get tired you get frustrated;

when you get frustrated you get bored;

when you get bored you QUIT"

Pichora-Fuller, 2003



What Do Teachers Say?

" My children are exhausted by the end of the school day!"

"The kids are so tired—they are ready to go home "

"Robbie's mother says he has to take a nap almost every day after school"

"From mid afternoon on we focus on activities that don't require much mental effort"

WHAT IS FATIGUE?

Occurs in the physical and **mental/ cognitive** domains;

Defined as a mood or feeling of tiredness, exhaustion or lack of energy

Effects focus, concentration, alertness and/or mental energy and efficiency

"Nothing so fatiguing as the eternal hanging on of an uncompleted task"

----William James, 1881

WHO HAS FATIGUE?

Everybody!-

Complaints of transient fatigue are common even in healthy populations

Recurrent fatigue

-Common in many chronic health conditions
-Cancer, HIV AIDs, Parkinson's, MS
-Almost no work on hearing loss and fatigue--

Especially Kids!

CONSEQUENCES OF FATIGUE

Adults—

-Stress, inattention, concentration, mental processing, and decision-making

-less productive and more prone to accidents

-less active, more isolated, less able to monitor own self-care

Children w/ Chronic Illnesses—

-inattention, concentration, distractibility

-poorer school achievement, higher absenteeism

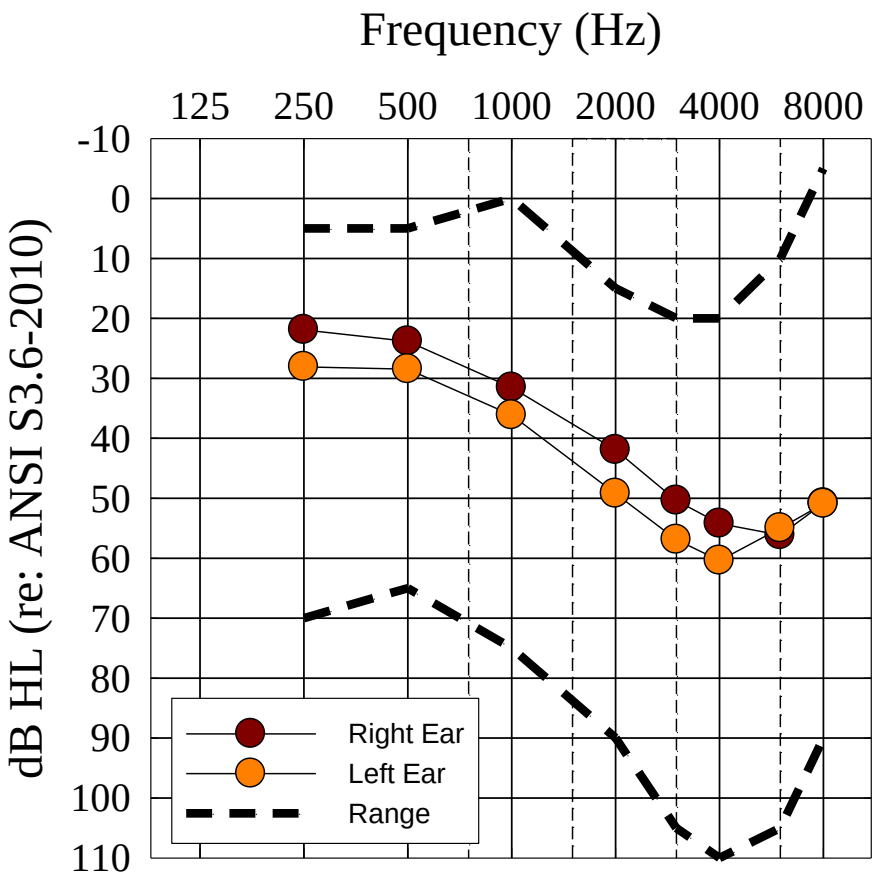
FATIGUE IN CHILDREN WITH HEARING LOSS

- Is fatigue more of a problem for CHL?
  - Anecdotal reports suggest yes but empirical work is lacking

FATIGUE IN CHL
(Participants)

- **Goal: 45 CHL & 45 CNH**
  - **All: 6-12 years old**
  - **CHL: Mild-Severe SNHL**
- **Inclusion/Exclusion:**
  - **General education classroom**
  - **Monolingual English speakers**
  - **No diagnosis of cognitive impairment, autism or developmental disorder**

- To date:
  - 30 CNH (mean = 8.3 years)
  - 13 CHL (mean = 10.4 years)



FATIGUE IN CHL

(Clinical Measures)

Subjective Assessment of Fatigue in the Child's Own Environment

Initial Visit: Demographic data, audiological exam, TONI, CELF, PPVT, parent training for later experiments and a **subjective measure of fatigue**

SUBJECTIVE FATIGUE IN AGE MATCHED CHL & CNH

- Preliminary data from 10 CNH and 10 CHL:
- CHL had a wide range of losses and amplification
  - 4 symmetric mild-moderate losses
    - bilateral hearing aids
  - 2 asymmetric losses
    - unilateral hearing aids
  - 4 bilateral profound losses
    - 2 bilateral CI users
    - 1 CI(R)/HA(L)
    - 1 CI(R)/Unaided(L)

Hornsby, Werfel, Camarata, and Bess (2013). Subjective Fatigue in Children with Hearing Loss: Some Preliminary Findings, AJA.

SUBJECTIVE FATIGUE IN AGE MATCHED CHL & CNH

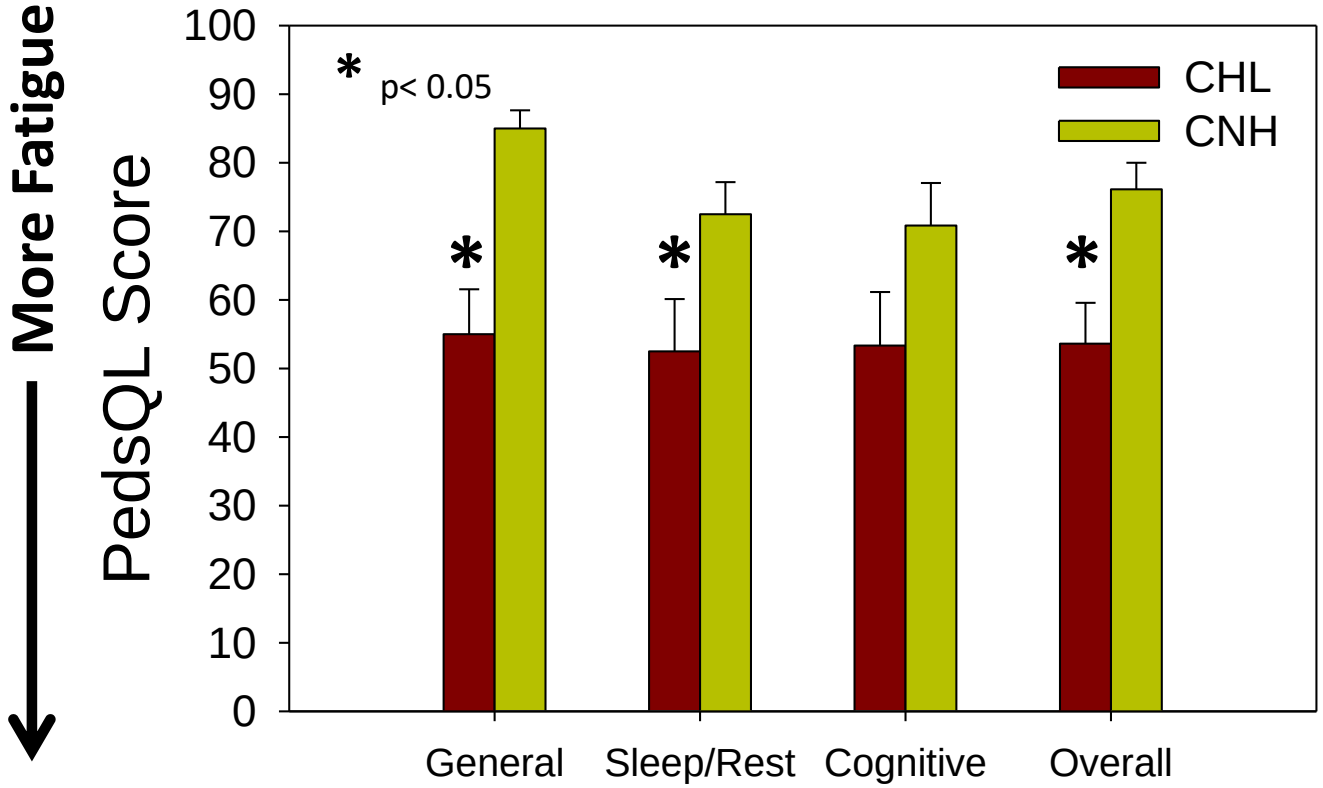
- The PedsQL MFS: Pediatric Quality of Life Multidimensional Fatigue Scale
  - Assesses general, sleep/rest, and cognitive fatigue and provides a "Total" fatigue score
  - Used in children with multiple chronic conditions
    - cancer, diabetes, rheumatic disease

*In the past **ONE month,** how much of a **problem** has this been for you …*

	Never	Almost Never	Sometimes	Often	Almost Always	
Item	0	1	2	3	4	Construct
I feel tired						General
I sleep a lot						Sleep/Rest
It is hard for me to keep my attention on things						Cognitive

Varni et al., 2002

SUBJECTIVE FATIGUE IN AGE MATCHED CHL & CNH



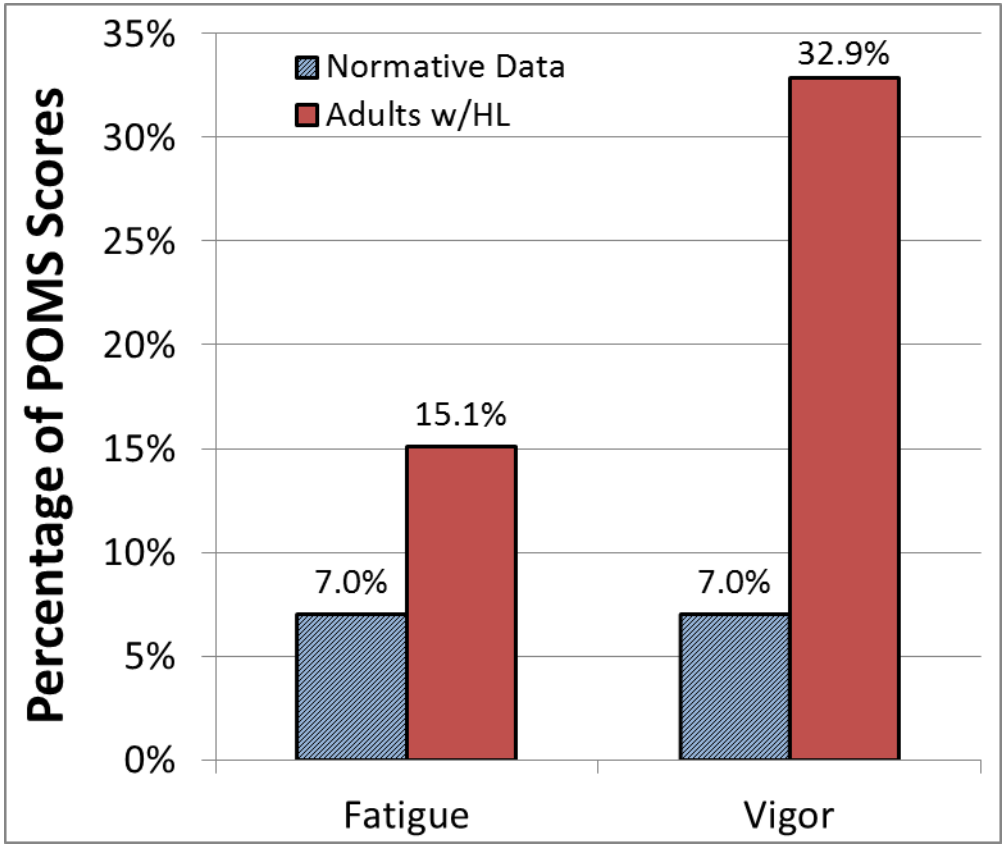
- CHL reported significantly more fatigue. Pervasive across domains

Hornsby, Werfel, Camarata, and Bess (2013). Subjective Fatigue in Children with Hearing Loss: Some Preliminary Findings, AJA.

SEVERE DEFICITS ARE COMMON IN AHL

- **Adults with HL** were twice as likely to report severe (>1.5 st. dev above mean) fatigue deficits and
- 4 times as likely to report severe vigor deficits!

Percentage of adults reporting severe fatigue and vigor deficits



116 **adults** with hearing complaints completed **Profile of Mood States** (POMS) a validated measure of fatigue and vigor

Hornsby and Kipp, AAS 2013

FATIGUE IN CHL

(Clinical Measures)

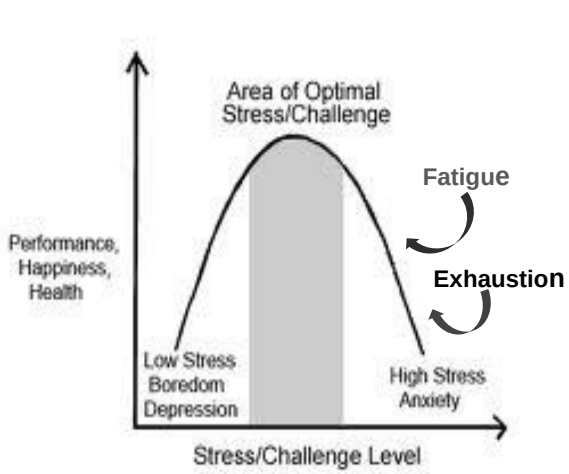
Initial Visit: Demographic data, audiological exam, TONI, CELF, PPVT, parent training for later experiments and a **subjective measure of fatigue**

Experiment 1: Salivary cortisol levels sampled six times throughout the day; each child sampled on two separate days

Objective assessment of stress, which can be associated with fatigue, in the child's own environment.

A Physiologic Marker in Fatigue Research

Experiment 1: Cortisol Levels in CHL & CNH

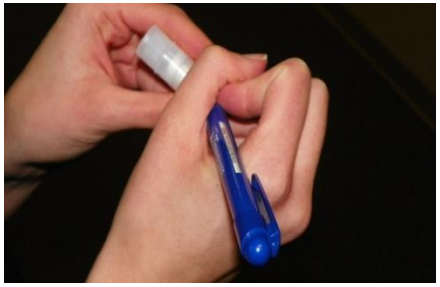


- Stress is the body's reaction to change that requires a physical, mental or emotional response
  - Stress is caused by both good experiences
    - and bad experiences

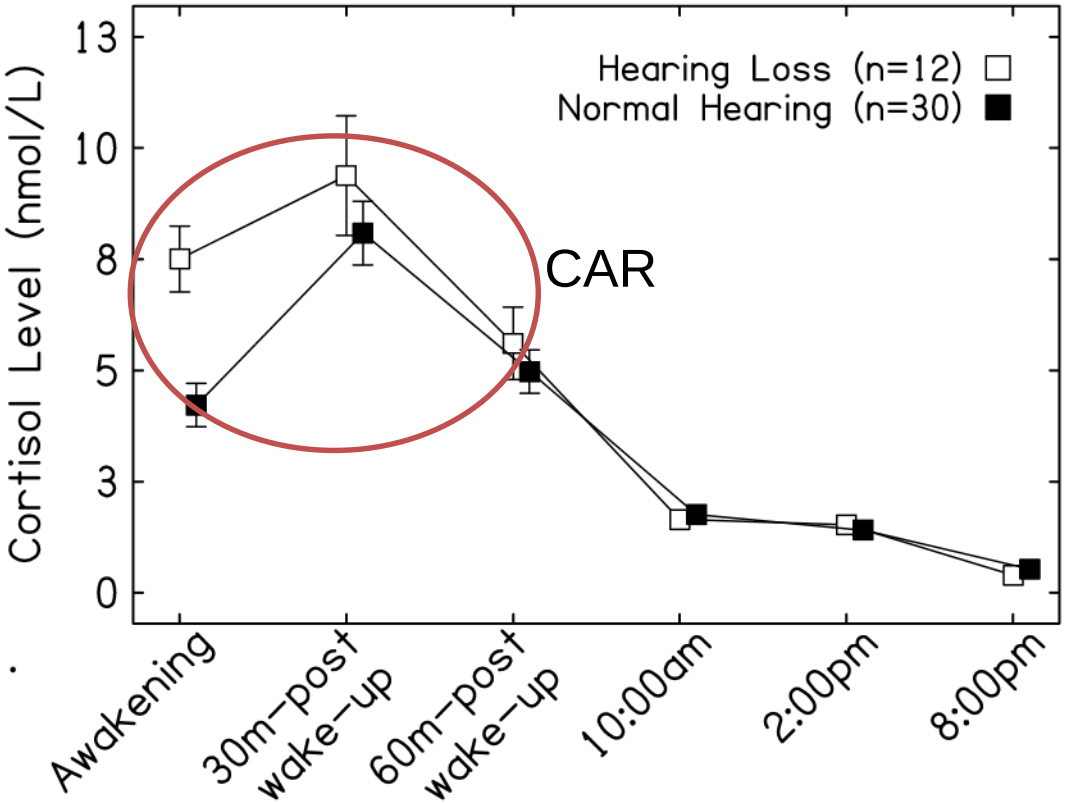
- Cortisol provides a physiologic/objective measure of stress that is associated with fatigue

Salivary Cortisol Levels in CHL & CNH (Experiment 1)

Booklet

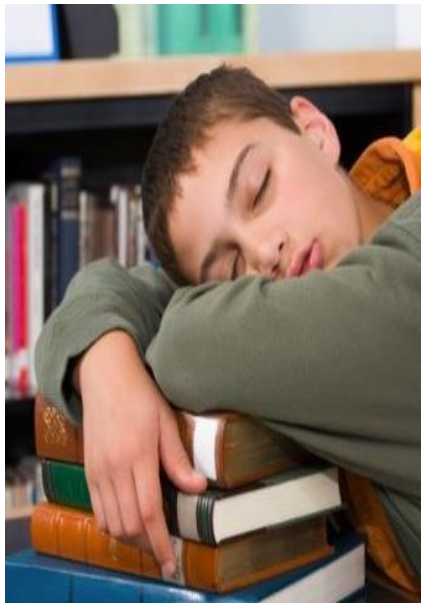


- Samples at awakening, 30 & 60 min post, 10 AM, 2 PM, 8 PM
- Samples stored in refrigerator
- Sampling procedure repeated several weeks later



Subjective and objective measures suggest fatigue is a significant problem for CHL

Can we measure this in the laboratory?



FATIGUE IN CHL

(Clinical Measures)

Initial Visit: Demographic data, audiological exam, TONI, CELF, PPVT, parent training for later experiments and a **subjective measure of fatigue**

Experiment 1: Salivary cortisol levels sampled six times throughout the day; each child sampled on two separate days

Experiment 2: Listening effort during speech processing tasks

Experiment 3: P300 measures

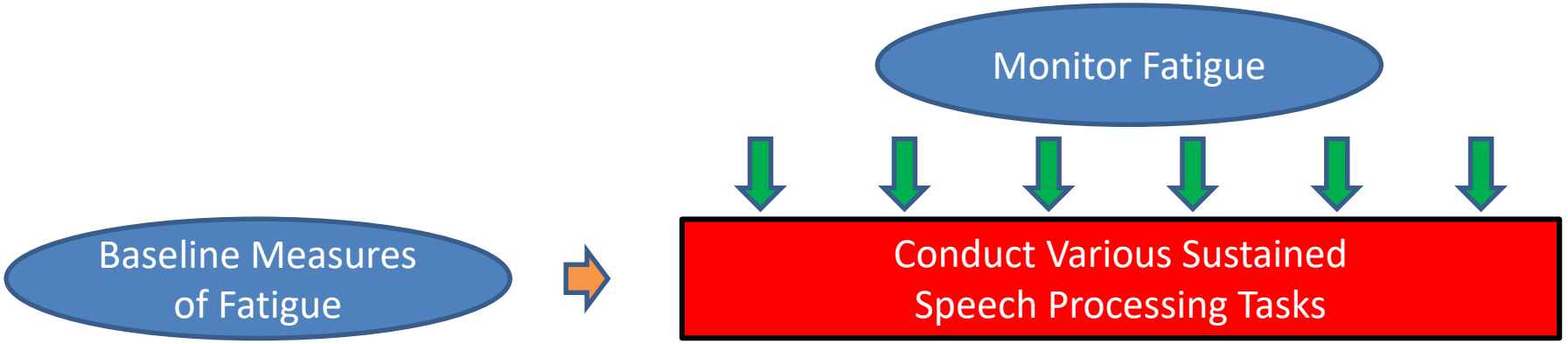
Laboratory assessment of speech processing-related fatigue

LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

- What causes fatigue in CHL?
  - We hypothesize that ***sustained*** mental demands required to overcome auditory deficits are a primary factor

LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

- Listening effort and fatigue (subjective and objective) are assessed during a series of cognitively demanding and sustained, primarily speech based, tasks
  - Total time ~ 2.5-3.5 hours
- CHL are tested unaided and aided



LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

Speech Processing Tasks

- Simple Speech Measures
  - CRM recognition- 0 dB SNR (cafeteria babble)
    - Coordinate Response Measure (Bolia et al., 2000)
      - E.g., Ready “Charlie” go to “Blue” “Five” now
  - Word recognition in noise
    - Isophonemic AB word lists (Boothroyd, 2008)
    - 3 SNRs (-4, 0, +4 dB; multitalker babble)

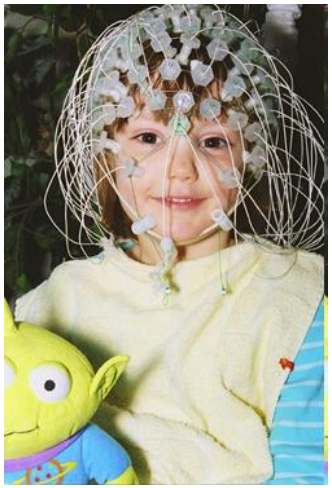
LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

Speech Processing Tasks

- Complex Speech Measures
  - Dual Task- assesses changes in listening effort across conditions via secondary task performance
    - Isophonemic word recognition (primary task) and visual reaction time (secondary task)
    - 3 SNRs (-4, 0, +4 dB)
  - Speech Vigilance Task- CRM at 0 dB SNR
    - Requires sustained auditory attention
      - Measures of accuracy and processing speed

LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

Fatigue Measures

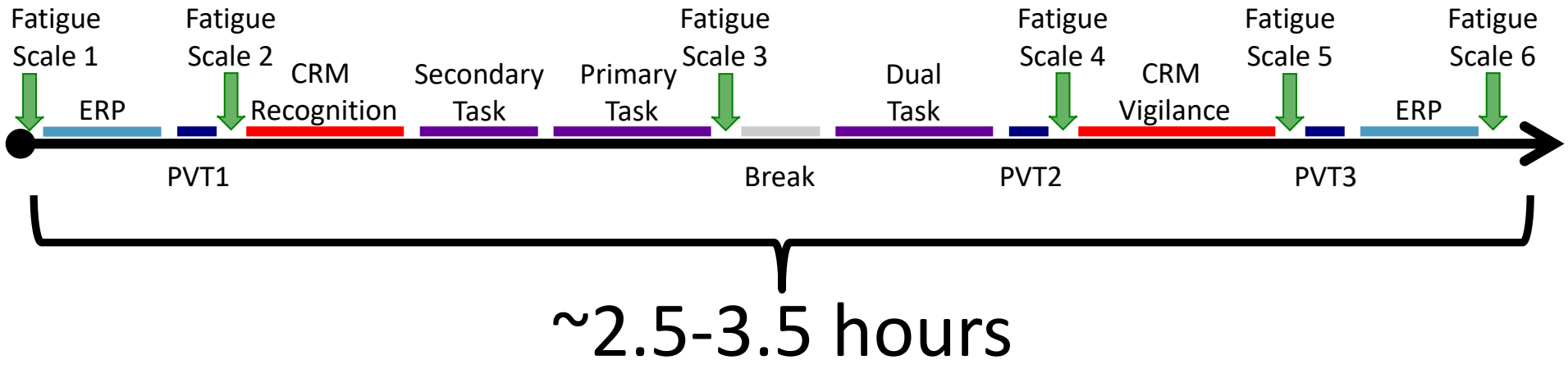


- Physiologic measure of fatigue
  - ERPs- P300 (oddball paradigm). Two (2) measures pre and post speech tasks
    - Not discussed today
- Subjective measure of fatigue (Right Now)
  - 5 items (e.g., I feel tired), responses on a 5-point scale. Assessed six (6) times during testing

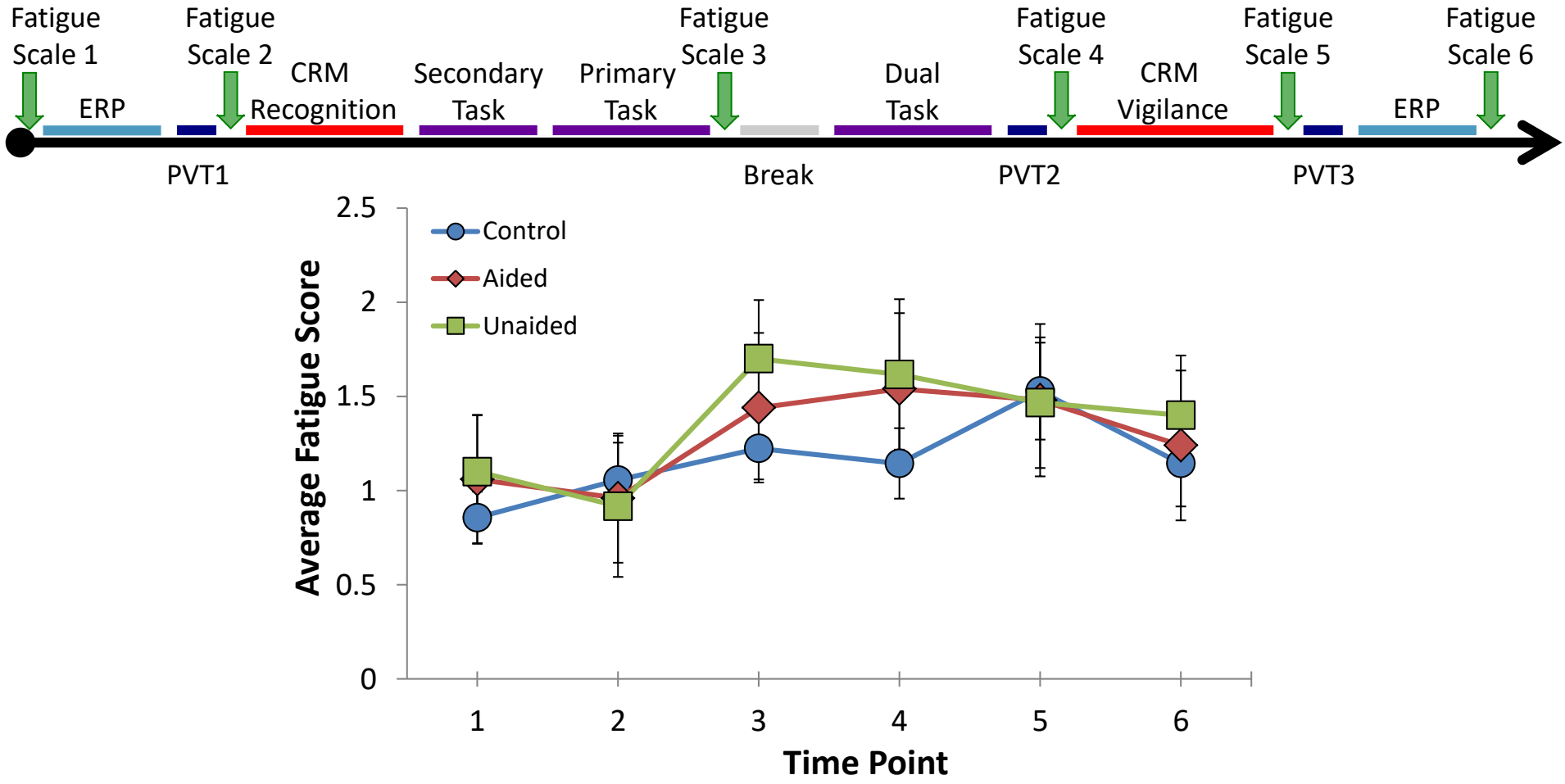
- Behavioral measure of fatigue
  - Psychomotor Vigilance Task (PVT). Visual measure of sustained attention which is sensitive to fatigue
    - Assessed three (3) times during testing

LABORATORY ASSESSMENT OF SPEECH PROCESSING RELATED FATIGUE

- Schematic timeline of study tasks and measurement points

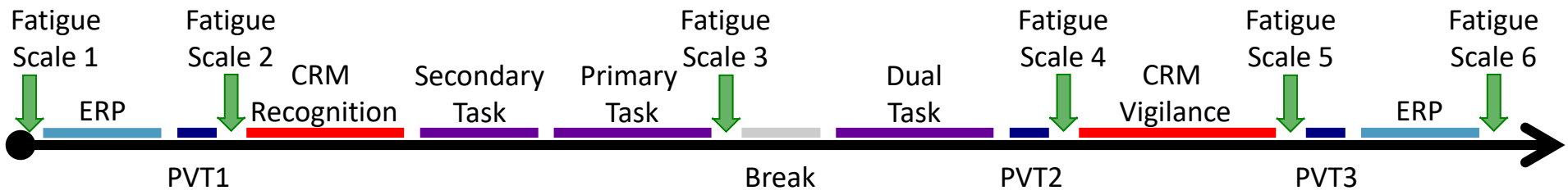


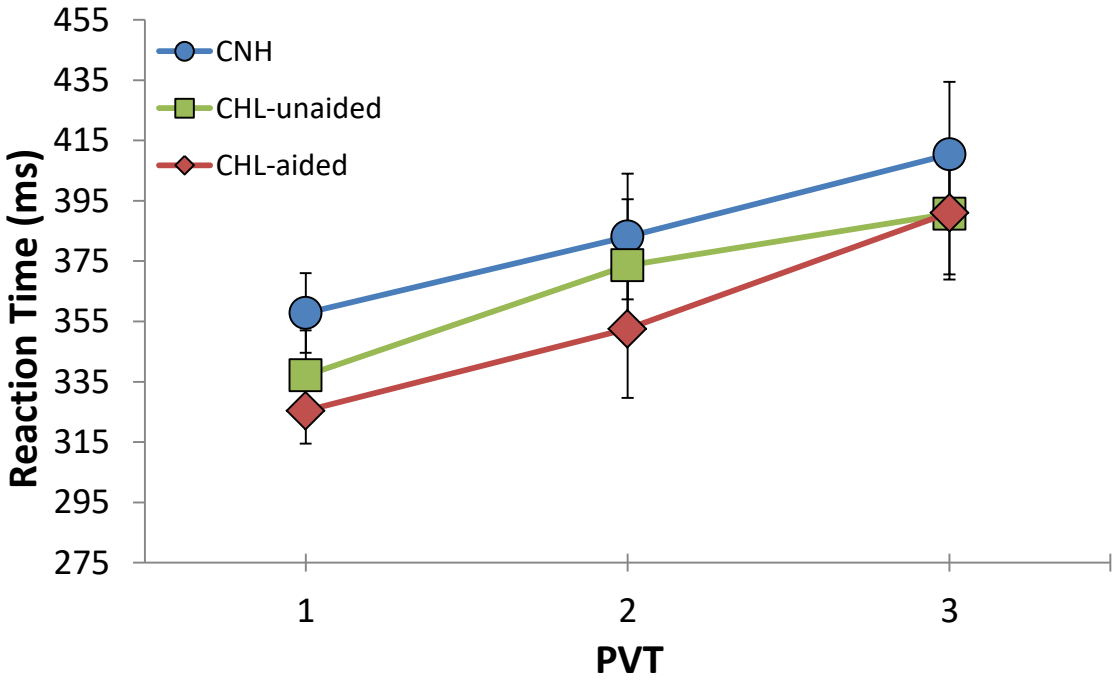
RESULTS: SUBJECTIVE RATINGS



- Significant interaction bw time and group
  - Unaided fatigue scores increased more than NH or Aided bw T2 and T3

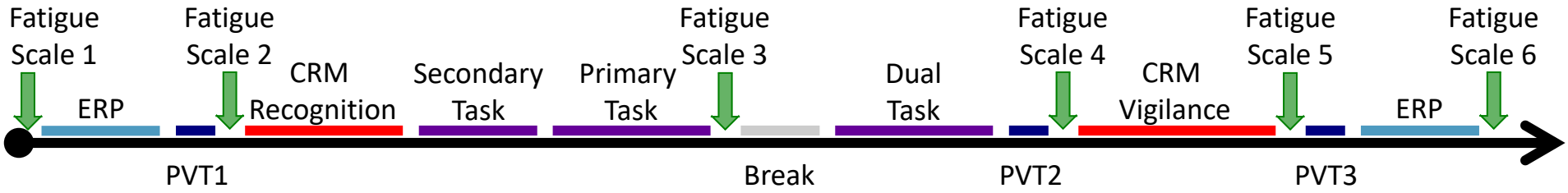
RESULTS: OBJECTIVE- PVT DATA





- Significant main effect of time- all groups demonstrate objective fatigue
  - But no group x time interaction

FUTURE ANALYSES



- ERPs- physiologic marker of fatigue
- Relationships between subjective/objective fatigue measures and
  - Speech task performance
  - Individual variables
    - Demographic
    - Audiologic
    - Academic

FATIGUE IN CHL

(Clinical Measures)

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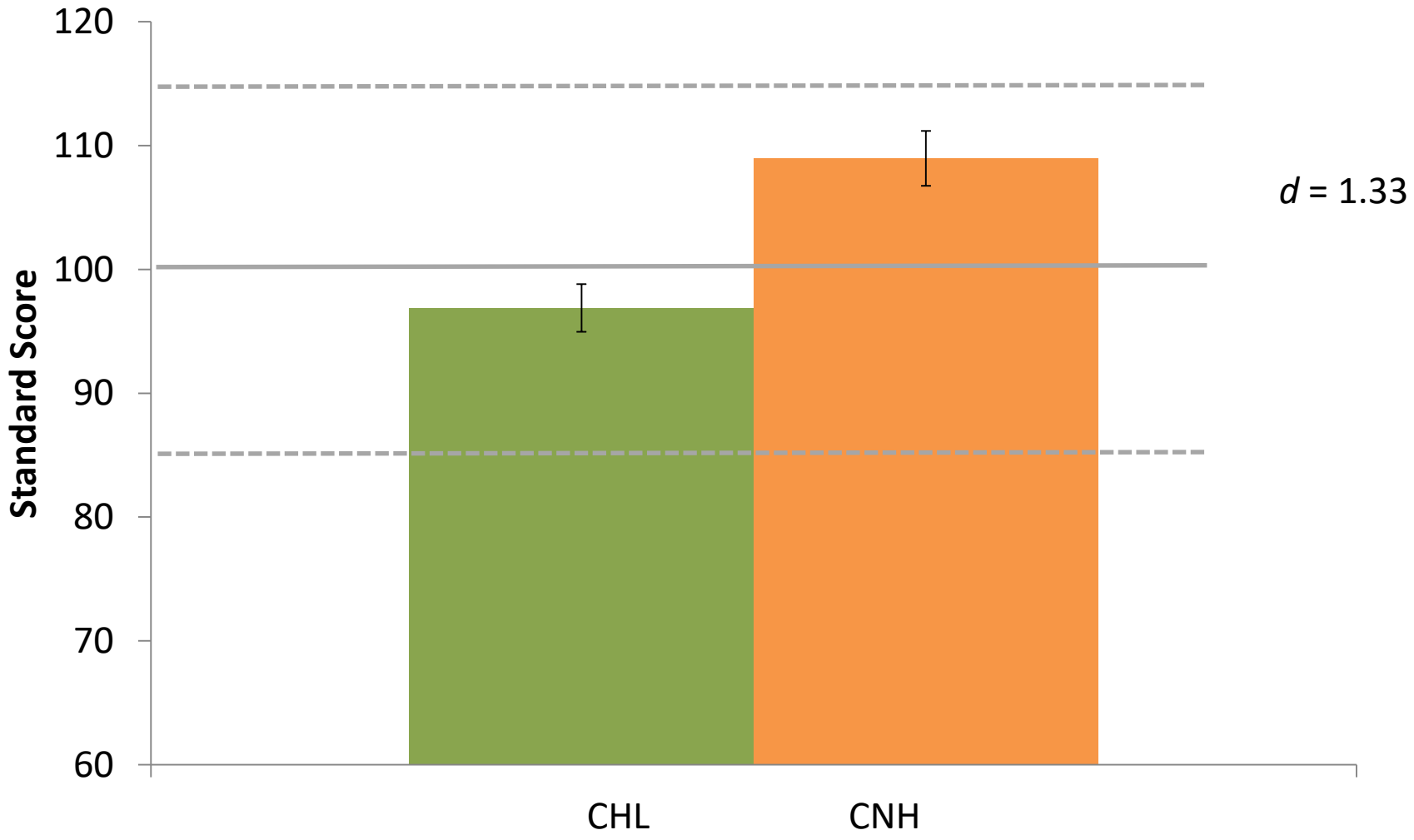
Experiment 1: Salivary cortisol levels sampled six times throughout the day; each child sampled on two separate days

Experiment 2: Listening effort during speech processing tasks

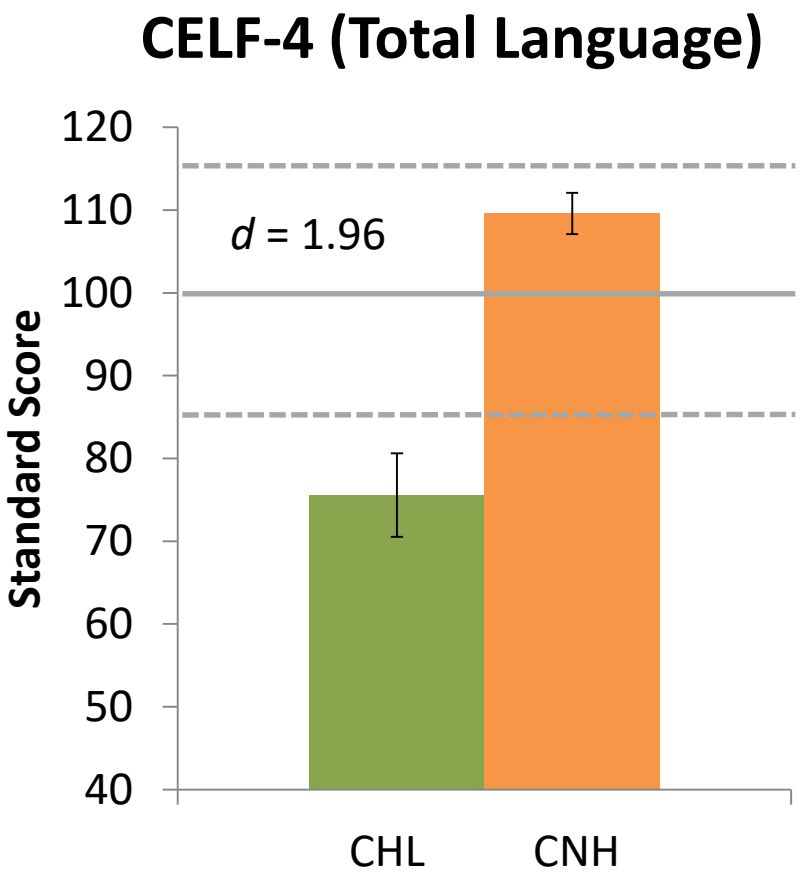
Experiment 3: P300 measures

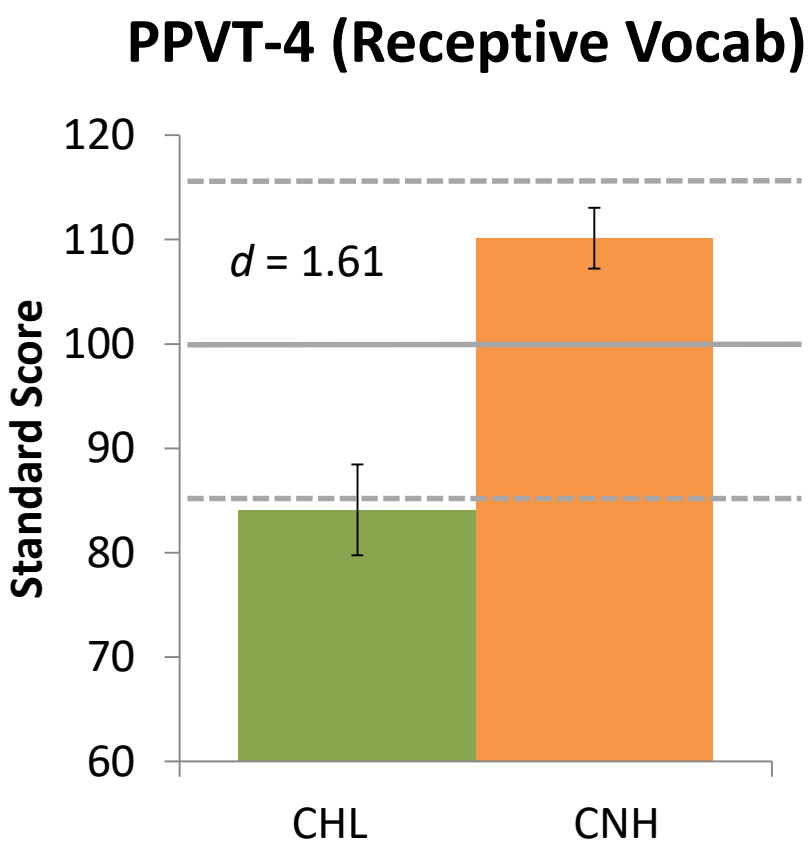
Experiment 4: Fatigue effects on learning skills important for school performance

Nonverbal Intelligence
(TONI-4)



Language

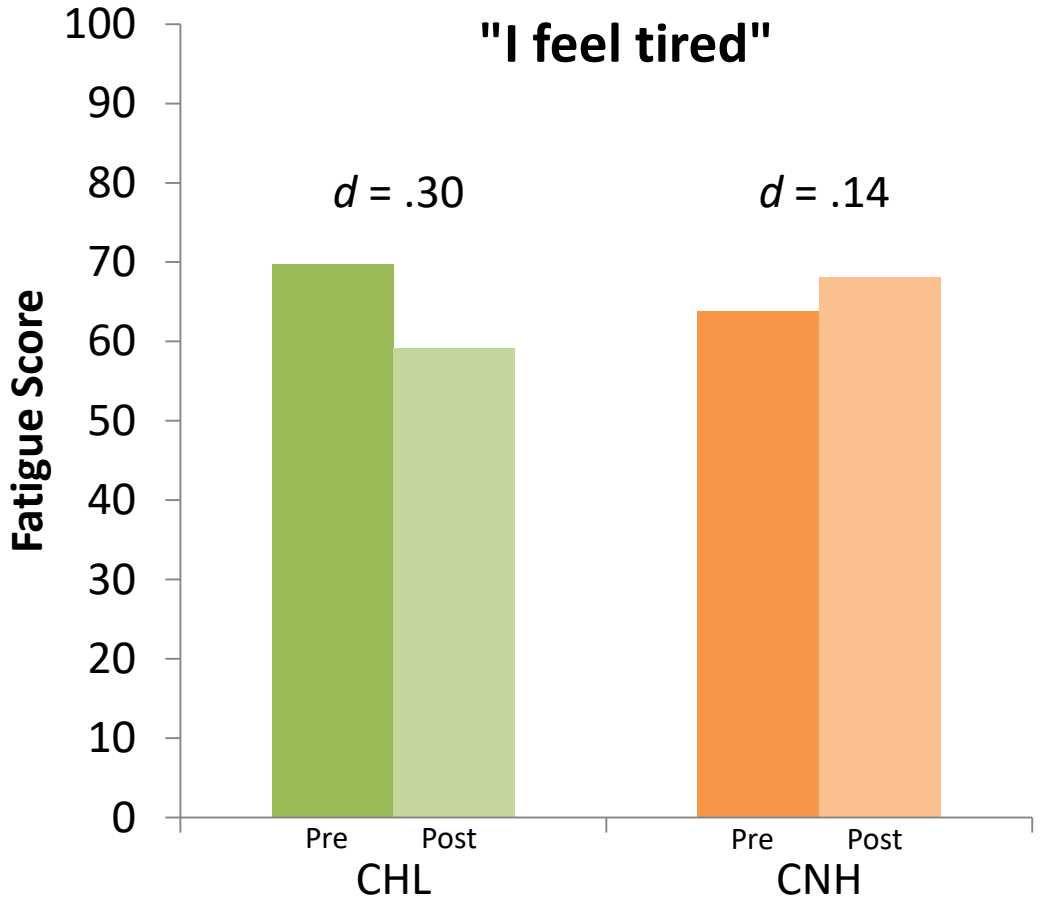

CELF-4 (Total Language)
Standard Score
120
110
100
90
80
70
60
50
40
d = 1.96
CHL
CNH


PPVT-4 (Receptive Vocab)
Standard Score
120
110
100
90
80
70
60
d = 1.61
CHL
CNH

Fatigue in CHL
(Effects on Literacy-Related Skills)

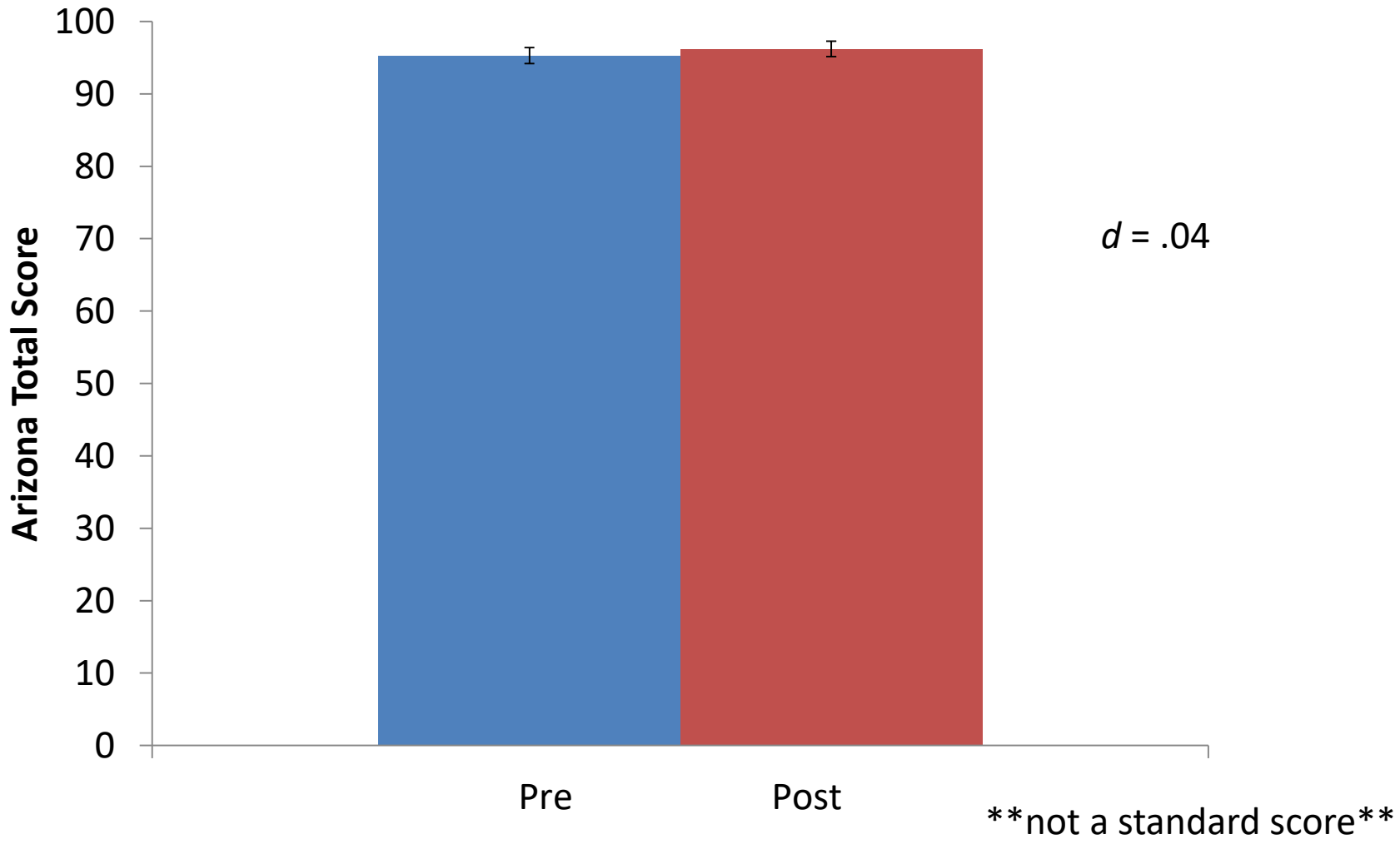
Two assessment sessions:

Pre: non-school day in AM
Post: school day in PM after school



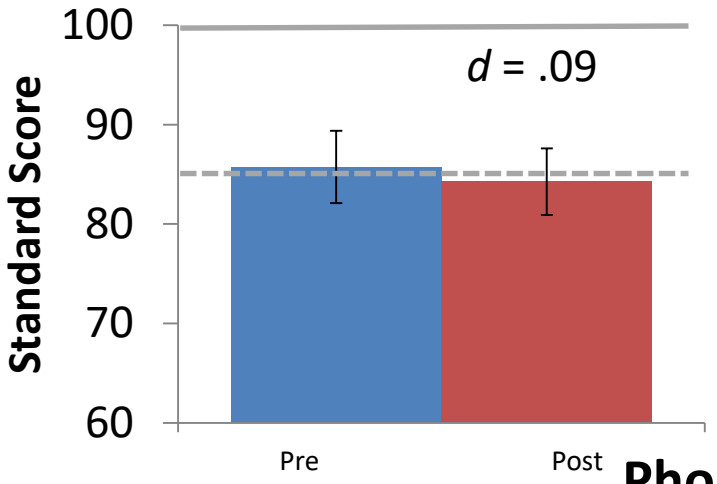
Higher scores indicate *LESS* fatigue

Articulation
(Arizona-3)

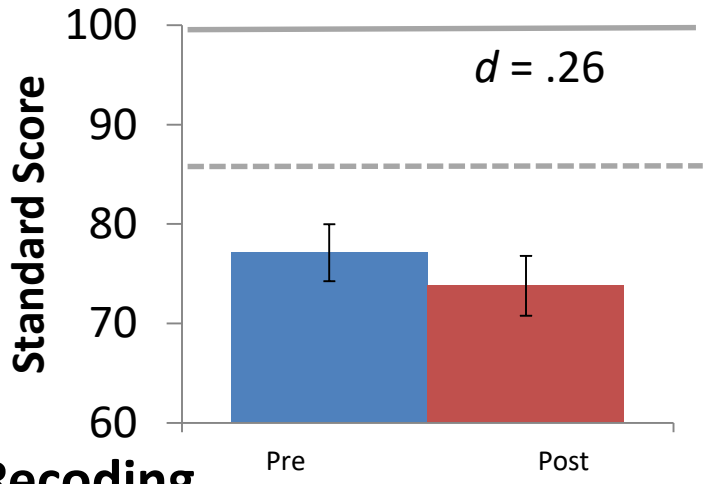


Phonological Processing
(CTOPP)

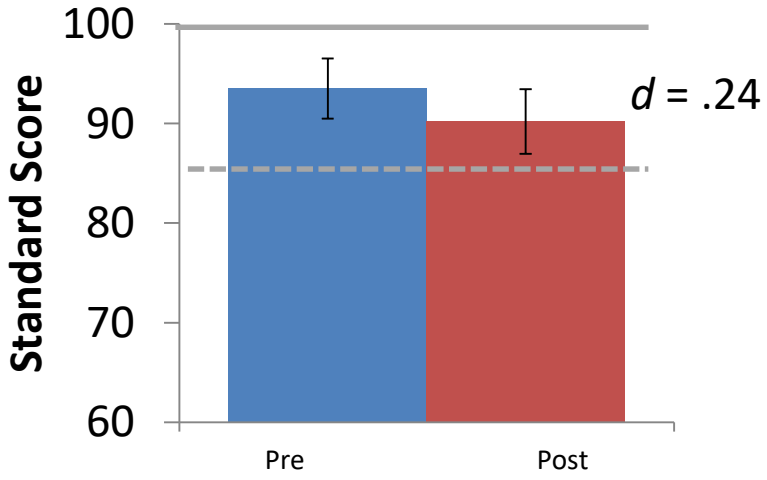
Phonological Awareness



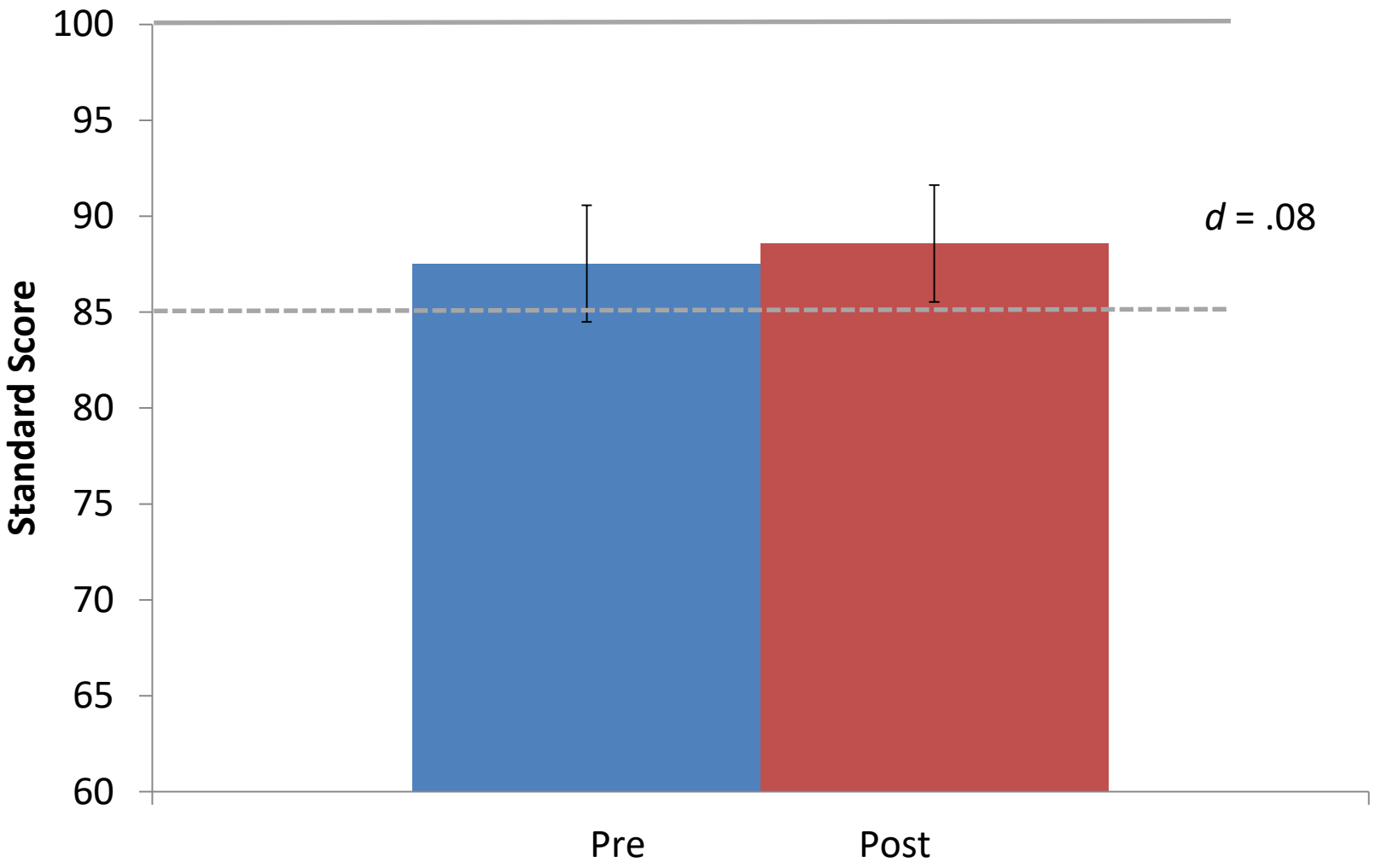
Phonological Memory



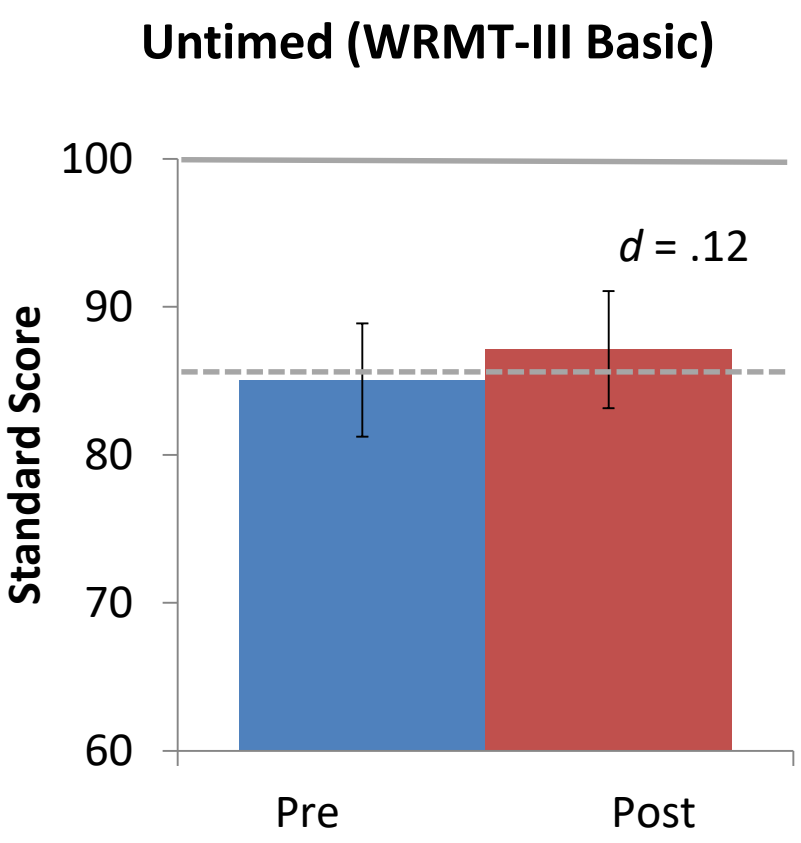
Phonological Recoding

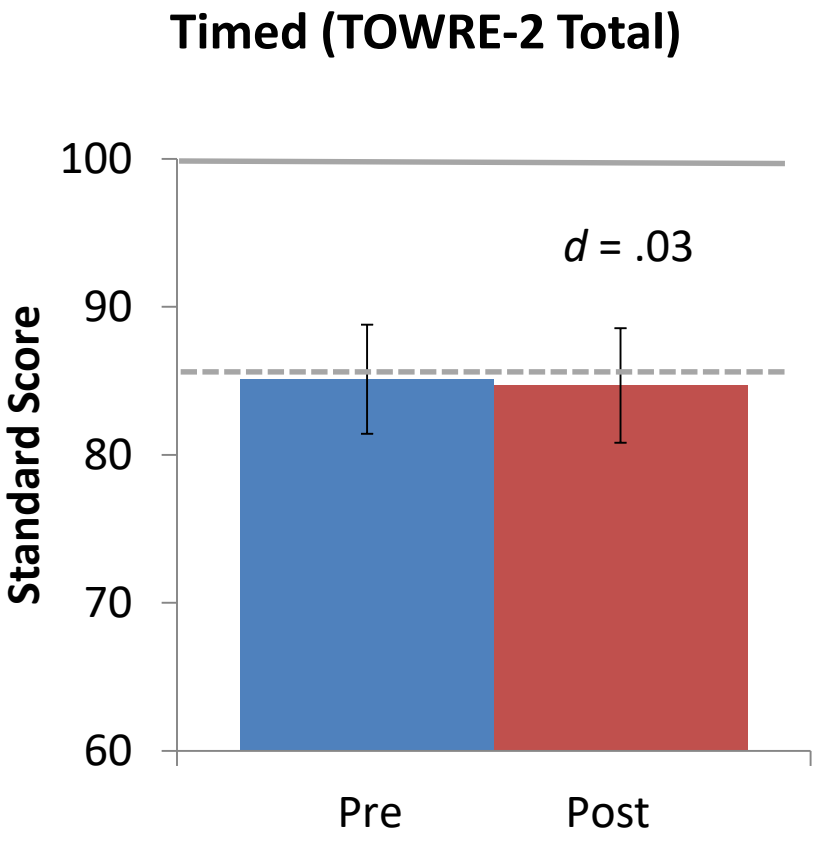


Spelling
(TWS-4)



Word Recognition

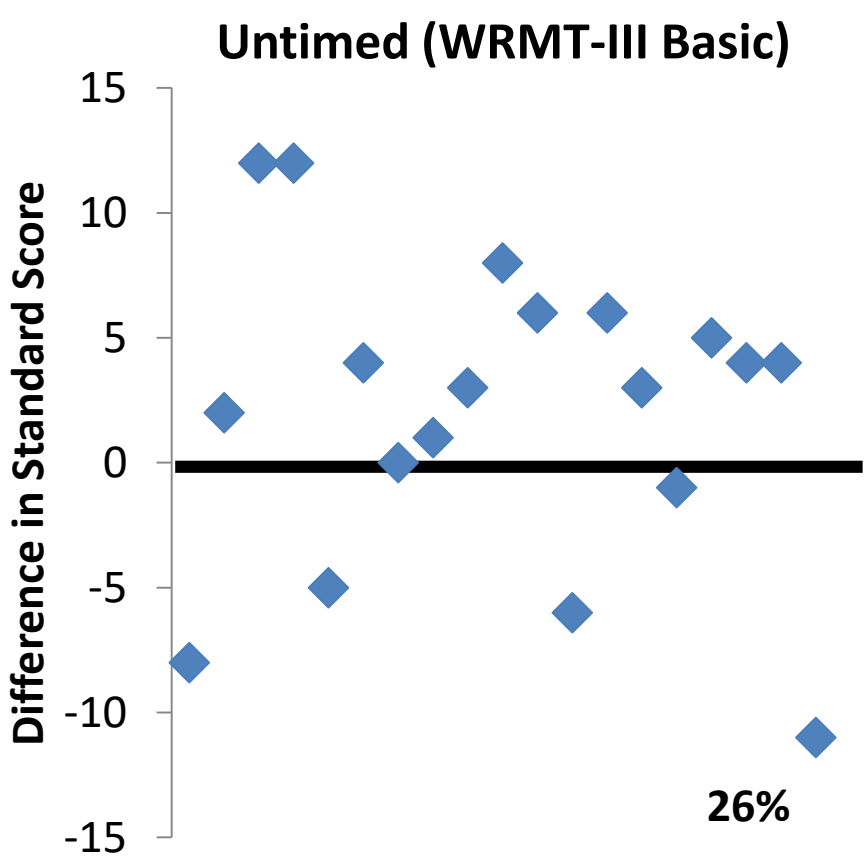


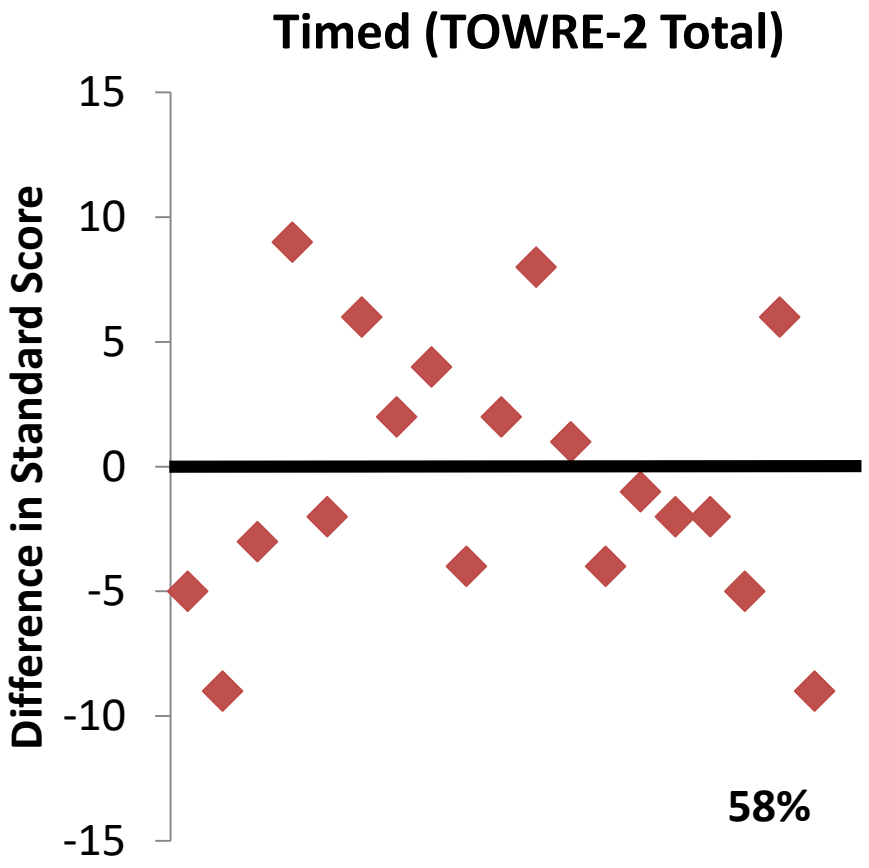


Group means appear to indicate no effect of fatigue on word recognition, even timed.

However…

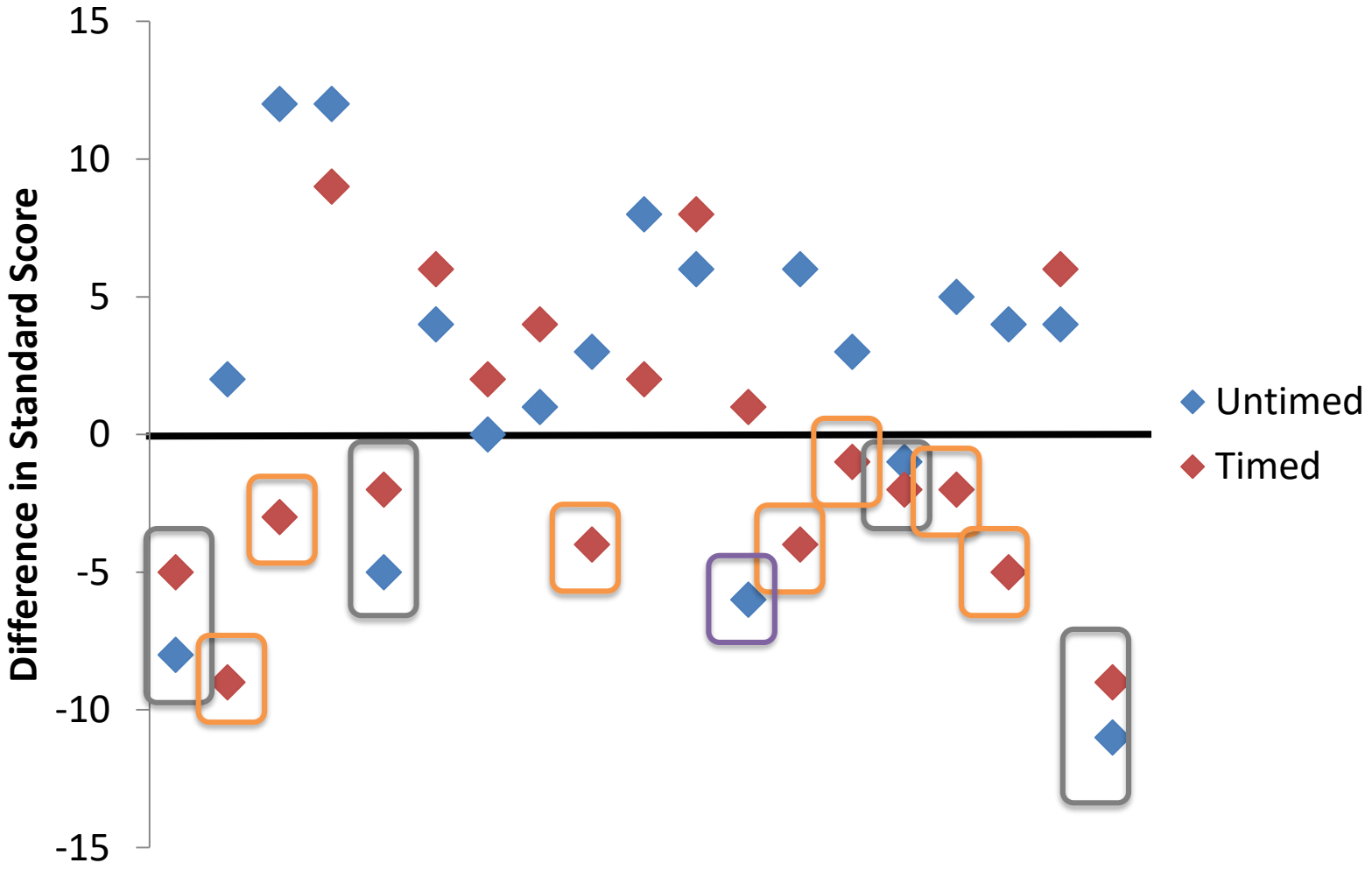
Word Recognition



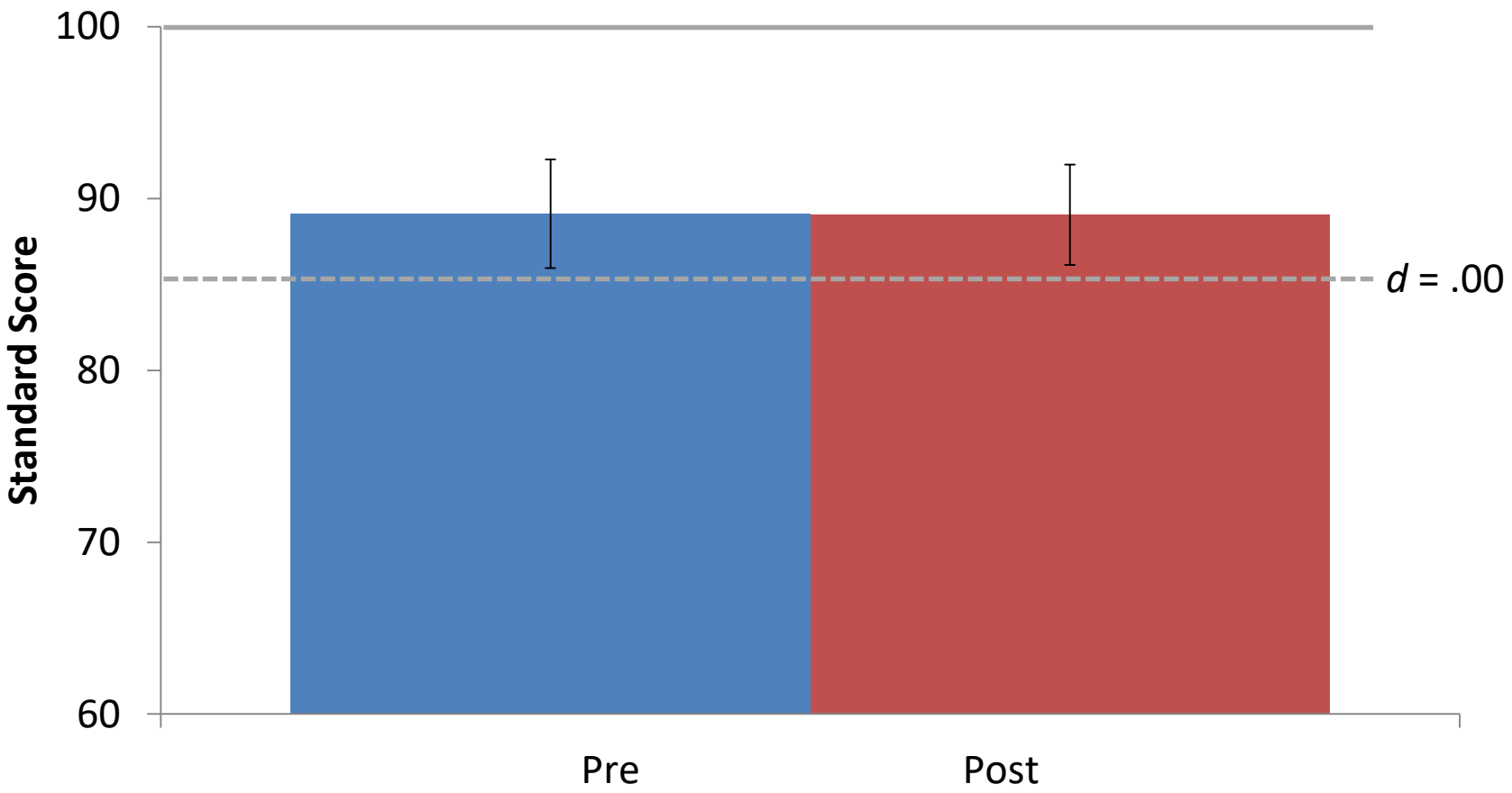


Individual performance indicates that, as hypothesized, fatigue plays **a larger role in timed word recognition for CHL**

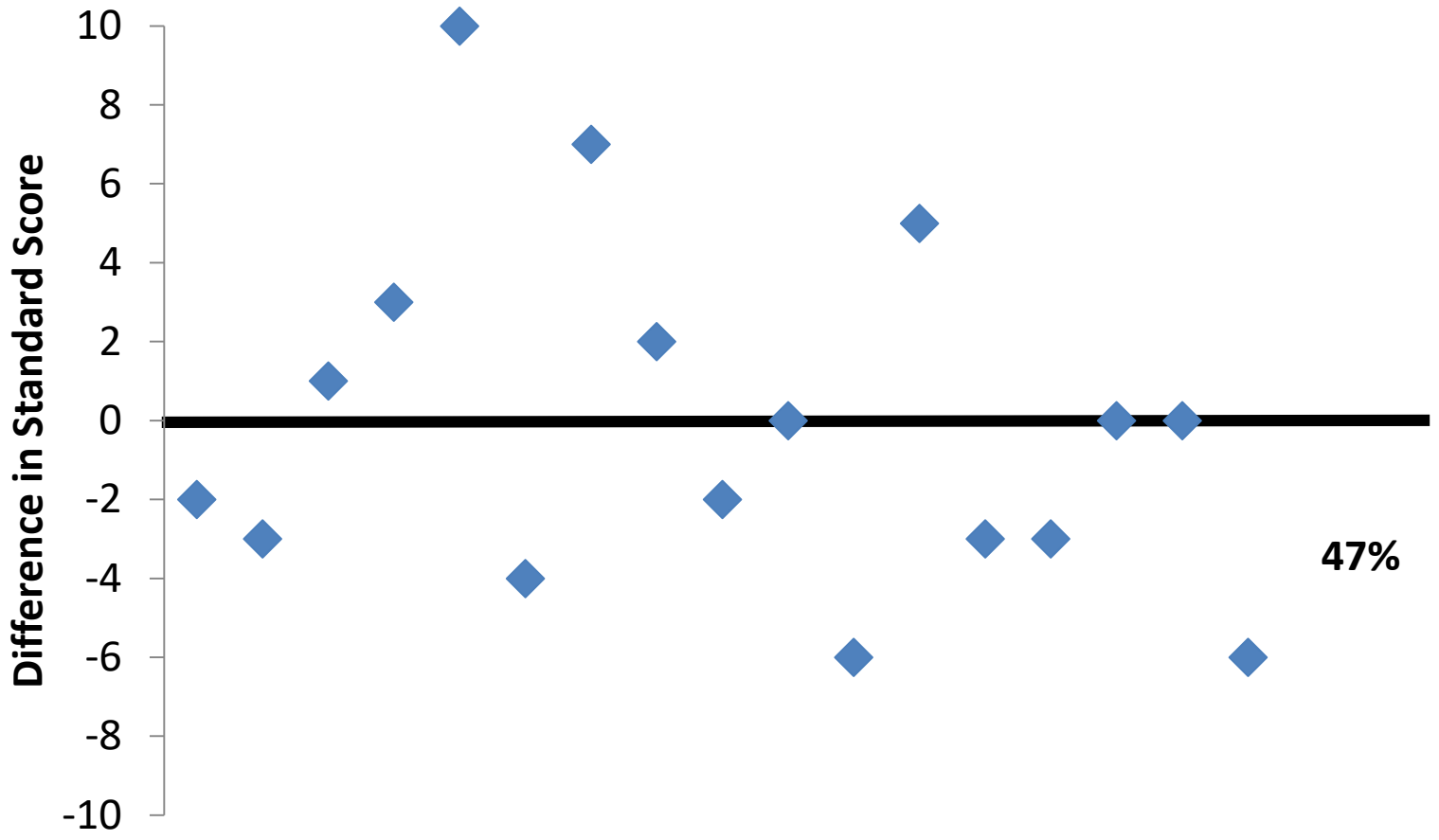
Word Recognition



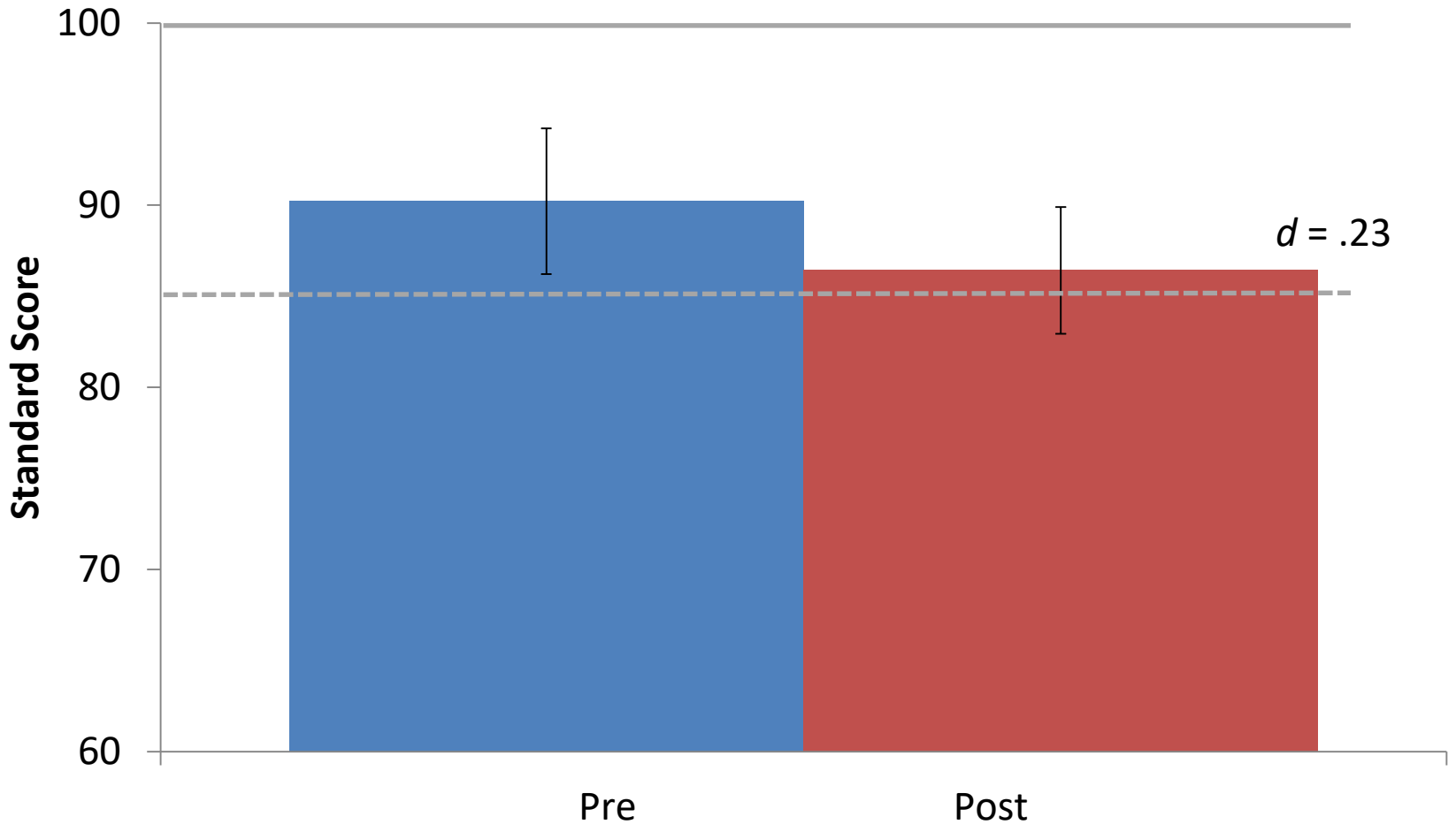
Oral Reading Fluency
(WRMT-III)



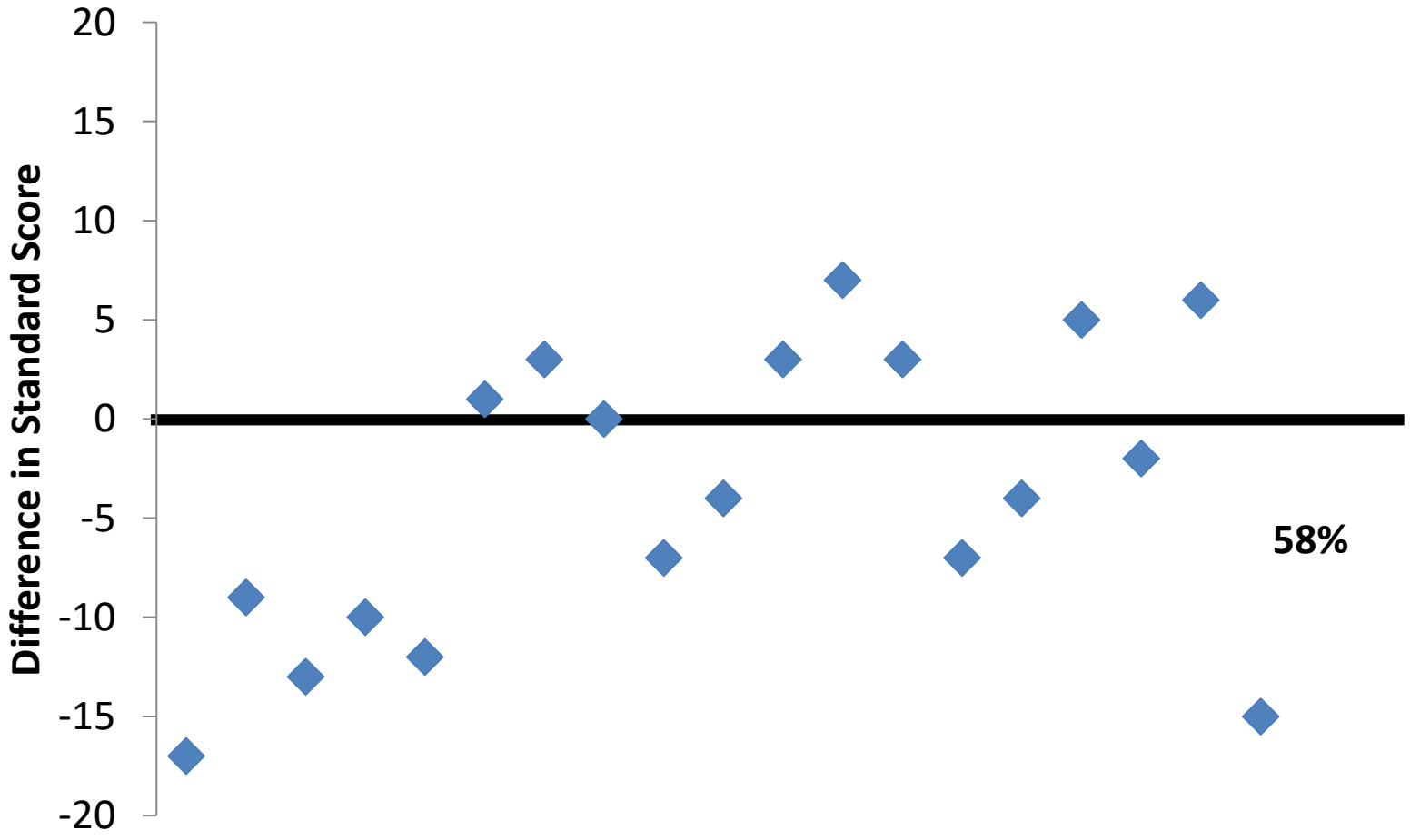
Oral Reading Fluency
(WRMT-III)



Reading Comprehension
(WRMT-III)



Reading Comprehension
(WRMT-III)



A Clinical Study of Fatigue: Summing Things up

- Subjective data confirm:
  - fatigue is increased in adults and children with HL,
  - risk for more severe fatigue is increased in these groups
  - fatigue affects some skills important for classroom learning
- This ongoing project explores fatigue in CHL
  - Subjectively (PedsQL) and objectively (Cortisol) in everyday environments
  - Due to sustained speech processing demands in a laboratory setting (Fatigue scale/PVT/ERP)
  - And its impact on skills important for classroom learning

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Ralph Leverett
Jeannie Luckey
Vicki Powers
Matthew Revi

Sites

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and West TN School for the Deaf

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THANK YOU