

**Working memory training: Does it help students with language disorders?  
If not, why?  
What should we do instead?**

**Digit Span** is the most common measure of verbal short-term and working memory<sup>9</sup>. Students are asked to immediately recall visually or auditorily presented digit lists, either in the order presented (forward digit span) or in reverse order (backward digit span). Backward digit span imposes a higher cognitive load because of the need to reverse the order of remembered digits.

**Working memory training often includes some form of digit span training.**

**Does working memory training help students with language disorders?**

**No, working memory training does not improve language**

- Digit span tasks do not improve sentence formation<sup>1 6</sup>
- Training does not advance development of vocabulary or phonological awareness<sup>1 2</sup>
- Working memory drills do not further language development<sup>2 3</sup>

**No, working memory training does not improve academic performance**

- There is no evidence of impact of working memory training on word reading or literacy skills<sup>1 8</sup>
- Digit span tasks do not increase understanding of mathematics or arithmetic<sup>1</sup>
- Training does not enhance reasoning, learning, or attentional control<sup>2</sup>
- No convincing evidence of generalization from working memory training to verbal and nonverbal abilities<sup>1 6</sup>

**Why doesn't working memory training improve language or academic performance?**

**a. Digit spans do not demand a new cognitive routine**

- New language or academic learning requires a new cognitive routine<sup>2 3</sup>
- The basic mechanisms of encoding and order retention in working memory are already in place early in childhood and do not warrant new routines<sup>3</sup>
- For training activities supported by cognitive routines or mechanisms that are already firmly established (i.e., repeating numbers in digit span training), a new routine is not required<sup>3</sup>
- Processes involved in the performance of a digit-span task, such as rehearsal, are well-learned and thus rely on mainly automatic processes.<sup>4</sup>
- Digits are highly familiar verbal labels and share characteristics with other language forms<sup>8</sup>

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<sup>1</sup> Melby-Lervåg, M., Redick, T. S., & Hulme, C. (2016). Working memory training does not improve performance on measures of intelligence or other measures of "far transfer." *Perspectives on Psychological Science*, 11(4), 512–534. <https://doi.org/10.1177/17456916166635612>

<sup>2</sup> Norris, D. G., Hall, J., & Gathercole, S. E. (2019). Can short-term memory be trained? *Memory & Cognition*, 47(5), 1012–1023. <https://doi.org/10.3758/s13421-019-00901-z>

<sup>3</sup> Gathercole, S. E., Dunning, D. L., Holmes, J., & Norris, D. (2019). Working memory training involves learning new skills. *Journal of Memory and Language*, 105, 19–42. <https://doi.org/10.1016/j.jml.2018.10.003>

<sup>4</sup> Buschkuhl, M., Jaeggi, S. M., Hutchison, S., Perrig-Chiello, P., Däpp, C., Müller, M., Breil, F., Hoppeler, H., & Perrig, W. J. (2008). Impact of working memory training on memory performance in old-old adults. *Psychology and Aging*, 23(4), 743–753. <https://doi.org/10.1037/a0014342>

**b. The cognitive distance between working memory training and specific language or academic skills is too wide**

- *Near transfer* from working memory training refers to improvements in untrained working memory tasks whereas *far transfer* refers to improvements in other cognitive tasks (e.g. reading)<sup>5</sup>
- Little-to-no far transfer has been observed for working memory training and no evidence of long-term maintenance.<sup>6</sup>
- Transfer occurs between tasks that are closely matched (i.e., require the same routine)<sup>2</sup>
- If existing mechanisms are available, a new routine is not required and no transfer will occur<sup>2</sup>
- Automatic processes might be difficult to alter, which is why transfer from digit span training to cognitive skills is unlikely<sup>4</sup>

**c. Language learning often draws on different cognitive processes**

- Language knowledge stored in long-term memory supports working memory performance<sup>7</sup>
- Working memory training gains may reflect the use of language-based strategies to support encoding and retrieval<sup>2</sup>
- Developmental increases in tasks such as digit span are dictated more by the extent of one's experience with sequences of verbal material in digit or numerical form than increases in working memory capacity<sup>8</sup>

**What should we do instead?**

- Expect near transfer only<sup>2 3 5</sup>
- Skills targeted in intervention must be sufficiently close to real life applications<sup>5 9</sup>
- In intervention practices, target knowledge and skills the child specifically needs<sup>10</sup>

**References**

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<sup>5</sup> von Bastian, C. C., & Oberauer, K. (2013). Effects and mechanisms of working memory training: A Review. *Psychological Research*, 78(6), 803–820. <https://doi.org/10.1007/s00426-013-0524-6>

<sup>6</sup> Delage, H., Stanford, E., & Durrleman, S. (2021). Working memory training enhances complex syntax in children with developmental language disorder. *Applied Psycholinguistics*, 42(5), 1341–1375. <https://doi.org/10.1017/s0142716421000369>

<sup>7</sup> Thorn, A. S., & Gathercole, S. E. (2001). Language differences in verbal short-term memory do not exclusively originate in the process of subvocal rehearsal. *Psychonomic Bulletin & Review*, 8(2), 357–364. <https://doi.org/10.3758/bf03196173>

<sup>8</sup> Jones, G., & Macken, B. (2015). Questioning short-term memory and its measurement: Why digit span measures long-term associative learning. *Cognition*, 144, 1–13. <https://doi.org/10.1016/j.cognition.2015.07.009>

<sup>9</sup> Wells, E. L., Kofler, M. J., Soto, E. F., Schaefer, H. S., & Sarver, D. E. (2018). Assessing working memory in children with ADHD: Minor administration and scoring changes may improve digit span backwards construct validity. *Research in developmental disabilities*, 72, 166–178. <https://doi.org/10.1016/j.ridd.2017.10.024>

<sup>10</sup> Brehmer, Y., Westerberg, H., & Bäckman, L. (2012). Working-memory training in younger and older adults: Training gains, transfer, and maintenance. *Frontiers in Human Neuroscience*, 6. <https://doi.org/10.3389/fnhum.2012.00063>

- Brehmer, Y., Westerberg, H., & Bäckman, L. (2012). Working-memory training in younger and older adults: Training gains, transfer, and maintenance. *Frontiers in Human Neuroscience*, 6. <https://doi.org/10.3389/fnhum.2012.00063>
- Buschkuhl, M., Jaeggi, S., Hutchison, S., Perrig-Chiello, P., Däpp, C., Müller, M., Breil, F., Hoppeler, H., & Perrig, W. (2008). Impact of working memory training on memory performance in old-old adults. *Psychology and Aging*, 23(4), 743–753. <https://doi.org/10.1037/a0014342>
- Delage, H., Stanford, E., & Durrleman, S. (2021). Working memory training enhances complex syntax in children with developmental language disorder. *Applied Psycholinguistics*, 42(5), 1341–1375. <https://doi.org/10.1017/s0142716421000369>
- Gathercole, S. E., Dunning, D. L., Holmes, J., & Norris, D. (2019). Working memory training involves learning new skills. *Journal of Memory and Language*, 105, 19–42. <https://doi.org/10.1016/j.jml.2018.10.003>
- Jones, G., & Macken, B. (2015). Questioning short-term memory and its measurement: Why digit span measures long-term associative learning. *Cognition*, 144, 1–13. <https://doi.org/10.1016/j.cognition.2015.07.009>
- Melby-Lervåg, M., Redick, T. S., & Hulme, C. (2016). Working memory training does not improve performance on measures of intelligence or other measures of “far transfer.” *Perspectives on Psychological Science*, 11(4), 512–534. <https://doi.org/10.1177/1745691616635612>
- Norris, D. G., Hall, J., & Gathercole, S. E. (2019). Can short-term memory be trained? *Memory & Cognition*, 47(5), 1012–1023. <https://doi.org/10.3758/s13421-019-00901-z>
- Thorn, A. S., & Gathercole, S. E. (2001). Language differences in verbal short-term memory do not exclusively originate in the process of subvocal rehearsal. *Psychonomic Bulletin & Review*, 8(2), 357–364. <https://doi.org/10.3758/bf03196173>
- von Bastian, C. C., & Oberauer, K. (2013). Effects and mechanisms of working memory training: A Review. *Psychological Research*, 78(6), 803–820. <https://doi.org/10.1007/s00426-013-0524-6>