# Auditory Processing Skills and Abilities in Children Who Stutter

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ASHA 2008, Technical session, 1569

# Statement of problem

- We know of stuttering persistence factors in ***preschool-aged children,*** and yet we lack information about factors negatively affecting treatment outcomes in ***school-age children*** who stutter.
- Auditory processing deficits is a general factor suspected to increase stuttering persistence or decrease treatment prognosis in school-age children who stutter (Arndt & Healey, 2001; Brown, Sambrooks & MacCulloch, 1975; MacCulloch & Eaton, 1971; Riley & Riley, 1980).

- Children who show difficulties in **auditory processing** perform poorly in:
  - sound localization and lateralization,
  - auditory discrimination,
  - auditory pattern recognition, and/or
  - temporal aspects of audition (e.g., integration)
- **An individual with an auditory processing deficit** has normal hearing, but difficulty in the reception and interpretation of auditory information (ASHA, 2005).

# Purpose

- Examine the basic level of auditory processing behaviors in school-age boys who do and do not stutter
- Three auditory tests were administered from the *Differential Screening Test for Processing* (Richard & Ferre, 2006)
  - Dichotic Digits
  - Temporal Patterning
  - Auditory Discrimination

# Methods

- Participants were 5 children who stutter (CWS), all boys, ages 6- to 9-years.
- Each of the 5 CWS were matched +/- 3 mos of age to children (boys) who did not stutter (CWNS).
- All 10 boys had normal hearing.
- Three of the 5 boys who stutter and one of the 5 typically fluent peers were judged to be left-handed, based on the *Edinburgh Handedness Inventory* (Oldfield, 1971).

Three subtests in the Level One “Acoustic Subtests” of the *DSTP,* including stimuli presented binaurally via headphones:

- **Dichotic digits:** Four numbers, two to each ear (e.g., Right = “8,2”; Left = “1,6”), simultaneously. Child is expected to repeat back all four numbers in any order.
- **Temporal patterning:** Three-tone patterns that vary in low- and high-pitch tones; Child is expected to imitate or state a “high/low” sequence (e.g., “low-low-high”).
- **Auditory discrimination:** Nonsense syllables (e.g., ) are presented in a background of steady state noise; Child must imitate the syllable accurately.

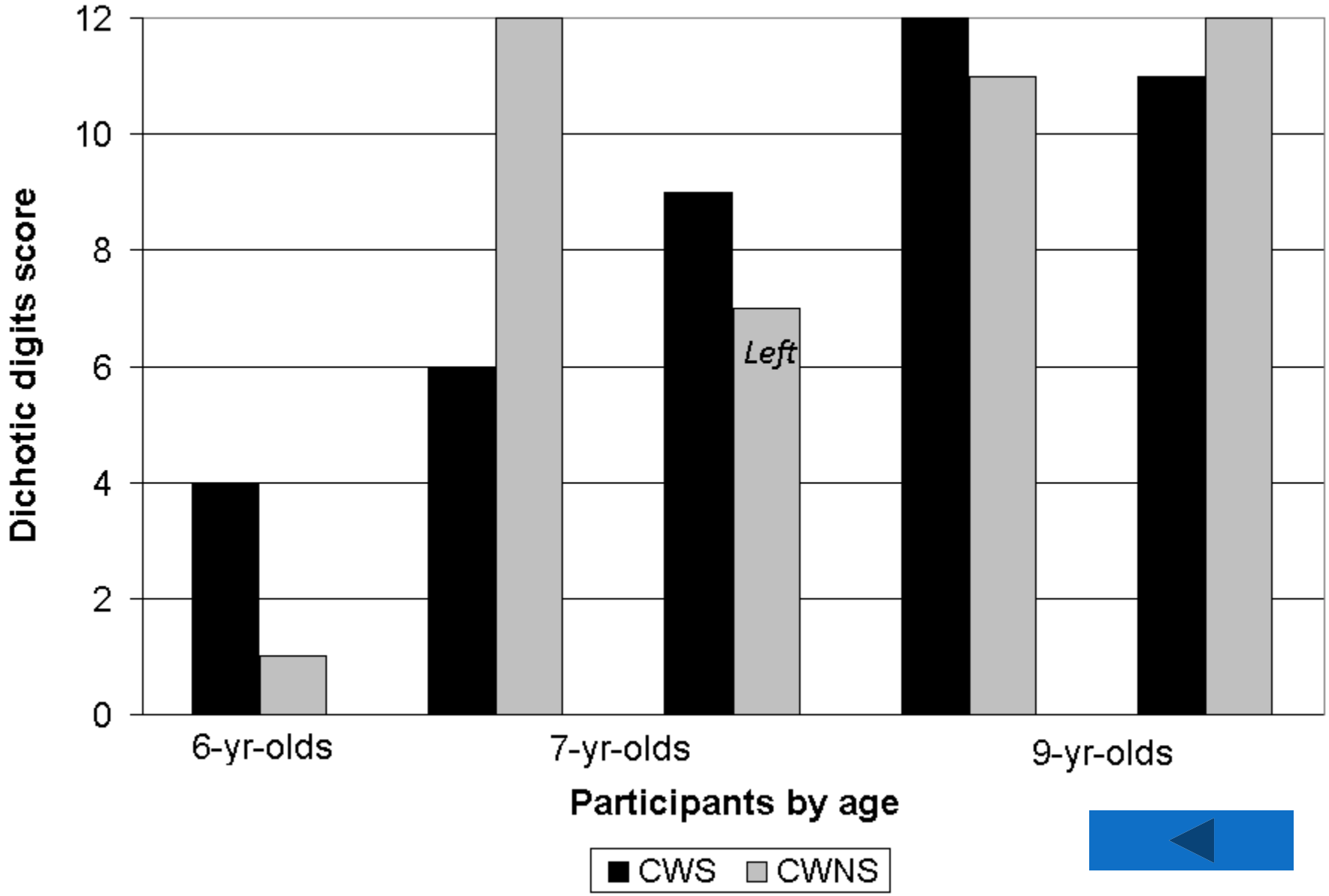
# Results

- No difference ($p > 0.017$) between children who stutter (CWS) and children who do not stutter (CWNS) on the Dichotic Digits subtest (Figure 1) and on the Temporal Patterning subtest (Figure 2).
- However, CWS had significantly ($U = 1.5$; $p = 0.016$) lower scores on the Auditory Discrimination subtest (*Mdn* = 11/18; 0.60; *Range* = 7-13) than the CWNS (*Mdn* =15/18; 0.83; *Range* = 12-18) (Figure 3).

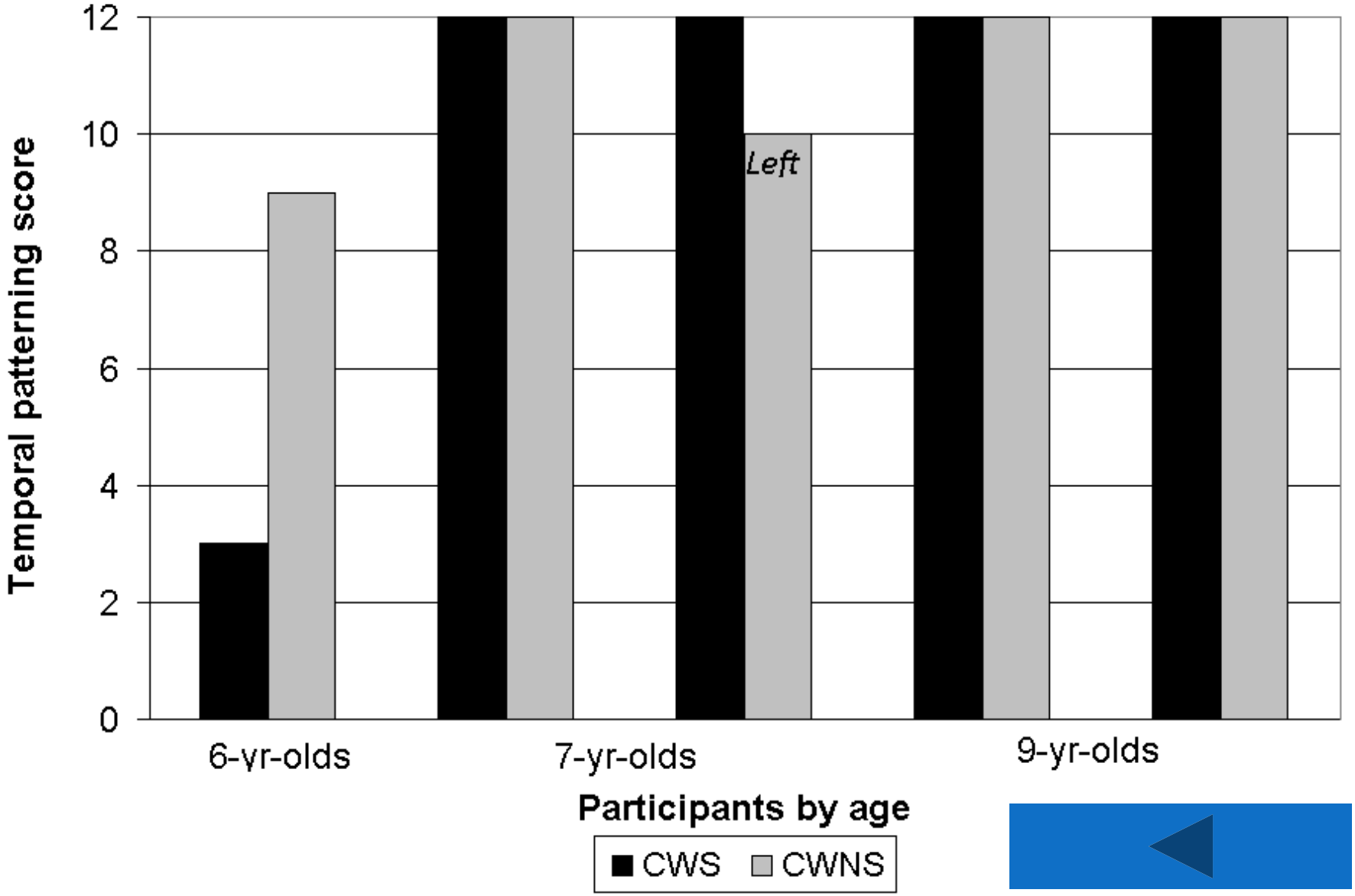
# Results

- Significant correlations were found between age and performance for two of the three subtests:
  - Spearman's *rho* = +0.791 for age and Dichotic digits;
  - Spearman's *rho* = +0.766 for age and Temporal patterning;
  - A weaker non-significant correlation (*rho* = +0.445; $p = 0.197$) was found between age and Auditory discrimination, due to the 7-year-old CWS scoring lower than his peers.

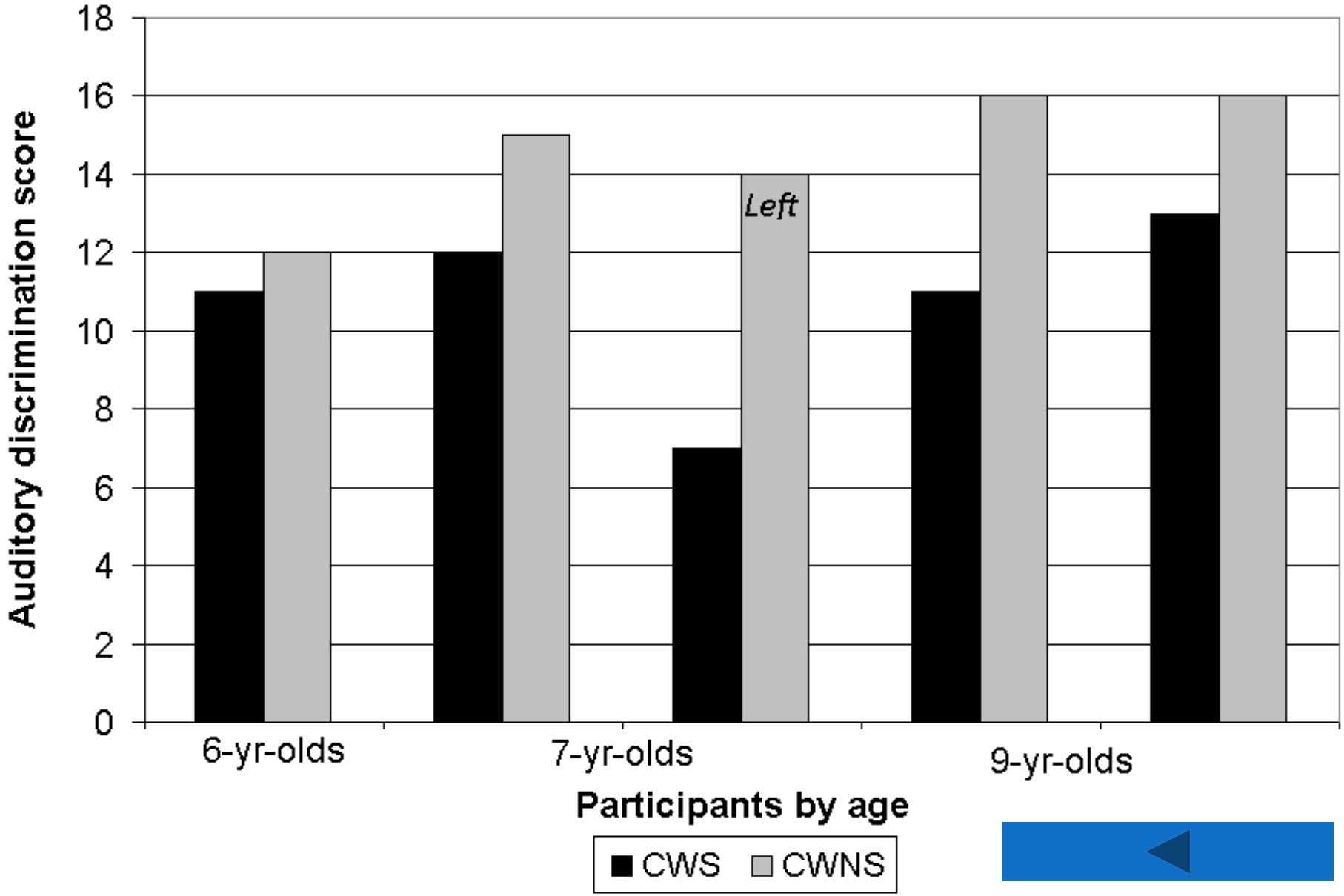
# Figure 1


12
10
8
6
4
2
0
Dichotic digits score
Left
6-yr-olds
7-yr-olds
9-yr-olds
Participants by age
CWS
CWNS

# Figure 2


12
10
8
6
4
2
0
Temporal patterning score
Left
6-yr-olds
7-yr-olds
9-yr-olds
Participants by age
CWS
CWNS

# Figure 3


Auditory discrimination score
18
16
14
12
10
8
6
4
2
0
Left
6-yr-olds
7-yr-olds
9-yr-olds
Participants by age
CWS
CWNS

# Discussion

- Six- to nine-year-old boys who stutter showed auditory discrimination deficits, compared to their peers who do not stutter.
- Present findings support speculations that stuttering is related to auditory discrimination difficulties, at least in linguistic format, and in some individuals who stutter (e.g., Harrington, 1988; Foundas, Corey, Hurley, & Heilman, 2004).
- Present limitations: a small sample, no matching for handedness, and only digits - not syllables - were used for dichotic listening.

# Discussion

- If we had dichotically tested syllables rather than digits, we might have seen lower scores in stuttering participants.
- Our findings help to explain the beneficial effects of a slow rate model and delayed auditory feedback for children who stutter (e.g., Bloodstein & Bernstein Ratner, 2008).
- Learning that a child who stutters may show auditory discrimination difficulties could allow us to enhance treatment accordingly (e.g., facilitate fluency when speaking with varying levels of background noise).

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