

ABSTRACT

Children with developmental dyslexia (DD) have deficits in short term (STM), working memory (WM), and vocabulary. However, the literature on adults with dyslexia is sparse, particularly with respect to concomitant cognitive deficits. In order to serve this population, it is important to know whether these deficits resolve or persist into adulthood. To address this question, this study compares 18 college students with DD to memory and vocabulary-matched normal readers (NR), as well as a larger group of unmatched normal readers on a variety of vocabulary, verbal working memory and executive function tasks. Based on the literature and clinical profiles, we expected to see differences between DD and NR groups in both WM and executive functions.

METHODS

Participants

- 18 adults with developmental dyslexia (DD)
 - age 16 - 28 ($M_{DD} = 20.4$, $SD = 3.3$)
- 108 adults with normal reading (NR)
 - Age 18 - 28 ($M_{NR} = 20.6$, $SD = 1.8$)
- All subgroups were similar in age to these groups

Evaluation

Individuals with a previous or suspected diagnosis of developmental dyslexia (DD) completed a 2 hour evaluation to confirm this diagnosis. Tasks used in the evaluation included:

From the WRMT: word ID, word attack and passage comprehension.

- From the WRAT-3: spelling
- From the CTOPP: elision, blending words, memory for digits, nonword repetition, rapid digit naming, and rapid letter naming.
- From the TOWRE: phonemic decoding efficiency and sight word efficiency.

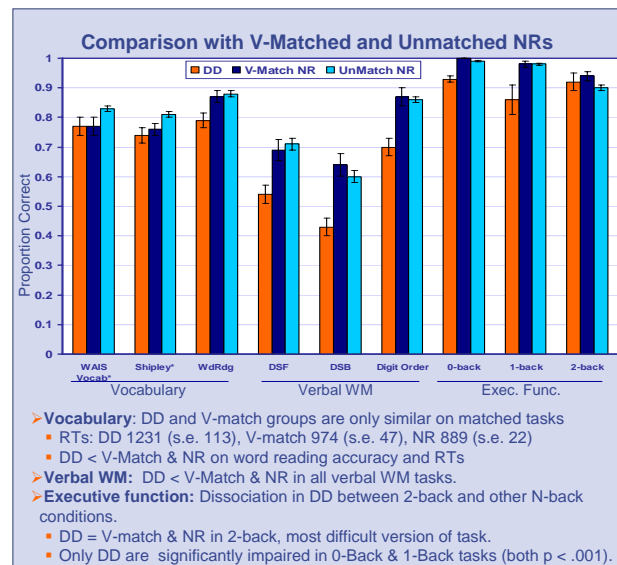
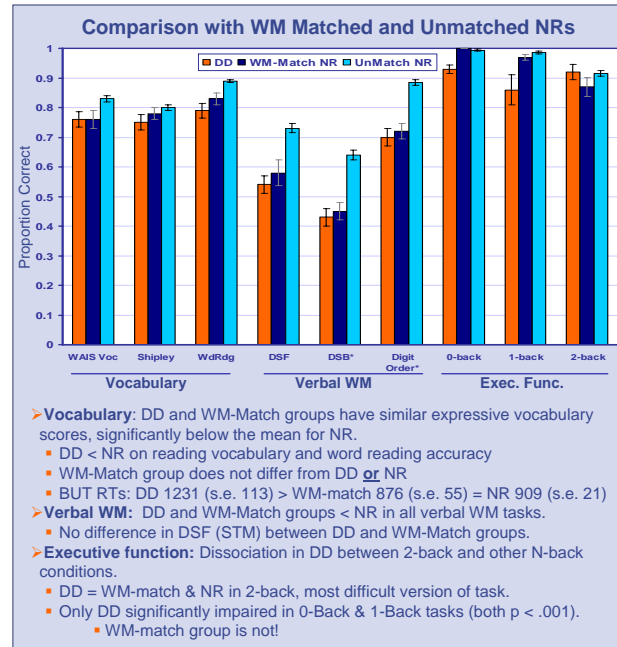
Experimental Tasks

- Vocabulary
 - WAIS-3 vocabulary test (expressive vocabulary; max score 70)
 - Shipley vocabulary test (receptive, reading vocabulary; max score 40)
 - Word Reading task including the word lists from the Woodcock Johnson (30 items), and the WRAT (40 items). Total 100 items.
- Verbal WM
 - Digit span forward (Wechsler, 1987; max = 14): short-term phonological memory
 - Digit span backward (Wechsler, 1987; max = 14): verbal working memory
 - Digit ordering: (MacDonald et al., 2001; max = 24): verbal working memory
- Executive Function
 - N-back task: attention & executive function. All versions included 100 trials total, with 15 critical ("yes") trials. All trials used upper case letters. Response was with a mouse button press. Score is percent of critical trials correct.
 - 0-back: Participants decided whether each example was an N or not.
 - 1-back: Participants decided whether the current letter matched the letter on the screen immediately previous.
 - 2-back: Participants decided whether the current letter matched the letter 2 screens previous.

Identifying Subgroups

- **WM-match:** NR matched to the DD group first DSB and secondarily on Digit Ordering scores
- **V-Match:** NR matched first to the DD group first on expressive vocabulary (WAIS Voc) and secondly on reading vocabulary (Shipley)

RESULTS



DISCUSSION

1. DD group < NR on all measure EXCEPT 2-back, a measure of complex executive processing.
2. The V-Match group differed from DD group on all measures except those that were matched on 2-back.
 - The two groups had little in common.
3. The WM-Match group performed similarly to the DD group on all measures EXCEPT 0-back and 1-back.
 - WM-Match and DD had similar vocabulary scores.
 - Verbal WM may contribute to vocabulary acquisition
 - Consistent with the literature in children indicating an interaction between WM capacity and vocabulary size.
4. The distinguishing factor between DD and WM-Match groups was performance on the N-back task.
 - No group differences were found in the 2-back task that demands deep encoding of information or strategic deployment of attention.
 - DD group differed from the WM-Match (and V-Match) group in performance on the 0-back and 1-back tasks, which tap into automatic orthographic recognition procedures in NR.
 - DD group differed from WM-Match (and V-Match) group in RT for word recognition.
 - Low verbal WM in the WM-Match group had no effect on performance in 0- and 1-back recognition and matching tasks
 - Performance of the WM-Match group is likely due to fundamental storage limitations.
 - Both storage limitations and phonological impairment appear to have similar effects on vocabulary acquisition and verbal WM tasks, but little effect on attention-demanding executive function tasks (i.e., 2-back).

Possible Explanations

- Phonological representations in DD may be detailed and concrete (i.e., phonetic), as opposed to concise and abstract (i.e., phonemic). Thus, each representation might require more storage space and be more difficult to manipulate.
 - This deficit would distinguish the DD group from the WM-matched NR group.
 - Impaired phonological representations of individuals with DD likely limit the ability to quickly recognize and match orthographic stimuli, as in the 0- and 1-back here..
 - Apparent deficits in DD on verbally mediated memory tasks may reflect the inefficiency of phonological coding, rather than differences in storage per se. These 2 issues are likely confounded in this population.
5. Preserved executive function abilities in DD may allow them to develop non-phonological strategies for dealing with the demands of academics.
 - But these were all relatively compensated DD, enrolled at UF or a local community college; we cannot generalize to all DD.
 - Normal executive function may be an indicator of the ability of someone with DD to succeed in higher education.

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