Relationships between reading and language ability and auditory temporal processing measured with the precedence effect

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Introduction
• Research suggests that auditory temporal processing is related to reading and language ability.
• Backward masking thresholds are higher in children with specific language impairment (SLI) (Wright et al., 1997) and in children with reading disabilities (RD) (Montgomery et al., 2005) than in control children...
• And temporal order judgment (TOJ) thresholds as measured in a precedence effect paradigm are higher in children with RD than in control children (Montgomery, 2002)
• However, findings are not conclusive on the relationships between auditory temporal processing and reading and/or language ability (cf. Mody, Studdert-Kennedy, & Brady, 1997)
• A timing mechanism common to auditory temporal processing and language and reading has not been found, and also may explain some of the disagreement across studies, as some individuals with SLI and/or RD have shown deficits in motor timing as well (cf. Wolf, 2002).
• Because of these disagreements, it would be beneficial to investigate the relationships in an adult sample with no history of language or reading impairment to understand how these processes interrelate in the typical adult population.

The present study measured lead discrimination in the precedence effect as an indicator of auditory timing in a large sample of adults who also were given a battery of language, reading, and motor timing measures.

Auditory Stimuli
• Localization
• TDT custom software program generated and digitized stimuli
• 20 kHz sampling rate
• 14-ms clicks
• 50 dB(A) SPL
• Single-source and dual-source conditions
• -5, 10, 20, 50, 100, 200, 400 ms delays between clicks in dual-source condition

Procedure
• Participants seated at a portable computer between two Bose loudspeakers placed 3 feet apart at 90º from the listener’s midline
• Clicks presented at a rate of 1.5/sec
• 10 Practice trials with single-source and dual-source stimuli
• In a single-source condition, participants identified the direction of the leading click by pressing the right or left key on the computer keyboard
• In a dual-source condition, participants identified the direction of the leading click by pressing the right or left key on the computer keyboard
• 80 trials (10 single-source, 10-dual-source trials at each delay presented)
• r index and (rho) inter-domain and counterbalanced across participants
• Five sessions visual matching following each correct response; incorrect responses resulted in recorded voice instructing participant to “listen for the news”
• At the conclusion of auditory testing, participants completed the non-auditory measures

Results
• TOJ threshold measured at 70.9%.
• Eight participants unexpectedly performed at or above 80% for all delays, resulting in no measurable threshold for these listeners on this measure and were dropped pairwise from the analyses on the TOJ measure (n=67)
• ANOVA revealed the expected quadratic trend of performance on the localization measure (F(1,74)=336.12, p < .01), with participants achieving a high level of performance in the single-source condition, dropping at short delays, and then improving with increasing delay.
• Mean TOJ threshold was 43.48 ms.
• Mean overall percent correct was 85.08.
• Descriptive statistics for performance in each delay condition are presented in Table 2.

Auditory Laterality Measure
• Core Language

Participants
• 75 naive adult listeners (mean age 21.23 years, 53 females)
• Criteria for inclusion:
  - Healthy with no suspicion of hearing loss
  - Not taking any medications affecting hearing
  - Native or fluent English speaker

Measures
• Kaufman Brief Intelligence Test (Kaufman & Kaufman, 1990)
• matricies subtest (nonverbal)
• Wide Range Auditory Memory Test Revised, Normative Update (WRMAT-R/NU), Woodcock (1998)
• Word identification, word attack, passage comprehension
• Clinical Evaluation of Language Fundamentals, 4th ed (CELF-4), Semel, Wig & Secord, 2003
• Core Language composite
• Comprehensive Test of Phonological Processing (CTOPP, Wagner et al., 1999)
• Minnesota, blending (phonological composite), rapid automated naming (RAN)
• Motor speed
• Finger tapping, counts of index finger of both hands pressing lever averaged for 5 sets of 10 seconds each

Significant correlations - Auditory and non-auditory measures:
• TOJ and word identification r = -269, p < .05
• Percent correct at 400 ms delay and latency index r = .242, p < .05
• 2 sets of hierarchical multiple regressions (Set 1: NVIQ, phonological composite, naming speed: letters and numbers; Set 2: NVIQ, motor latency index, motor speed)
• none of the localization variables (TOJ, 5 ms delay, and 400 ms delay) accounted for any significant variance in NVIQ, phonological composite, or naming speed, nor did these variables account for significant variance in motor speed as measured by finger tapping (p > .05)
• The motor speed regression revealed that the latency index continued to predict significant variance in performance on localization at 400 ms delay after controlling for NVIQ, suggesting that those individuals who are more lateraled in motor ability performed better on TOJ at 400 ms delays. However, listeners had little difficulty with the task at 400 ms delay in any case.

Discussion
• The significant correlation found between TOJ and word identification suggests a relationship between children with indication affecting hearing and reading measures. Results on the auditory task...