

Nelson Cowan's Publications Organized by Topic
Updated January 10, 2026

For reprints contact Nelson Cowan at cowann@missouri.edu

Note – In this document, most articles are listed only once, not under multiple categories. If you don't find what you are looking for under one category, it may be under another category. Several categories are rather diverse and a few papers only loosely fit their categories. You can also search for words or search my CV on the web page, <https://memory.psych.missouri.edu/cowan.html>, to find the most recent papers. Here, they are approximately alphabetical within each topic.

Clickable Table of Contents for Categories (cntl + mouse-click)

[Aging Effects on Working Memory](#)

[Alleviating the Effects of Dense Amnesia through Minimal Interference](#)

[Books](#)

[Brain Studies of Working Memory](#)

[Grouping and Chunking Processes and Working Memory Capacity](#)

[Cocktail Party Phenomenon and Working Memory](#)

[Decay of Working Memory Over Time](#)

[Dual-task Procedures to Examine the Role of Attention in Working Memory](#)

[Effects of Alcohol on Working Memory](#)

[Information Processing, Attention, and Language](#)

[Latent Structure of Working Memory](#)

[Learning Difficulties and Disorders in Relation to Attention and Working Memory](#)

[Methodology](#)

[Processes of Working Memory Maintenance](#)

[Reviews of Working Memory and Its Development*](#)

[Reviews on Information Processing](#)

[Typical Development of Working Memory in Childhood](#)

Aging Effects on Working Memory ([Top of Document](#))

- Costa, A. N., Nowakowski, L. M., McCrae, C. S., Cowan, N., & Curtis, A. F. (2023). Discrepancies in Objective and Subjective Cognition in Middle-Aged and Older Adults: Does Personality Matter? *Gerontology and Geriatric Medicine*, 9, 23337214221146663. <https://doi.org/10.1177/23337214221146663>
- Cowan, N., Naveh-Benjamin, M., Kilb, A., & Sauls, J.S. (2006). Life-Span development of visual working memory: When is feature binding difficult? *Developmental Psychology*, 42, 1089-1102. PMC1635970
- Forsberg, A., Belletier, C., Graham, A., Rhodes, S., Barrouillet, P., Camos, V., Cowan, N., Naveh-Benjamin, M., & Logie, R. (in press). Different measures of working memory decline at different rates across adult ageing, and dual task costs plateau in mid life. *Quarterly Journal of Experimental Psychology*.
<https://doi.org/10.1177/17470218251351307>
- Forsberg, A., Guitard, D., Greene, N.R., Naveh-Benjamin, M., & Cowan, N. (2022). The proportion of working memory items recoverable from long-term memory remains fixed despite adult aging. *Psychology and Aging*, 37, 777-786. <https://doi.org/10.1037/pag0000703>
- Gilchrist, A.L., Cowan, N., & Naveh-Benjamin, M. (2008). Working memory capacity for spoken sentences decreases with adult ageing: Recall of fewer, but not smaller chunks in older adults. *Memory*, 16, 773-787. PMC2610466
- Greene, N.R., Naveh-Benjamin, M., & Cowan, N. (2020). Adult age differences in working memory capacity: Spared central storage but deficits in ability to maximize peripheral storage. *Psychology and Aging*, 35, 866-880.

- Jaroslawska, A., Rhodes, S., Belletier, C., Doherty, J., Cowan, N., Naveh-Benjamin, M., Barrouillet, P., Camos, V., & Logie, R. (2021). What affects the magnitude of age-related dual-task costs in working memory? The role of stimulus domain and access to semantic representations. *Quarterly Journal of Experimental Psychology*, 74(4), 682-704. doi: 10.1177/1747021820970744
- Multhaup, K.S., Balota, D.A., & Cowan, N. (1996). Implications of aging, lexicality, and item length for the mechanisms underlying memory span. *Psychonomic Bulletin & Review*, 3, 112-120.
- Naveh-Benjamin, M., Cowan, N., Kilb, A., & Chen, Z. (2007). Age-related differences in immediate serial recall: Dissociating chunk formation and capacity. *Memory & Cognition*, 35, 724-737. PMC1995413
- Naveh-Benjamin, M., Kilb, A., Maddox, G., Thomas, J., Fine, H., Chen, T., & Cowan, N. (2014). Older adults don't notice their names: A new twist to a classic attention task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 1540-1550
- Rhodes, S., Doherty, J.M., Jaroslawska, A.J., Forsberg, A., Belletier, C., Naveh-Benjamin, M., Cowan, N., Barrouillet, P., Camos, V., and Logie, R.H. (2021). Exploring the influence of temporal factors on age differences in working memory dual task costs. *Psychology and Aging*, 36(2), 200-213. doi: 10.1037/pag0000531
- Rhodes, S., Parra, M.A., Cowan, N. & Logie, R.H. (2017). Healthy aging and visual working memory: The effect of mixing feature and conjunction changes. *Psychology and Aging*, 32, 354-366.
- Rhodes, S., Jaroslawska, A.J., Doherty, J.M., Belletier, C., Naveh-Benjamin, M., Cowan, N., Camos, V., Barrouillet, P., & Logie, R.H. (2019). Storage and processing in working memory: Assessing dual task performance and task prioritization across the adult lifespan. *Journal of Experimental Psychology: General*, 148, 1204-1227.

Effects of Alcohol on Working Memory ([Top of Document](#))

- Bartholow, B.D., Fleming, K.A., Wood, P.K., Cowan, N., Saults, J.S., Altamirano, L., Miyake, A., Martins, J., & Sher, K.J. (2018). Alcohol effects on response inhibition: Variability across tasks and individuals. *Experimental and Clinical Psychopharmacology*, 26(3), 251-267. doi: 10.1037/pha0000190
- Cofresi, R.U., Watts, A.L., Martins, J.S., Wood, P.K., Sher, K.J., Cowan, N., Miyake, A., & Bartholow, B.D. (2021). Acute effect of alcohol on working memory updating. *Addiction*, 116, 3029-3043. doi: 10.1111/add.15506
- Saults, J., Cowan, N., Sher, K.J., & Moreno, M.V. (2007). Differential effects of alcohol on working memory: Distinguishing multiple processes. *Experimental and Clinical Psychopharmacology*, 15, 576-587.

Alleviating the Effects of Dense Amnesia through Minimal Interference ([Top of Document](#))

- Cowan, N., Beschin, N., & Della Sala, S. (2004). Verbal recall in amnesiacs under conditions of diminished retroactive interference. *Brain*, 127, 825-834.
- Della Sala, S., Cowan, N., Beschin, N., & Perini, M. (2005). Just lying there, remembering: Improving recall of prose in amnesic patients with mild cognitive impairment by minimizing interference. *Memory*, 13, 435-440.
- Dewar, M., Alber, J., Butler, C., Cowan, N., & Della Sala, S. (2012). Brief wakeful resting boosts new memories over the long term. *Psychological Science*, 23, 955-960.
- Dewar, M., Alber, J., Cowan, N., & Della Sala, S. (2014). Boosting long-term memory via wakeful rest: Intentional rehearsal is not necessary, consolidation is sufficient. *PLOS One*, 9(10), e109542, 1-10.
- Dewar, M., Della Sala, S., Beschin, N., & Cowan, N. (2010). Profound retroactive interference in anterograde amnesia: What interferes? *Neuropsychology*, 24, 357-367.
- Dewar, M., Fernandez Garcia, Y., Cowan, N., & Della Sala, S. (2009). Delaying interference enhances memory consolidation in amnesic patients. *Neuropsychology*, 23, 627-634.
- Dewar, M., Pesallaccia, M., Cowan, N., Provinciali, L., & Della Sala, S. (2012). Insights into spared memory capacity in amnesic MCI and Alzheimer's Disease via minimal interference. *Brain and Cognition*, 78, 189-199.
- Dewar, M.T., Cowan, N., & Della Sala, S. (2007). Forgetting due to retroactive interference: A fusion of Müller

- and Pilzecker's (1900) early insights into everyday forgetting and recent research on anterograde *Cortex*, 43, 616-634.
- Dewar, M.T., Della Sala, S., & Cowan, N. (2010). Forgetting due to retroactive interference in amnesia: Findings and implications. In S. Della Sala, *Forgetting. Current Issues in Memory*. Psychology Press. (Pp. 185-209)
- McGhee, J.D., Cowan, N., Beschin, N., Mosconi, C., & Della Sala, S. (2020). Wakeful rest benefits before and after encoding in anterograde amnesia. *Neuropsychology*, 34, 524-534.
- Segura, I.A., McGhee, J., Della Sala, S., Cowan, N., & Pompéia, S. (2021). A reappraisal of acute doses of benzodiazepines as a model of anterograde amnesia. *Human Psychopharmacology: Clinical and Experimental*, 36, 3, e2774. DOI: 10.1002/hup.2774

Brain Studies of Working Memory ([Top of Document](#))

- Cowan, N. (2011). The focus of attention as observed in visual working memory tasks: Making sense of competing claims. *Neuropsychologia*, 49, 1401-1406. PMC3095706
- Cowan, N., Li, D., Moffitt, A., Becker, T.M., Martin, E.A., Sauls, J.S., & Christ, S.E. (2011). A neural region of abstract working memory. *Journal of Cognitive Neuroscience*, 23, 2852-2863. PMC3138911
- Cowan, N., Winkler, I., Teder, W., & Näätänen, R. (1993). Memory prerequisites of the mismatch negativity in the auditory event-related potential (ERP). *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 19, 909-921.
- Gossaries, O., Yu, Q., LaRocque, J.J., Starrett, M.J., Rose, N.S., Cowan, N., & Postle, B.R. (2018). Parietal-occipital interactions underlying control- and representation-related processes in working memory for nonspatial visual features. *Journal of Neuroscience*, 38, 4357– 4366.
- Li, D., Christ, S.E., & Cowan, N. (2014). Domain-general and domain-specific functional networks in working memory. *Neuroimage*, 102, 646-656.
- Majerus, S., Cowan, N., Péters, F., Van Calster, L., Phillips, C., & Schrouff, J. (2016). Cross-modal decoding of neural patterns associated with working memory: Evidence for attention-based accounts of working memory. *Cerebral Cortex*, 26, 166-179.
- Majerus, S., Péters, F., Bouffier, M., Cowan, N., & Phillips, C. (2018). The dorsal attention network reflects both encoding load and top-down control during working memory. *Journal of Cognitive Neuroscience*, 30, 144-159.
- Richardson, J. S., Cowan, N., Hartman, R., & Jacobowitz, D. M. (1974). On the behavioral and neurochemical actions of 6-hydroxydopa and 5, 6- dihydroxytryptamine in rats. *Research Communications in Chemical Pathology and Pharmacology*, 8, 29-44.
- Rinne, T., Gratton, G., Fabiani, M., Cowan, N., Maclin, E., Stinard, A., Sinkkonen, J., Alho, K., & Näätänen, R. (1999). Scalp-recorded optical signals make sound processing in the auditory cortex visible. *Neuroimage*, 10, 620-624.
- Ritter, W., Gomes, H., Cowan, N., Sussman, E., & Vaughan, H.G., Jr. (1998). Reactivation of a dormant representation of an auditory stimulus feature. *Journal of Cognitive Neuroscience*, 10, 605-614.
- Ritter, W., Sussman, E., Deacon, D., Cowan, N., & Vaughan, H.G. (1999). Two cognitive systems simultaneously prepared for opposite events. *Psychophysiology*, 36, 835-838.
- Winkler, I., Cowan, N., Csépe, V., Czigler, I., & Näätänen, R. (1996). Interactions between transient and long-term auditory memory as reflected by the mismatch negativity. *Journal of Cognitive Neuroscience*, 8, 403-415.
- Winkler, I., Schröger, E., & Cowan, N. (2001). The role of large-scale memory organization in the mismatch negativity event-related brain potential. *Journal of Cognitive Neuroscience*, 13, 59-71.

Grouping and Chunking Processes and Working Memory Capacity ([Top of Document](#))

- Blume, C.L., & Cowan, N. (2016). On the use of response chunking as a tool to investigate strategies. *Frontiers in Psychology*, 19, <http://dx.doi.org/10.3389/fpsyg.2015.01942>

- Chekaf, M., Cowan, N., & Mathy, F. (2016). Chunk formation in immediate memory and how it relates to data compression. *Cognition*, 155, 96-107
- Chen, Z., & Cowan, N. (2009). Core verbal working memory capacity: The limit in words retained without covert articulation. *Quarterly Journal of Experimental Psychology*, 62, 1420-1429. PMC2693080
- Chen, Z., & Cowan, N. (2005). Chunk limits and length limits in immediate recall: A reconciliation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 1235-1249.
- Cowan, N., & Chen, Z. (2009). How chunks form in long-term memory and affect short-term memory limits. In M. Page & A. Thorn (Eds.), *Interactions between short-term and long-term memory in the verbal domain* (pp. 86–107). Hove, UK: Psychology Press.
- Cowan, N., Chen, Z., & Rouder, J.N. (2004). Constant capacity in an immediate serial-recall task: A logical sequel to Miller (1956). *Psychological Science*, 15, 634-640.
- Cowan, N., & Elliott, E.M. (2023). Deconfounding serial recall: Response timing and the overarching role of grouping. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 49, 249-268. <http://dx.doi.org/10.1037/xlm0001157>
- Cowan, N., & Hardman, K.O. (2021). Immediate recall of grouped serial numbers with or without multiple item repetitions. *Memory*, 29(6), 744-761 doi.org/10.1080/09658211.2021.1942920
- Cowan, N., Rouder, J.N., Blume, C.L., & Saults, J.S. (2012). Models of verbal working memory capacity: What does it take to make them work? *Psychological Review*, 119, 480-499.
- Gilchrist, A.L., & Cowan, N. (2011). Can the focus of attention accommodate multiple separate items? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 37, 1484-1502. PMC3197943
- Gilchrist, A.L., & Cowan, N. (2012). Chunking. In V. Ramachandran (ed.) *Encyclopedia of human behavior*, 1, 476-483. Academic Press. [Reprinted in 2015 in the online reference database titled *Neuroscience and Biobehavioral Psychology*]
- Guitard, D., Saint-Aubin, J., & Cowan, N. (2022). Grouping effects in immediate reconstruction of order and the preconditions for long-term learning. *Quarterly Journal of Experimental Psychology*, 75, 70-97.
- Lazartigues, L., Lavigne, F., Aguilar, C., Cowan, N., & Mathy, F. (2021). Benefits and pitfalls of data compression in visual working memory. *Attention, Perception, and Psychophysics*, 83, 2843–2864. <https://doi.org/10.3758/s13414-021-02333-x>
- Mathy, F., Chekaf, M. & Cowan, N., (2018). Simple and complex working memory tasks allow similar benefits of information compression. *Journal of Cognition*. 1(1), 31. DOI: <http://doi.org/10.5334/joc.31>

Cocktail Party Phenomenon and Working Memory ([Top of Document](#))

- Conway, A.R.A., Cowan, N., & Bunting, M.F. (2001). The cocktail party phenomenon revisited: The importance of working memory capacity. *Psychonomic Bulletin & Review*, 8, 331-335. [Reprinted in B. Robinson-Riegler & G. Robinson-Riegler (Eds.) (2004). *Readings in Cognitive Psychology: Applications, Connections, and Individual Differences*. Boston: Pearson Education, Inc.]
- Naveh-Benjamin, M., Kilb, A., Maddox, G., Thomas, J., Fine, H., Chen, T., & Cowan, N. (2014). Older adults don't notice their names: A new twist to a classic attention task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 1540-1550
- Röer, J.P., & Cowan, N. (2021). A preregistered replication and extension of the cocktail party phenomenon: One's name captures attention, unexpected words do not. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 47, 234–242. <https://doi.org/10.1037/xlm0000874>
- Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: Attention and memory in the classic selective listening procedure of Cherry (1953). *Journal of Experimental Psychology: General*, 124, 243-262.
- Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: How frequent are attention shifts to one's name in an irrelevant auditory channel? *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 21, 255-260.

Decay of Working Memory Over Time ([Top of Document](#))

- Cowan, N., & AuBuchon, A.M. (2008). Short-term memory loss over time without retroactive stimulus

- interference. *Psychonomic Bulletin & Review*, 15, 230-235. PMC2662695
- Cowan, N., Lichty, W., & Grove, T.R. (1990). Properties of memory for unattended spoken syllables. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 16, 258-269.
- Cowan, N., Nugent, L.D., Elliott, E.M., & Saults, J.S. (2000). Persistence of memory for ignored lists of digits: Areas of developmental constancy and change. *Journal of Experimental Child Psychology*, 76, 151-172.
- Cowan, N., Saults, J.S., & Nugent, L.D. (1997). The role of absolute and relative amounts of time in forgetting within immediate memory: The case of tone pitch comparisons. *Psychonomic Bulletin & Review*, 4, 393-397. <http://www.psychonomic.org/psp/publications-resources.html>
- Cowan, N., Saults, J.S., & Nugent, L. (2001). The ravages of absolute and relative amounts of time on memory. In H.L. Roediger III, J.S. Nairne, I. Neath, & A. Surprenant (eds.), *The nature of remembering: Essays in honor of Robert G. Crowder*. Washington, D.C.: American Psychological Association. (pp. 315 - 330)
- Ricker, T.J., & Cowan, N. (2010). Loss of visual working memory within seconds: The combined use of refreshable and non-refreshable features. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 36, 1355-1368. PMCID: PMC2970679
- Ricker, T.J., Sandry, J., Vergauwe, E., & Cowan, N. (2020). Do familiar memory items decay? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46, 60-76
- Ricker, T.J., Spiegel, L.R., & Cowan, N. (2014). Time-based loss in visual short-term memory is from trace decay, not temporal distinctiveness. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 1510-1523.
- Ricker, T.J., Vergauwe, E., & Cowan, N. (2016). Decay theory of immediate memory: From Brown (1958) to today (2014). *Quarterly Journal of Experimental Psychology*, 69, 1969-1995.

Typical Development of Working Memory in Childhood ([Top of Document](#))

- Adams, E.J., & Cowan, N. (2021). The girl was watered by the flower: Effects of working memory loads on syntactic production in young children. *Journal of Cognition and Development*, 22, 125-148. doi.org/10.1080/15248372.2020.1844710
- Bao, C., & Cowan, N. (2023). Generalization of skill for a working memory recognition procedure in children: The benefit of starting with easy materials. *Journal of Intelligence*, 11, 56. <https://doi.org/10.3390/jintelligence11030056> [Editor's Choice article]
- Bao, C., Li, Y., & Cowan, N. (2025). Object- and feature-based working memory limits for pairs of complex objects and their development during the school years. *Cognition*, 262, 106163. <https://doi.org/10.1016/j.cognition.2025.106163>
- Bodner, K.E., Cowan, N., & Christ, S.E. (2019). Contributions of filtering and attentional allocation to working memory performance in individuals with autism spectrum disorder. *Journal of Abnormal Psychology*, 128, 881-891.
- Braine, M.D.S., Brooks, P.J., Cowan, N., Samuels, M.C., & Tamis-LeMonda, C. (1993). The Development of categories at the semantics/syntax interface. *Cognitive Development*, 8, 465-494.
- Brunner, R., & Cowan, N. (2000). The role of attention in the development of working memory. *McNair Journal*, Fall, 2000.
- Clark, K.M., Hardman, K., Schachtman, T.R., Saults, J.S., Glass, B.A., & Cowan, N. (2018). Tone series and the nature of working memory capacity development. *Developmental Psychology*, 54, 663-676.
- Courage, M.L., & Cowan, N. (2009). What's new in research on the development of children's memory?. In M. Courage & N. Cowan (eds.), *The development of memory in infancy and childhood*. Hove, East Sussex, UK: Psychology Press. (pp. 1-10)
- Cowan, N. (1998). Children's memories according to fuzzy-trace theory: An endorsement of the theory's purpose and some suggestions to improve its application. *Journal of Experimental Child Psychology*, 71, 144-154.
- Cowan, N. (2000). Childhood development of some basic parameters of working memory. In E. Schröger, A. Mecklinger, & A.D. Friederici (eds.), *Working on working memory*. Leipzig Series in Cognitive Sciences 1. Leipzig: Leipziger Universitätsverlag.
- Cowan, N. (2002). Experimental psychology and its implications for human development. *Encyclopedia of*

- Life Support Systems* (EOLSS). Oxford, U.K. [<http://www.eolss.net>]
- Cowan, N. (2014). Working memory underpins cognitive development, learning, and education. *Educational Psychology Review*, 26, 197-223. DOI: 10.1007/s10648-013-9246-y.
- Cowan, N. (1997). The development of working memory. In N. Cowan (ed.), *The development of memory in childhood*. Hove, East Sussex, UK: Psychology Press.
- Cowan, N. (1999). The differential maturation of two processing rates related to digit span. *Journal of Experimental Child Psychology*, 72, 193-209.
- Cowan, N. (2002). Childhood development of working memory: An examination of two basic parameters. In P. Graf and N. Ohta, *Lifespan development of human memory*. Cambridge, MA: MIT Press. (pp. 39 – 57)
- Cowan, N. (2003). Comparisons of developmental modeling frameworks and levels of analysis in cognition: Connectionist and dynamic systems theories deserve attention, but don't yet explain attention. In J.P. Spencer & E. Thelen (Eds.) (2002). *Connectionism and dynamic systems approaches to development*. [Special issue] *Developmental Science*, 6, 440-447.
- Cowan, N. (2007). What can infants tell us about working memory development? In L.M. Oakes & P.J. Bauer (eds.), *Short- and long- term memory in infancy and early childhood: Taking the first steps toward remembering*. New York: Oxford University Press. (Pp. 126-150)
- Cowan, N. (2010). Multiple concurrent thoughts: The meaning and developmental neuropsychology of working memory. *Developmental Neuropsychology*, 35, 447-474.
- Cowan, N. (2013). Short-term and working memory in childhood. In P.J. Bauer and R. Fivush (eds.), *The Wiley handbook on the development of children's memory*. Wiley-Blackwell.
- Cowan, N. (2016). Exploring the possible and necessary in working memory development. *Monographs of the Society for Research in Child Development*, 81, 149-158. (Commentary on article by Vanessa R. Simmering, "Working memory capacity in context: Modeling dynamic processes of behavior, memory, and development")
- Cowan, N. (2016). Working memory maturation: Can we get at the essence of cognitive growth? *Perspectives on Psychological Science*, 11, 239-264.
- Cowan, N. (2017). Mental objects in working memory: Development of basic capacity or of cognitive completion? *Advances in Child Development and Behavior*, 52, 81-104.
- Cowan, N. (2020). Why and how to study working memory development. *L'Année Psychologique/Topics in Cognitive Psychology*, 120, 135-156. [Special issue on working memory development edited by Valerie Camos.]
- Cowan, N. (2021). Differentiation of two working memory tasks normed on a large U.S. sample of children 2 to 7 years old. *Child Development*, 92, 2268–2283. DOI: 10.1111/cdev.13562
- Cowan, N., & Alloway, T. (2009). The development of working memory. In M. Courage & N. Cowan (eds.), *The development of memory in infancy and childhood*. Hove, East Sussex, UK: Psychology Press. (pp. 303-342)
- Cowan, N., AuBuchon, A.M., Gilchrist, A.L., Blume, C.L., Boone, A.P., and Saults, J.S. (2021). Developmental change in the nature of attention allocation in a dual task. *Developmental Psychology*, 57, 33-46. Doi: 10.1037/dev0001134
- Cowan, N., & Davidson, G. (1984). Salient childhood memories. *Journal of Genetic Psychology*, 145, 101-107.
- Cowan, N., & Guitard, D. (2024). Encoding colors and tones into working memory concurrently: A developmental investigation. *Developmental Science*, e13552. <https://doi.org/10.1111/desc.13552>
- Cowan, N., & Kielbasa, L. (1986). Temporal properties of memory for speech in preschool children. *Memory & Cognition*, 14, 382-390.
- Cowan, N., & Leavitt, L. A. (1987). The developmental course of two children who could talk backward five years ago. *Journal of Child Language*, 14, 393-395.
- Cowan, N., AuBuchon, A.M., Gilchrist, A.L., Ricker, T.J., & Saults, J.S. (2011). Age differences in visual working memory capacity: Not based on encoding limitations. *Developmental Science*, 14, 1066-1074. PMC3177168
- Cowan, N., Cartwright, C., Winterowd, C., & Sher, M. (1987). An adult model of preschool children's speech memory. *Memory and Cognition*, 15, 511-517.

- Cowan, N., Elliott, E.M., & Saults, J.S.. (2002). The search for what is fundamental in the development of working memory. In R. Kail & H. Reese (Eds.), *Advances in Child Development and Behavior*, 29, 1-49.
- Cowan, N., Elliott, E.M., Saults, J.S., Nugent, L.D., Bomb, P., & Hismjatullina, A. (2006). Rethinking speed theories of cognitive development: Increasing the rate of recall without affecting accuracy. *Psychological Science*, 17, 67-73. PMC2615186
- Cowan, N., Fristoe, N.M., Elliott, E.M., Brunner, R.P., & Saults, J.S. (2006). Scope of attention, control of attention, and intelligence in children and adults. *Memory & Cognition*, 34, 1754-1768. PMC1868392
- Cowan, N., Hismjatullina, A., AuBuchon, A.M., Saults, J.S., Horton, N., Leadbitter, K., & Towse, J. (2010). With development, list recall includes more chunks, not just larger ones. *Developmental Psychology*, 46, 1119-1131.
- Cowan, N., Keller, T., Hulme, C., Roodenrys, S., McDougall, S., & Rack, J. (1994). Verbal memory span in children: Speech timing clues to the mechanisms underlying age and word length effects. *Journal of Memory and Language*, 33, 234-250.
- Cowan, N., Li, Y., Glass, B., & Saults, J.S. (2018). Development of the ability to combine visual and acoustic information in working memory. *Developmental Science*, 21, e12635, 1-14. doi: 10.1111/desc.12635.
- Cowan, N., Morey, C.C., AuBuchon, A.M., Zwilling, C.E., & Gilchrist, A.L. (2010). Seven-year-olds allocate attention like adults unless working memory is overloaded. *Developmental Science*, 13, 120-133.
- Cowan, N., Morey, C.C., AuBuchon, A.M., Zwilling, C.E., Gilchrist, A.L., & Saults, J.S. (2011). New insights into an old problem: Distinguishing storage from processing in the development of working memory. In P. Barrouillet & V. Gaillard (eds.), *Cognitive development and working memory: A dialogue between neo-Piagetian theories and cognitive approaches*. Hove, UK: Psychology Press. (pp. 137-150)
- Cowan, N., Nugent, L.D., Elliott, E.M., Ponomarev, I., & Saults, J.S. (1999). The role of attention in the development of short-term memory: Age differences in the verbal span of apprehension. *Child Development*, 70, 1082-1097.
- Cowan, N., Ricker, T.J., Clark, K.M., Hinrichs, G.A., & Glass, B.A. (2015). Knowledge cannot explain the developmental growth of working memory capacity. *Developmental Science*, 18, 132-145.
- Cowan, N., Saults, J.S., & Clark, K.M. (2015). Exploring age differences in visual working memory capacity: Is there a contribution of memory for configuration? *Journal of Experimental Child Psychology*, 135, 72-85.
- Cowan, N., Saults, J.S., Nugent, L.D., & Elliott, E.M. (1999). The microanalysis of memory span and its development in childhood. *International Journal of Psychology*, 34, 353-358. (Special Quebec Memory Conference issue)
- Cowan, N., Saults, J.S., Winterowd, C., & Sherk, M. (1991). Enhancement of 4-year-old children's memory span for phonologically similar and dissimilar word lists. *Journal of Experimental Child Psychology*, 51, 30-52.
- Cowan, N., Suomi, K., & Morse, P. A. (1982). Echoic storage in infant perception. *Child Development*, 53, 984-990.
- Cowan, N., Towse, J.N., Hamilton, Z., Saults, J.S., Elliott, E.M., Lacey, J.F., Moreno, M.V., & Hitch, G.J. (2003). Children's working-memory processes: A response-timing analysis. *Journal of Experimental Psychology: General*, 132, 113-132.
- Cowan, N., Wood, N.L., Wood, P.K., Keller, T.A., Nugent, L.D., & Keller, C.V. (1998) . Two separate verbal processing rates contributing to short-term memory span. *Journal of Experimental Psychology: General*, 127, 141-160.
- Emily M. Elliott, Candice C. Morey, Angela M. AuBuchon, Eryn Adams, Meg Attwood, Büsra Bayram, Stefen Beeler, Taran Blakstvedt, Gerhard Büttner, Thomas Castelain, Shari Cave, Nelson Cowan, Davide Crepaldi, Eivor Fredricksen, Bret Glass, Andrew Graves, Dominic Guitard, Stefanie Hoh, Alexis Hosch, Chris Jarrold, Stéphanie Jeanneret, Tanya Joseph, Chris Koch, Jaroslaw Lelonkiewicz, Amalia McDonald, Grace Meissner, Whitney Mendenhall, David Moreau, Thomas Ostermann, Asil Ali Özdogru, Sebastian Poloczek, Jan Phillip Röer, Christina Schonberg, Christian Tamnes, Martin Tomasik, Beatrice Valentini, & Evie Vergauwe (2021). Multi-lab direct replication of Flavell, Beach and Chinsky (1966): Spontaneous Verbal Rehearsal in a Memory Task as a Function of Age. *Advances in Methods and Practices in Psychological Science*, 4 (2), 1-20.
- Forsberg, A., Adams, E.J., & Cowan, N. (2022). The Development of Visual Memory. In Bainbridge, W., &

- Brady, T. (eds.), *Visual Memory*. Frontiers of Cognitive Psychology Series, Routledge Press.
- Forsberg, A., Adams, E.J., & Cowan, N. (2023). Why does visual working memory ability improve with age: More objects, more feature detail, or both? A registered report. *Developmental Science*, 26, e13283, 1-18. DOI: 10.1111/desc.13283
- Forsberg, A., Blume, C., and Cowan, N. (2021). The development of metacognitive accuracy in working memory across childhood. *Developmental Psychology*, 57, 1297-1317. DOI: 10.1037/dev0001213
- Forsberg, A., Guitard, D., Adams, E. J., Pattanakul, D., & Cowan, N. (2022). Children's long-term retention is directly constrained by their working memory capacity limitations. *Developmental Science*, 25 (2), e13164. <https://doi.org/10.1111/desc.13164> [Developmental Science Early Career Researcher Prize, 2021]
- Forsberg, A., Guitard, D., Adams, E.J., Pattanakul, D., & Cowan, N. (2023). Working memory constrains long-term memory in children and adults: Memory for objects and bindings. *Journal of Intelligence*, 11(5), 94. <https://doi.org/10.3390/jintelligence11050094> [Editor's Choice article]
- Gilchrist, A.L., Cowan, N., & Naveh-Benjamin, M. (2009). Investigating the childhood development of working memory using sentences: New evidence for the growth of chunk capacity. *Journal of Experimental Child Psychology*, 104, 252-265. PMC2752294 doi:10.1016/j.jecp.2009.05.006
- Gomes, H., Molholm, Christodoulou, C., Ritter, W. & Cowan, N. (2000). The development of auditory attention in children. *Frontiers in Bioscience*, 5, d108-120.
- Gomes, H., Molholm, S., Ritter, W., Kurtzberg, D., Cowan, N., & Vaughan, Jr., H.G. (2000). Mismatch negativity in children and adults, and effects of an attended task. *Psychophysiology*, 37, 807-816.
- Gomes, H., Sussman, E., Ritter, W., Kurtzberg, D., Cowan, N., & Vaughan Jr., H.G. (1999). Electrophysiological evidence of developmental changes in the duration of auditory sensory memory. *Developmental Psychology*, 35, 294-302.
- Goodsitt, J., Morse, P., Ver Hoeve, J., & Cowan, N. (1984). Infant speech recognition in multisyllabic contexts. *Child Development*, 55, 903-910.
- Gray, S., Lancaster, H., Alt, M., Hogan, T., Green, S., Levy, R., & Cowan, N. (2020). The structure of word learning in young school-age children. *Journal of Speech, Language, and Hearing Research*, 63, 1446-1466
- Keller, T.A., & Cowan, N. (1994). Developmental increase in the duration of memory for tone pitch. *Developmental Psychology*, 30, 855-863.
- Morey, C.C., AuBuchon, A.M., Attwood, M., Castelain, T., Cowan, N., Crepaldi, D., Fjerdningstad, E., Fredriksen, E., Jarrold, C., Koch, C., Lelonkiewicz, J.R., Lupyan, G., Mendenhall, W., Moreau, D. Schonberg, C., Tamnes, C.K., Vlach, H., & Elliott, E.M. (2024). Is verbal rehearsal strategic? An investigation into overt rehearsal of nameable pictures in 5- to 10-year-old children. *Journal of Cognition and Development*. : <https://doi.org/10.1080/15248372.2024.2389123>
- Morse, P. A., & Cowan, N. (1982). Infant auditory and speech perception. In T. M. Field, A. Huston, H. C. Quay, L. Troll, & G. E. Finley (Eds.), *Review of human development*. New York: Wiley & Sons. (pp. 32-61)
- Petrovich-Bartell, N., Cowan, N., & Morse, P. A. (1982). Mothers' perceptions of infant distress vocalizations. *Journal of Speech and Hearing Research*, 25, 371-376.
- Petrovich-Bartell, N., Cowan, N., & Morse, P. A. (1982). Perceptual and acoustic attributes of infant distress vocalizations. In C. L. Thew & E. L. Johnson (Eds.), *Proceedings of the Second International Congress for the Study of Child Language* (Vol. 1). Lanham, MD: University Press of America.
- Saults, J.S., & Cowan, N. (1996). The development of memory for ignored speech. *Journal of Experimental Child Psychology*, 63, 239-261.
- Saults, J.S., & Cowan, N. (1998). Developmental and individual differences in short-term memory. In N. Raz (ed.), *The other side of the error term: Aging and development as model systems in cognitive neuroscience*. Amsterdam: Elsevier. (pp. 155-196).
- Superbia-Guimarães, Lavers, R., Steiger, M., Hendrix, K., Glass, B., & Cowan, N. (in press). Children's use of semantic elaboration in immediate serial order memory. *Cognitive Development*.
- Towse, J.N., Cowan, N., Horton, N.J., & Whytock, S. (2008). Task experience and children's working memory performance: A perspective from recall timing. *Developmental Psychology*, 44, 695-706.

Dual-task Procedures to Examine the Role of Attention in Working Memory ([Top of Document](#))

- Belletier, C., Doherty, J., Jaroslawska, A., Rhodes, S., Cowan, N., Naveh-Benjamin, M., Barrouillet, P., Camos, V., & Logie, R. (2023). Strategic adaptation to dual-task in verbal working memory: Potential routes for theory integration. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 49, 51–77. doi: 10.1037/xlm0001106.
- Chen, Z., & Cowan, N. (2009). How verbal memory loads consume attention. *Memory & Cognition*, 37, 829–836. PMID: PMC2804027
- Cowan, N., & Morey, C.C. (2007). How can dual-task working memory retention limits be investigated? *Psychological Science*, 18, 686–688. PMC2615808
- Cowan, N., Blume, C.L., & Saults, J.S. (2013). Attention to attributes and objects in working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 39, 731–747.
- Cowan, N., & Guitard, D. (2025). Similar working memory outcomes with successive versus concurrent presentation of tones and colors. *Attention, Perception & Psychophysics*, 87, 884–898. <https://doi.org/10.3758/s13414-025-03036-3>
- Cowan, N., Lichty, W., & Grove, T.R. (1990). Properties of memory for unattended spoken syllables. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 16, 258–269.
- Cowan, N., Saults, J.S., & Blume, C.L. (2014). Central and peripheral components of working memory storage. *Journal of Experimental Psychology: General*, 143, 1806–1836.
- Doherty, J.M., Belletier, C., Rhodes, S., Jaroslawska, A.J., Barrouillet, P., Camos, V., Cowan, N., Naveh-Benjamin, M., & Logie, R.H. (2019). Dual-task costs in working memory: An adversarial collaboration. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 45, 1529–1551.
- Guitard, D., & Cowan, N. (2023). Attention allocation between item and order information in short-term memory. *Quarterly Journal of Experimental Psychology* 76(6): 1391–1409. DOI: 10.1177/17470218221118451
- Guitard, D., & Cowan, N. (2023). The tradeoff between item and order information in short-term memory does not depend on encoding time. *Journal of Experimental Psychology: Human Perception and Performance*, 49, 51–70. <https://doi.org/10.1037/xhp0001074> [Editor's Choice Award]
- Guitard, D., Saint-Aubin, J., & Cowan, N. (2022). Tradeoffs between item and order information in short-term memory. *Journal of Memory and Language*, 122, 104300. <https://doi.org/10.1016/j.jml.2021.104300>
- Li, Y., & Cowan, N. (2021). Attention effects in working memory that are asymmetric across sensory modalities. *Memory & Cognition*, 49(5), 1050–1065. doi.org/10.3758/s13421-021-01142-9
- Morey, C.C., & Cowan, N. (2004). When visual and verbal memories compete: Evidence of cross-domain limits in working memory. *Psychonomic Bulletin & Review*, 11, 296–301.
- Li, Y., & Cowan, N. (2022). Constraints of attention, stimulus modality, and feature similarity in working memory. *Attention, Perception, & Psychophysics*, 84, 2519–2539. <https://doi.org/10.3758/s13414-022-02549-5>
- Morey, C.C., & Cowan, N. (2005). When do visual and verbal memories conflict? The importance of working-memory load and retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 703–713.
- Morey, C.C., Cowan, N., Morey, R.D., & Rouder, J.N. (2011). Flexible attention allocation to visual and auditory working memory tasks: Manipulating reward induces a tradeoff. *Attention, Perception, & Psychophysics*, 73, 458–472. PMC3037478
- Pannell, B., Guitard, G., Li, Y., & Cowan, N. (2023). Can synchronized tones facilitate immediate memory for printed lists? *Memory*, 31, 1163–1175. doi: 10.1080/09658211.2023.2231672.
- Saults, J.S., & Cowan, N. (2007). A central capacity limit to the simultaneous storage of visual and auditory arrays in working memory. *Journal of Experimental Psychology: General*, 136, 663–684.
- Superbia-Guimarães, L., & Cowan, N. (in press). Colors, characters, locations, and shapes: The capacity of working memory for multiple, dissimilar sets of items. *Memory & Cognition*.
- Ünal, Z.E., Forsberg, A., Geary, D.C., & Cowan, N. (2022). The Role of Domain-General Attention and Domain-Specific Processing in Working Memory in Algebraic Performance: An Experimental Approach. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 48, 348–374.

<https://doi.org/10.1037/xlm0001117>

Books ([Top of Document](#))

- Logie, R.H., Wen, Z., Gathercole, S., Cowan, N., & Engle, R. (Eds.) (2023), *Memory in Science for Society: There is nothing as practical as a good theory*. Oxford University Press.
- Courage, M.L., & Cowan, N. (eds) (2022). *The development of memory in infancy and childhood*. 2nd Edition. Routledge.
- Logie, R.H., Camos, V., & Cowan, N. (eds) (2021). *Working Memory: State of the Science*. Oxford University Press.
- Cowan, N. (2016). *Working memory capacity*. Psychology Press and Routledge Classic Edition. New York: Routledge. [Original edition 2005. New Foreword to the Classic Edition.]
- Courage, M.L., & Cowan, N. (eds.) (2009). *The development of memory in infancy and childhood*. Hove, U.K.: Psychology Press.
- Cowan, N. (2005). *Working memory capacity*. Hove, East Sussex, UK: Psychology Press. [Psychology Press and Routledge Classic Edition with new foreword, 2016]
- Cowan, N. (ed.) (1997). *The development of memory in childhood*. Hove, East Sussex, UK: Psychology Press. (Paperback edition: 1997)
- Cowan, N. (1995). *Attention and memory: An integrated framework*. Oxford Psychology Series, No. 26. New York: Oxford University Press. (Paperback edition: 1997)

Information Processing, Attention, and Language ([Top of Document](#))

- Adams, E.J., & Cowan, N. (2021). The girl was watered by the flower: Effects of working memory loads on syntactic production in young children. *Journal of Cognition and Development*, 22, 125-148. doi.org/10.1080/15248372.2020.1844710
- Adams, E.J., Forsberg, A., & Cowan, N. (2022). The embedded-processes model and language use. In J.W. Schwieter & Z. Wen (eds.), *Cambridge handbook of working memory and language*. Cambridge University Press. (pp. 73-97)
- Alt, M., Hunter, D., Levy, R. Neiling, S.L., Leon, K., Arizmendi, G., Cowan, N., & Gray, S. (2025). Working memory structure in young Spanish-English bilingual children. *Bilingualism: Language and Cognition*, 28, 469-483. <https://doi.org/10.1017/S1366728924000580>
- AuBuchon, A.M., Emily M. Elliott, Candice C. Morey, Chris Jarrold, Nelson Cowan, Eryn J. Adams, Meg Attwood, Büsra Bayram, Taran Y. Blakstvedt, Gerhard Büttner, Thomas Castelain, Shari Cave, Davide Crepaldi, Eivor Fredriksen, Bret A. Glass, Dominic Guitard, Stefanie Hoehl, Alexis Hosch, Stéphanie Jeanneret, Tanya N. Joseph, Chris Koch, Jaroslaw R. Lelonkiewicz, Grace Meissner, Whitney Mendenhall, David Moreau, Thomas Ostermann, Asil Ali Özdogru, Francesca Padovani, Sebastian Poloczek, Jan Philipp Röer, Christina Schonberg, Christian K. Tamnes, Martin J. Tomasik, Beatrice Valentini, Evie Vergauwe, Haley Vlach, & Martin Voracek. (2022). Lexical access speed and the development of phonological recoding during immediate serial recall. *Journal of Cognition and Development*, 23, NO. 5, 624–643. <https://doi.org/10.1080/15248372.2022.2083140>
- Costa, A.N., McCrae, C.S., Cowan, N., & Curtis, A.F. (2022). Paradoxical Relationship Between Subjective and Objective Cognition: The Role of Sleep. *Journal of Clinical Sleep Medicine*, 18, 2009-2022. doi: 10.5664/jcsm.10070
- Cowan, N. (1989). A reply to Miles, Madden, and Jones: Mistakes and other flaws in the challenge to the cross-modal Stroop effect. *Perception & Psychophysics*, 45, 82-84.
- Cowan, N. (1989). Acquisition of Pig Latin: A Case Study. *Journal of Child Language*, 16, 365-386.
- Cowan, N. (1989). The reality of cross-modal Stroop effects. *Perception & Psychophysics*, 45, 87-88.
- Cowan, N. (1991). Recurrent speech patterns as cues to the segmentation of multisyllabic sequences. *Acta Psychologica*, 77, 121-135.
- Cowan, N. (1996). Can we resolve contradictions between process dissociation models? *Consciousness and Cognition*, 5, 255-259.

- Cowan, N., & Barron, A. (1987). Cross-modal, auditory-visual Stroop interference and possible implications for speech memory. *Perception & Psychophysics*, 41, 393-401.
- Cowan, N., & Greenspahn, E. (1995). Timed reactions to an object in apparent motion: Evidence on Cartesian and non-Cartesian perceptual hypotheses. *Perception & Psychophysics*, 57, 546-554.
- Cowan, N., & Leavitt, L. A. (1981). Juggling acts with linguistic units. In M. F. Miller, C. S. Masek, & R. A. Hendrick (Eds.), *Proceedings from the parasession on language and behavior*. Chicago: Chicago Linguistic Society.
- Cowan, N., & Leavitt, L. A. (1982). Talking backward: Exceptional speech play in late childhood. *Journal of Child Language*, 9, 481-495.
- Cowan, N., & Leavitt, L. A. (1983). Talking backward: Speech play in late childhood. In C. L. Thew & E. L. Johnson (Eds.), *Proceedings of the Second International Congress for the Study of Child Language* (Vol. 2). Lanham, MD: University Press of America.
- Cowan, N., & Leavitt, L.A. (1992). Speakers' access to the phonological structure of the syllable in word games. In M. Ziolkowski, M. Noske, & K. Deaton (eds.), *Papers from the 26th Regional Meeting of the Chicago Linguistic Society, Volume 2: The Parasession On the Syllable in Phonetics and Phonology*. Chicago: Chicago Linguistic Society.
- Cowan, N., & Stadler, M.A. (1996). Estimating unconscious processes: Implications of a general class of models. *Journal of Experimental Psychology: General*, 125, 195-200.
- Cowan, N., & Wood, N.L. (1997). Constraints on awareness, attention, and memory: Some recent investigations with ignored speech. *Consciousness and Cognition*, 6, 182-203.
- Cowan, N., Braine, M. D. S., & Leavitt, L. A. (1985). The phonological and metaphonological representation of speech: Evidence from fluent backward talkers. *Journal of Memory and Language*, 24, 679-698.
- Cowan, N., Braine, M. D. S., & Leavitt, L. A. (1986). Identifying phonemes and syllables: Evidence from people who rapidly reorder speech. *University of Massachusetts Occasional Papers in Linguistics*, 9, 1-39.
- Cowan, N., Leavitt, L. A., Massaro, D. W., & Kent, R. D. (1982). A fluent backward talker. *Journal of Speech and Hearing Research*, 25, 48-53.
- Elliott, E.M., Cowan, N., & Valle-Inclan, F. (1998). The nature of cross-modal, color-word interference effects. *Perception & Psychophysics*, 60, 761-767.
- Jiang, Q., & Cowan, N. (2020). Incidental learning of list membership is affected by serial position in the list. *Memory*, 28, 669-676.
- Luke, M., & Cowan, N. (in press). The ups and downs of melodic interval appreciation: Ascending intervals yield more pleasure. *Music Perception*.
- Massaro, D.W., & Cowan, N. (1993). Information processing models: Microscopes of the mind. *Annual Review of Psychology*, 44, 383-425.
- Sfeir, N., Guitard, D., & Cowan, N. (2024, online ahead of print). Short- and long-term influences of repeated speech examples on segmentation in an unfamiliar language analog. *Memory & Cognition*. doi: 10.3758/s13421-024-01517-8
- Sfeir, N., & Cowan, N. (in press). Working memory and language. In H. Nesi & P. Milin (Eds.-in-Chief), *International Encyclopedia of Language and Linguistics*, 3rd Edition. Elsevier.
- Wood, N.L., Stadler, M.A., & Cowan, N. (1997). Is there implicit memory without attention? A re-examination of task demands in Eich's (1984) procedure. *Memory & Cognition*, 25, 772-779.

Reviews of Information Processing ([Top of Document](#))

- Cowan N (2009), Sensory and Immediate Memory. In W.P. Banks (editor), *Encyclopedia of Consciousness*, Volume 2. Oxford: Elsevier. (pp. 327-339)
- Cowan, N. (2008). Sensory Memory. In H.L. Roediger, III (Ed.), *Cognitive psychology of memory*. Vol. 2 of *Learning and memory: A comprehensive reference*, 4 vols. (J.Byrne, Editor). Oxford: Elsevier. (pp. 23-32)
- Cowan, N. (2008). Autobiography of the president-elect. *The Experimental Psychology Bulletin*, vol. 12, #1. (web publication: <http://www.apa.org/divisions/div3/Newsletter2008-12-1/Newsletter2008-12-1-b.htm>)
- Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? In W. Sossin, J.-C. Lacaille, V.F. Castellucci & S. Belleville (eds.), "The essence of memory." *Progress in Brain*

- Research*, Vol. 169. Amsterdam: Elsevier / Academic Press. (pp. 323-338)
- Cowan, N. (1984). On short and long auditory stores. *Psychological Bulletin*, 96, 341-370.
- Cowan, N. (1988). Evolving conceptions of memory storage, selective attention, and their mutual constraints within the human information processing system. *Psychological Bulletin*, 104, 163-191.
- Cowan, N. (1989). Speech perception by ear, eye, hand, and mind. *Behavioral & Brain Sciences*, 12, 759-760. (Invited commentary on a source article by D. W. Massaro)
- Cowan, N. (1990). Converging evidence about information processing. *Behavioral & Brain Sciences*, 13, 237-238. (Invited commentary on a source article by R. Naatanen)
- Cowan, N. (1991). Neuropsychology and mental structure: Where do we go from here? *Behavioral & Brain Sciences*, 14, 445-446. (Invited commentary on source article by T. Shallice.)
- Cowan, N. (1993). Activation, attention, and short-term memory. *Memory & Cognition*, 21, 162-167. [* Reprinted in R.J. Sternberg & R.K. Wagner (eds.) (1999), *Readings in Cognitive Psychology*. Fort Worth, TX: Harcourt Brace College Publishers.]
- Cowan, N. (1994). Sensory memory and its role in information processing. In G. Karmos, M. Molnár, V. Csépe, I. Czigler, & J.E. Desmedt (Eds.), *Perspectives of event-related potential research (Electroencephalography & Clinical Neurophysiology Supplement 44)*. New York: Elsevier Science Publishers. pp. 21-31.
- Cowan, N. (1995). Memory theories from A to Z. *Contemporary Psychology*, 40, 552-555. (Review of *Theories of Memory*, edited by A.F. Collins, S.E. Gathercole, M.A. Conway, & P.E. Morris)
- Cowan, N. (1998). What is more explanatory, processing capacity or processing speed? *Behavioral and Brain Sciences*, 21, 835-836. (Commentary on target article by Graham Halford)
- Cowan, N. (1998). Five enigmas regarding LaBerge's (1997) triangular-circuit theory of attention and self-referential theory of awareness. *Psyche*, 4 (08).
- Cowan, N. (2003). Preserving the spirit and respect of academia through traditions. *APS Observer*, 16, 10. (American Psychological Society)
- Cowan, N. (2004). On the psychophysics of memory. In C. Kaernbach, E. Schröger, & H. Müller (eds.), *Psychophysics beyond sensation: Laws and invariants of human cognition*. Scientific Psychology Series. Mahwah, NJ: Erlbaum. (pp. 313-317)
- Cowan, N. (2005). Selective attention tasks in cognitive research. In A. Wenzel and D.C. Rubin (eds.), *Cognitive methods and their application to clinical research*. Washington, D.C.: APA Books. (pp. 73 – 96)
- Cowan, N. (2005). Understanding intelligence: A summary and an adjustable-attention hypothesis. In O. Wilhelm & R.W. Engle (Eds.), *Handbook of understanding and measuring intelligence*. London: Sage. (pp. 469-488)
- Cowan, N. (2006). Within fluid cognition: Fluid processing and fluid storage? *Behavioral and Brain Sciences*, 29, 129-130. Commentary on C. Blair target article.
- Cowan, N. (2008). Arrogance, social consensus, and experimental psychology. APA Division 3 presidential essay. *The Experimental Psychology Bulletin*, vol. 12, #2.
- Cowan, N. (2009). A brief history of experimental psychology, 1850 – 2125. APA Division 3 presidential essay. *The Experimental Psychology Bulletin*, 13(1).
- Cowan, N. (2009). Capacity limits and consciousness. In T. Baynes, A. Cleeremans, & P. Wilken (eds.), *Oxford companion to consciousness*. New York: Oxford University Press (pp. 127-130)
- Cowan, N. (2012). Focused and divided attention to the eyes and ears: A research journey. In J.M. Wolfe & L. Robertson, *From perception to consciousness: Searching with Anne Treisman*. Oxford, U.K.: Oxford University Press.
- Cowan, N. (2015). George Miller's magical number of immediate memory in retrospect: Observations on the faltering progression of science. *Psychological Review*, 122, 536-41.
- Cowan, N. (2015). Second-language use, theories of working memory, and the Vennian mind. In Z. Wen, M.B. Mota, & A. McNeill (eds.), *Working memory in second language acquisition and processing*. Bristol, UK: Multilingual Matters. (pp. 29-40)
- Cowan, N. (2016). Process Overlap Theory and first principles of intelligence testing. *Psychological Inquiry*, 27, #3, 190-191.
- Cowan, N. (2018). Experimental psychology generally, and the Journal today. Editorial essay. *Journal of*

- Experimental Psychology: General*, 147, 459-461.
- Cowan, N. (2020). The importance of awareness of our human limits: A view from cognitive psychology and beyond. *BPS Cognitive Section Bulletin*, British Psychological Society, Spring 2020, Issue 5, 9-16. [Essay based on keynote address.]
- Cowan, N. (2022). Life is pointless – good point...And how do you feel about that? *Journal of Controversial Ideas*, 2(1), 13. doi: 10.35995/jci02010013
- Cowan, N., & Morey, C.C. (2019). The wealth of evidence from brain lesions affecting memory: How should we use it? In S.E. MacPherson & S. Della Sala (eds.), *Cases of amnesia: Contributions to understanding memory and the brain*. New York: Routledge. (pp. 354-364)
- Cowan, N., & Rachev, N.R. (2018). Merging with the path not taken: Wilhelm Wundt's work as a precursor to the embedded-processes approach to memory, attention, and consciousness. *Consciousness and Cognition*, 63, 228-238.
- Cowan, N., Adams, E.J., Bhangal, S., Corcoran, M., Decker, R., Dockter, C.E., Eubank, A.T., Gann, C.L., Greene, N.R., Helle, A.C., Lee, N., Nguyen, A.T., Ripley, K.R., Scofield, J.E., Tapia, M.A., Threlkeld, K.L., & Watts, A.L. (2019). Foundations of arrogance: A broad survey and framework for research. *Review of General Psychology*, 23, 425-443.
- Cowan, N., Ahmed, N.I., Bao, C., Cissne, M.N., Flores, R.D., Gutierrez, R.M., Hayse, B., Musich, M.L., Nourbakhshi, H., Nuraini, N., Schroeder, E.E., Sfeir, N., Sparrow, E., & Superbia-Guimarães, L. (2025). Theories of consciousness from the perspective of an embedded processes view. *Psychological Review*, 132(1), 76-106. <https://doi.org/10.1037/rev0000510>
- Cowan, N., Lichty, W., & Grove, T. (1988). Memory for unattended speech during silent reading. In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory: Current research and issues (Vol. 2)*. NY: Wiley & Sons.
- Cowan, N., Rouder, J.N., & Stadler, M.A. (2000). Conjuring a work from the dream time of cognitive psychology. *American Journal of Psychology*, 113, 639-671.
- Crowder, R.G., & Cowan, N. (2003). Sensory memory. Revision by N. Cowan of first-edition entry by Robert G. Crowder. In J.H. Byrne, H. Eichenbaum, H. Roediger III, & R.F. Thompson (eds.), *Learning and Memory*. (2nd edition). Macmillan. (pp. 607-609)
- Hackley, S.A., & Cowan, N. (2012). In memory of David G. McDonald, 1933-2012. *Experimental Psychology Bulletin*, 16, 13-14.
- Halford, G.S., Cowan, N., & Andrews, G. (2007). Separating cognitive capacity from knowledge: A new hypothesis. *Trends in Cognitive Sciences*, 11, 236-242. PMC2613182
- Li, D., & Cowan, N. (2015). Auditory memory. In D. Jaeger & R. Jung (eds.), *Encyclopedia of computational neuroscience*. Springer. (pp. 236-238)
- Li, D., & Cowan, N. (2019). Auditory memory. In D. Jaeger & R. Jung (eds.), *Encyclopedia of computational neuroscience*. https://doi.org/10.1007/978-1-4614-7320-6_244-3 (pp. 1-3).
- Li, D., Christ, S.E., Johnson, J.D., & Cowan, N. (2015). Attention and memory. In *Brain mapping: An encyclopedic reference*. Elsevier.
- Morey, C.C., Rhodes, S., & Cowan, N. (2019). Sensory-motor integration and brain lesions: Progress toward explaining domain-specific phenomena within domain-general working memory. *Cortex*, 112, 149-161.
- Mueser, P.R., Cowan, N., & Mueser, K.T. (1999). A generalized signal detection model to explain rational variation in base rate use. *Cognition*, 69, 267-312.
- Öztekin, I., & Cowan, N. (2015). Representational states in memory: Where do we stand? *Frontiers in Human Neuroscience*, <http://dx.doi.org/10.3389/fnhum.2015.00453>.
- Rachev, N.R., & Cowan, N. (2025). Decision making and working memory: Bridging the gap. In T. McElroy (ed.), *Decision-making in life and work: Foundations, strategies, and current neuroscience*. Springer.
- Rhodes, S., Cowan, N., Parra, M.A., & Logie, R.H. (2019). Interaction effects on common measures of sensitivity: Choice of measure, Type I error, and power. *Behavior Research Methods*, 51, 2209–2227. doi: 10.3758/s13428-018-1081-0
- Vergauwe, E., & Cowan, N. (2014). Assessing and revising the plan for intelligence testing. *Journal of Intelligence*, 2, 29-32. doi:10.3390/jintelligence2020029
- Winkler, I., & Cowan, N. (2005). From sensory to long term memory: Evidence from auditory memory

- reactivation studies. *Experimental Psychology*, 52, 3-20.
- Winkler, I., Korzyukov, O., Gumenyuk, V., Cowan, N., Linkenkaer-Hansen, K., Ilmoniemi, R.J., Alho, K., & Näätänen, R. (2002). Temporary and longer term retention of acoustic information. *Psychophysiology*, 39, 530-534.
- Yiend, J., Mathews, A., & Cowan, N. (2005). Selective attention tasks in clinical and cognitive research. In A. Wenzel and D.C. Rubin (eds.), *Cognitive methods and their application to clinical research*. Washington, D.C.: APA Books. (pp. 65 – 71)
- See under books, Cowan (1995), *Attention and memory, and integrated framework*
- See under books, Cowan (2016), *Working memory capacity*.
- See **Reviews of Working Memory**

Learning Difficulties and Disorders in Relation to Attention and Working Memory ([Top of Document](#))

- Alt, M., Arizmendi, G., Gray, S., Hogan, T.P., Green, S., & Cowan, N. (2019). Novel word learning in children who are bilingual: comparison to monolingual peers. *Journal of Speech, Language, and Hearing Research*, 62, 2332-2360.
- Alt, M., Fox, A., Levy, R., Hogan, T.P., Cowan, N., & Gray, S. (2022). Phonological working memory and central executive function differ in children with typical development and dyslexia, *Dyslexia*. 28, 20-39. <https://doi.org/10.1002/dys.1699>
- Alt, M., Gray, S., Hogan, T.P., Schlesinger, N., & Cowan, N. (2019). Spoken word learning differences among children with dyslexia, concomitant dyslexia and developmental language disorders, and typical development. *Language, Speech, and Hearing Services in Schools*, 50, 540-561.
- Alt, M., Hogan, T., Green, S., Gray, S., Cabbage, K. L., & Cowan, N. (2017). Word learning deficits in children with dyslexia. *Journal of Speech, Language, and Hearing Research*, 60, 1012-1028.
- Arizmendi, G.D., Alt, M., Gray, S., Hogan, T., Green, S., & Cowan, N. (2018). Do bilingual children have an executive function advantage? Results from inhibition, shifting, and updating tasks. *Language, Speech, and Hearing Services in Schools*, 49(3), 356-378. doi: 10.1044/2018_LSHSS-17-0107.
- Baron, L. S., Hogan, T. P., Alt, M., Gray, S., Cabbage, K. L., Green, S., & Cowan, N. (2018). Children with dyslexia benefit from orthographic facilitation during spoken word learning. *Journal of Speech, Language, and Hearing Research*, 61, 2002-2014.
- Becker, T. M., Cicero, D. C., Cowan, N., & Kerns, J. G. (2012). Cognitive control components and speech symptoms in people with schizophrenia. *Psychiatry Research*, 196, 20-26.
- Cowan, N. (1996). Short-term memory, working memory, and their importance in language processing. *Topics in language disorders*, 17, 1-18. [Special issue: K.G. Butler & R.B. Gillam (eds.), "Working memory and language impairment: New perspectives."] reprinted in 1998 within *Memory and language impairment in children and adults: New perspectives*. Gaithersburg, MD: Aspen Publishers.
- Cowan, N., Hogan, T.P., Alt, M., Green, S., Cabbage, K.L., Brinkley, S., & Gray, S. (2017). Short-term memory in childhood dyslexia: Deficient serial order in multiple modalities. *Dyslexia*, 23, 209-233.
- Erikson, J. Alt., M. Gray, S., Green, S., Hogan, T.P., & Cowan, N. (2018). Phonological vulnerability for school-aged Spanish-English-speaking bilingual children. *International Journal of Bilingual Education and Bilingualism*. <https://doi.org/10.1080/13670050.2018.1510892>
- Gillam, R., Cowan, N., & Marler, J. (1998). Information processing by school-age children with specific language impairment: Evidence from a modality effect paradigm. *Journal of Speech, Language and Hearing Research*, 41, 913-926.
- Gillam, R.B., Cowan, N., & Day, L.S. (1995). Sequential memory in children with and without language impairment. *Journal of Speech & Hearing Research*, 38, 393-402.
- Gray, S., Fox, A., Green, S., Alt, M., Hogan, T., Petscher, Y., & Cowan, N. (2019). Working memory profiles of children with dyslexia, developmental language disorder, or both. *Journal of Speech, Language, and Hearing Research*, 62, 1839-1858.
- Jarrold, C., Cowan, N., Hewes, A.K., & Riby, D.M. (2004). Speech timing and verbal short-term memory: Evidence for contrasting deficits in Down syndrome and Williams syndrome. *Journal of Memory and*

Language, 51, 365-380.

- Javitt, D.C., Strous, R., Cowan, N., & Ritter, W. (1995). Behavioral evidence for auditory sensory ("echoic") memory deficit in schizophrenia. *American Journal of Psychiatry*, 152, 1517-1519.
- Javitt, D.C., Strous, R., Grochowski, S., Ritter, W., & Cowan, N. (1997). Impaired precision, but normal retention, of auditory sensory ("echoic") memory information in schizophrenia. *Journal of Abnormal Psychology*, 106, 315-324.
- Lee, E., Cowan, N., Vogel, E.K., Rolan, T., Valle-Inclán, F., & Hackley, S.A. (2010). Visual working memory deficits in Parkinson's patients are due to both reduced storage capacity and impaired ability to filter out irrelevant information. *Brain*, 133, 2677-2689.
- Majerus, S., & Cowan, N. (2016). The nature of verbal short-term impairment in dyslexia: The importance of serial order. *Frontiers in Psychology*, 7, 1-8, article 1522. doi: 10.3389/fpsyg.2016.01522.
- March, L., Cienfuegos, A., Goldbloom, L., Ritter, W., Cowan, N., & Javitt, D.C. (1999). Normal time course of auditory recognition in schizophrenia, despite impaired precision of the auditory sensory ("echoic") memory code. *Journal of Abnormal Psychology*, 108, 69-75.
- Mettler, H.M., Alt, M., Gray, S., Hogan, T., Green, S., & Cowan, N. (2022). Phonological Working Memory and Sentence Production in School-Age Children with Typical Language, Dyslexia, and Comorbid Dyslexia and Developmental Language Disorder. *Journal of Child Language*, 51, 56 - 901.
<https://www.doi.org/10.1017/S0305000922000435>
<https://www.doi.org/10.1017/S0305000922000435>

Methodology ([Top of Document](#))

- Balazs Aczel, Barnabas Szaszi, Alexandra Sarafoglou, Zoltan Kekecs, Šimon Kucharský, Daniel Benjamin, Christopher Chambers, Agneta Fischer, Andrew Gelman, Morton Ann Gernsbacher, John Ioannidis, Eric Johnson, Kai Jonas, Stavroula Kousta, Scott Lilienfeld, D. Stephen Lindsay, Candice Morey, Marcus Munafo, Ben Newell, Harold Pashler, David Shanks, Daniel Simons, Jelte Wicherts, Dolores Albarracín, Nicole Anderson, John Antonakis, Hal Arkes, Mitja Back, George Banks, Christopher Beevers, Andrew Bennett, Wiebke Bleidorn, Ty Boyer, Cristina Cacciari, Alice Carter, Joseph Cesario, Charles Clifton, Ronán Conroy, Mike Cortese, Fiammetta Cosci, **Nelson Cowan**, Jarret Crawford, Eveline Crone, John Curtin, Randall Engle, Simon Farrell, Pasco Fearon, Mark Fichman, Mr. Willem Frankenhuis, Alexandra Freund, Gareth Gaskell, Roger Giner-Sorolla, Donald Green, Robert Greene, Lisa Harlow, Fernando Hoces de la Guardia, Derek Isaacowitz, Janet Kolodner, Debra Lieberman, Gordon Logan, Wendy Mendes, Lea Moersdorf, Brendan Nyhan, Jeffrey Pollack, Christopher Sullivan, Simine Vazire, Eric-Jan Wagenmakers (2020). A consensus-based transparency checklist. *Nature Human Behavior*, 4, 4-6. doi:10.1038/s41562-019-0772-6
- Balazs Aczel, Barnabas Szaszi, Gustav Nilsson, Olmo R van den Akker, Casper J Albers, Marcel A L M van Assen, Jolanneke A Bastiaansen, Dan Benjamin, Udo Boehm, Rotem Botvinik-Nezer, Laura F Bringmann, Niko A Busch, Emmanuel Caruyer, Andrea M Cataldo, Nelson Cowan, Andrew Delios, Noah N N van Dongen, Chris Donkin, Johnny B van Doorn, Anna Dreber, Gilles Dutilh, Gary F Egan, Morton Ann Gernsbacher, Rink Hoekstra, Sabine Hoffmann, Felix Holzmeister, Juergen Huber, Magnus Johannesson, Kai J Jonas, Alexander T Kindel, Michael Kirchler, Yoram K Kunkels, D Stephen Lindsay, Jean-Francois Mangin, Dora Matzke, Marcus R Munafo, Ben R Newell, Brian A Nosek, Russell A Poldrack, Don van Ravenzwaaij, Jörg Rieskamp, Matthew J Salganik, Alexandra Sarafoglou, Tom Schonberg, Martin Schweinsberg, David Shanks, Raphael Silberzahn, Daniel J Simons, Barbara A Spellman, Samuel St-Jean, Jeffrey J Starns, Eric L Uhlmann, Jelte Wicherts, Eric-Jan Wagenmakers. (2021). Consensus-based guidance for conducting and reporting multi-analyst studies. *E-Life*, 10:e72185, 1-13. DOI: <https://doi.org/10.7554/eLife.7218>
- Cabbage, K.L., Brinkley, S., Gray, S., Alt, M., Cowan, N., Green, S., Kuo, T., & Hogan, T.P. (2017). Assessing working memory in children: The Comprehensive Assessment Battery for Children – Working Memory (CABC-WM). *Journal of Visualized Experiments*, 124, e55121, 1-11.
- Cowan, N. (1986). A matrix of consonant-cluster-free monosyllabic words in English. *Behavior Research Methods, Instruments, and Computers*, 18, 434-446.
- Cowan, N. (2009). By their bootstraps: Brain imaging in the Show-Me State. *RT Image*, 22(8), February 23. <http://www.rt-image.com/>

- Cowan, N. (2022). The adversarial collaboration within each of us. *Journal of Applied Research in Memory and Cognition*, 11, 19–22. doi.org/10.1037/mac0000001
- Cowan, N. (2024). To Reduce Editor Bias and Increase Diversity and Transparency, Editors Must be Motivated: Comment on Sharpe (2024). *American Psychologist*, 79 (7), 893–895. <https://doi.org/10.1037/amp0001305>
- Cowan, N., Belletier, C., Doherty, J.M., Jaroslawska, A.J., Rhodes, S., Forsberg, A., Naveh-Benjamin, M., Barrouillet, P. Camos, V., & Logie, R.H. (2020). How do scientific views change? Notes from an extended adversarial collaboration. *Perspectives on Psychological Science*, 15, 1011-1025. <https://doi.org/10.1177/1745691620906415>
- Green, S.B., Yang, Y., Alt, M., Brinkley, S., Gray, S., Hogan, T., & Cowan, N. (2016). Use of internal consistency coefficients for estimating reliability of experimental task scores. *Psychonomic Bulletin & Review*, 23, 750-763.
- Rhodes, S., Cowan, N., Hardman, K.O., & Logie, R.H. (2018). Informed guessing in change detection. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 44, 1023-1035.
- Rhodes, S., Cowan, N., Parra, M.A., & Logie, R.H. (2019). Interaction effects on common measures of sensitivity: Choice of measure, Type I error, and power. *Behavior Research Methods*, 51, 2209–2227. doi:10.3758/s13428-018-1081-0
- Rouder, J.N., Morey, R.D., Cowan, N., & Pfaltz, M. (2004). Learning in a unidimensional absolute identification task. *Psychonomic Bulletin & Review*, 11, 938-944.
- Rouder, J.N., Morey, R.D., Morey, C.C., & Cowan, N. (2011). How to measure working-memory capacity in the change-detection paradigm. *Psychonomic Bulletin & Review*, 18, 324-330. PMC3070885

Processes of Working Memory Maintenance ([Top of Document](#))

- Cowan, N. (2022). Item-position binding capacity limits and word limits in working memory: A reanalysis of Oberauer (2019). *Journal of Cognition*, 5(1), 3. DOI: <http://doi.org/10.5334/joc.193>
- Balota, D.A., Cowan, N., & Engle, R.W. (1990). Suffix interference in the recall of linguistically coherent speech. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 16, 446-456.
- Barton, A.U., Valle-Inclán, F., Cowan, N., & Hackley, S. (2022). Unconsciously registered items reduce working memory capacity. *Consciousness and Cognition*, 105, 103399
- Bunting, M.F., & Cowan, N. (2005). Working memory and flexibility in awareness and attention. *Psychological Research*, 69, 412-419.
- Bunting, M.F., Cowan, N., & Colflesh, G.H. (2008). The deployment of attention in short-term memory tasks: Tradeoffs between immediate and delayed deployment. *Memory & Cognition*, 36, 799-812. PMC2667108
- Bunting, M.F., Cowan, N., & Saults, J.S. (2006). How does running memory span work? *Quarterly Journal of Experimental Psychology*, 59, 1691-1700.
- Chen, Z., & Cowan, N. (2013). Working memory inefficiency: Minimal information is utilized in visual recognition tasks. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 39, 1449-1462.
- Cowan, N. (1987). Auditory sensory storage in relation to the growth of sensation and acoustic information extraction. *Journal of Experimental Psychology: Human Perception and Performance*, 13, 204-215.
- Cowan, N. (1992). Verbal memory span and the timing of spoken recall. *Journal of Memory and Language*, 31, 668-684.
- Cowan, N. (1994). Mechanisms of verbal short-term memory. *Current Directions in Psychological Science*, 3, 185-189.
- Cowan, N. (2011). Working memory and attention in language use. In J. Guendouzi, F. Loncke, & M.J. Williams (eds.), *The Handbook of psycholinguistic and cognitive processes: Perspectives in communication disorders*. New York: Taylor & Francis. (pp. 75-97)
- Cowan, N. (2012). Covert pronunciation and rehearsal. In N.M. Seel (ed.), *Encyclopedia of the sciences of learning*. Springer: Heidelberg, Germany. DOI 10.1007/978-1-4419-1428-6.
- Cowan, N., Guitard, D., Greene, N.R., & Fiset, S. (2022). Exploring the use of phonological and semantic representations in working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 48, 1638–1659.
- Cowan, N., & Kail, R. (1996). Covert processes and their development in short-term memory. In S. Gathercole

- (ed.), *Models of short-term memory*. Hove, U.K: Erlbaum Associates, Ltd. (pp. 29-50)
- Cowan, N., & Morey, C.C. (2006). Visual working memory depends on attentional filtering. *Trends in Cognitive Sciences*, 10, 139-141.
- Cowan, N., & Morse, P. A. (1979). Influence of task demands on the categorical versus continuous perception of vowels. In J. J. Wolf & D. H. Klatt (Eds.), *Speech communication papers presented at the 97th meeting of the Acoustical Society of America*. New York: ASA.
- Cowan, N., & Morse, P. A. (1986). The use of auditory and phonetic memory in vowel discrimination. *Journal of the Acoustical Society of America*, 79, 500-507.
- Cowan, N., & Rouder, J.N. (2009). Comment on "Dynamic shifts of limited working memory resources in human vision." *Science*, 323 (no. 5916), 877. PMC2730043
- Cowan, N., & Saults, J.S. (2013). When does a good working memory counteract proactive interference? Surprising evidence from a probe recognition task. *Journal of Experimental Psychology: General*, 142, 12-17.
- Cowan, N., & Vergauwe, E.A. (2015). Applying how adults rehearse to understand how rehearsal may develop. *Frontiers in Psychology*. doi: 10.3389/fpsyg.2014.01538
- Cowan, N., Baddeley, A.D., Elliott, E.M., & Norris, J. (2003). List composition and the word length effect in immediate recall: A comparison of localist and globalist assumptions. *Psychonomic Bulletin & Review*, 10, 74-79.
- Cowan, N., Day, L., Saults, J.S., Keller, T.A., Johnson, T., & Flores, L. (1992). The role of verbal output time in the effects of word length on immediate memory. *Journal of Memory and Language*, 31, 1-17.
- Cowan, N., Donnell, K., & Saults, J.S. (2013). A list-length constraint on incidental item-to-item associations. *Psychonomic Bulletin & Review*, 20, 1253-1258.
- Cowan, N., Hardman, K., Saults, J.S., Blume, C.L., Clark, K.M., & Sunday, M.A. (2016). Detection of the number of changes in a display in working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42, 169-185.
- Cowan, N., Johnson, T.D., & Saults, J.S. (2005). Capacity limits in list item recognition: Evidence from proactive interference. *Memory*, 13, 293-299.
- Cowan, N., Nugent, L.D., & Elliott, E.M. (2000). Memory-search and rehearsal processes and the word length effect in immediate recall: A synthesis in reply to Service. *Quarterly Journal of Experimental Psychology*, 53A, 666-670.
- Cowan, N., Nugent, L.D., Elliott, E.M., and Geer, T. (2000). Is there a temporal basis of the word length effect? A response to Service (1998). *Quarterly Journal of Experimental Psychology*, 53A, 647-660.
- Cowan, N., Saults, J.S., & Morey, C.C. (2006). Development of working memory for verbal-spatial associations. *Journal of Memory and Language*, 55, 274-289.
- Cowan, N., Saults, J.S., Elliott, E.M., & Moreno, M. (2002). Deconfounding serial recall. *Journal of Memory and Language*, 46, 153-177.
- Cowan, N., Wood, N.L., & Borne, D.N. (1994). Reconfirmation of the short-term storage concept. *Psychological Science*, 5, 103-106.
- Cowan, N., Wood, N.L., Nugent, L.D., & Treisman, M. (1997). There are two word length effects in verbal short-term memory: Opposed effects of duration and complexity. *Psychological Science*, 8, 290-295.
- Delooze, M.A., Guitard, D., Cowan, N., & Morey, C.C. (2024). Rapid source forgetting across modalities: A problem for working memory models. *Memory & Cognition*. <https://doi.org/10.3758/s13421-024-01664-y>
- Elliott, E.M., & Cowan, N. (2001). Habituation to auditory distractors in a cross-modal, color-word interference task. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 27, 654-667.
- Elliott, E.M., & Cowan, N. (2005). Coherence of the irrelevant-sound effect: Individual profiles of short-term memory and susceptibility to task-irrelevant materials. *Memory & Cognition*, 33, 664-675.
- Elliott, E.M., Barrilleaux, K.M., & Cowan, N. (2006). Individual differences in the ability to avoid distracting sounds. *European Journal of Cognitive Psychology*, 18, 90-108.
- Forsberg, A., Guitard, D., & Cowan, N. (2021). Working memory limits severely constrain long-term retention. *Psychonomic Bulletin & Review*, 28, 537-547. Doi: 10.3758/s13423-020-01847-z
- Forsberg, A., Guitard, D., Greene, N.R., Naveh-Benjamin, M., & Cowan, N. (2025). Differential information transfer and loss between working memory and long-term memory across serial positions. *Journal of*

- Experimental Psychology: Learning, Memory, and Cognition*, 51(8), 1191–1212.
<https://doi.org/10.1037/xlm0001437>
- Gardiner, J.M., & Cowan, N. (2003). Modality effects. In J.H. Byrne, H. Eichenbaum, H. Roediger III, & R.F. Thompson (eds.), *Learning and Memory*. (2nd edition). New York, NY: Macmillan. (pp. 397–400)
- Gaspelin, N., & Cowan, N. (2025). Restoring a top-down control assumption: salience effects in working memory are overcome with time. *Journal of Experimental Psychology: General*, 154 (8), 2301–2317.
<https://doi.org/10.1037/xge0001776>
- Gaspelin, N., & Cowan, N. (in press). Cue-driven attentional guidance nearly eliminates salience effects in working memory. *Journal of Experimental Psychology: Learning, Memory, & Cognition*.
- Gilchrist, A.L., & Cowan, N. (2014). A two-stage search of visual working memory: Investigating speed in the change-detection paradigm. *Attention, Perception, & Psychophysics*, 76, 2031–2050.
- Greene, N.R., Guitard, D., Forsberg, A., Cowan, N., & Naveh-Benjamin, M. (2024). Working memory limitations constrain visual episodic long-term memory at both specific and gist levels of representation. *Memory & Cognition*, 52, 1958–1982. <https://doi.org/10.3758/s13421-024-01593-w>
- Greene, N.R., Guitard, D., Forsberg, A., Cowan, N., & Naveh-Benjamin, M. (in press). Long-term representational costs of overloading working memory. *Psychonomic Bulletin & Review*.
- Guitard, D., & Cowan, N. (in press). Do we use visual codes when information is not presented visually? *Memory & Cognition*.
- Guitard, D., Saint-Aubin, J., & Cowan, N. (2021). Asymmetrical interference between item and order information in short-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 47, 243–263 DOI: 10.1037/xlm0000956
- Hardman, K., & Cowan, N. (2015). Remembering complex objects in visual working memory: Do capacity limits restrict objects or features? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 41, 325–347.
- Hardman, K.O., & Cowan, N. (2016). Reasoning and memory: People make varied use of the information available in working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42, 700–722.
- Hulme, C., Newton, P., Cowan, N., Stuart, G., & Brown, G. (1999). Think before you speak: pause, memory search and trace reintegration processes in verbal memory span. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 25, 447–463.
- Keller, T.A., Cowan, N., & Saults, J.S. (1995). Can auditory memory for tone pitch be rehearsed? *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 21, 635–645.
- Lawrence, C.O., Guitard, D., & Cowan, N. (2024). Short-term retention of words as a function of encoding depth. *Memory & Cognition*, 1338–1356. doi: 10.3758/s13421-024-01546-3
- Li, D., Cowan, N., & Saults, J.S. (2013). Estimating working memory capacity for lists of nonverbal sounds. *Attention, Perception, & Psychophysics*, 75, 145–160.
- Lutfi-Proctor, D.A., Elliott, E.M., & Cowan, N. (2014). The role of visual stimuli in cross-modal stroop interference. *PsyCh Journal*, 3, 17–29.
- Ricker, T.J., & Cowan, N. (2014). Differences between presentation methods in working memory procedures: A matter of working memory consolidation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40, 417–428.
- Ricker, T.J., Cowan, N., & Morey, C.C. (2010). Visual working memory is disrupted by covert verbal retrieval. *Psychonomic Bulletin & Review*, 17, 516–521. PMC3050528
- Ricker, T.J., Vergauwe, E., Hinrichs, G.A., Blume, C.L., & Cowan, N. (2015). No recovery of memory when cognitive load is decreased. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 41, 872–880.
- Rouder, J.N., Morey, R.D., Cowan, N., Zwilling, C.E., Morey, C.C., & Pratte, M.S. (2008). An assessment of fixed-capacity models of visual working memory. *Proceedings of the National Academy of Sciences (PNAS)*, 105, 5975–5979. PMC2329704
- Shelton, J.T., Elliott, E.M., & Cowan, N. (2008). Attention and working memory: Tools for understanding consciousness. *Psyche*, 14(8), 0–6.
- Tamm, G., Kreegipuu, K., Harro, J., & Cowan, N. (2017). Updating schematic emotional facial expressions in

- working memory: Response bias and sensitivity. *Acta Psychologica*, 172, 10-18.
- Towse, J.N., Cowan, N., Hitch, G.J., & Horton, N.J. (2008). The recall of information from working memory: insights from behavioural and chronometric perspectives. *Experimental Psychology*, 55, 371-383.
- Vergauwe, E., & Cowan, N. (2014). A common short-term memory retrieval rate may describe many cognitive procedures. *Frontiers in Human Neuroscience*, 8 (article 126), 1-7. doi: 10.3389/fnhum.2014.00126
- Vergauwe, E., Hardman, K.O., Rouder, J.N., Roemer, E. McAllaster, S. & Cowan, N. (2016). Searching for serial refreshing in working memory: Using response times to track the content of the focus of attention over time. *Psychonomic Bulletin & Review*, 23, 1818-1824.
- Vergauwe, E., Langerock, N., & Cowan, N. (2018). Evidence for spontaneous serial refreshing in verbal working memory? *Psychonomic Bulletin & Review*, 25, 674-680.
- Vergauwe, E., Ricker, T.J., Langerock, N., & Cowan, N. (2019). What do people typically do between list items? The nature of attention-based mnemonic activities depends on task context. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 45, 779-794. doi: 10.1037/xlm0000625
- Vergauwe, E.A., & Cowan, N. (2015). Attending to items in working memory: Evidence that refreshing and memory search are closely related. *Psychonomic Bulletin & Review*, 22, 1001-1006.
- Vergauwe, E.A., & Cowan, N. (2015). Working memory units are all in your head: Factors that influence whether features or objects are the favored units. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 41, 1404-16.

Reviews of Working Memory and Its Development* (marked by *) ([Top of Document](#))

- Adams, E.J., Nguyen, A.T., & Cowan, N. (2018). Theories of working memory: Differences in definition, degree of modularity, role of attention, and purpose. *Language, Speech, and Hearing Services in Schools*, 49, 340-355.
- Cowan, N. (1998). Evidence against the global speed of processing theory of working memory. In M.A. Gernsbacher & S.J. Derry (Eds.), *Proceedings of the twentieth annual conference of the Cognitive Science Society*. Mahwah, NJ: Erlbaum. (p. 1211)
- Cowan, N. (2003). Varieties of procedural accounts of working memory retention systems. *Behavioral and Brain Sciences*, 26, 731-732. (Commentary on target article by Ruchkin et al.)
- Cowan, N. (1987). Auditory memory: Procedures to examine two phases. In W. A. Yost & C. S. Watson (Eds.), *Auditory processing of complex sounds*. Hillsdale, NJ: Erlbaum.
- Cowan, N. (1995). Verbal working memory: A view with a room. *American Journal of Psychology*, 108, 123-155. (Review of *Working memory and language* by S. Gathercole & A. Baddeley)
- Cowan, N. (1998). Visual and auditory working memory. *Trends in Cognitive Sciences*, 2, 77-78.
- Cowan, N. (1999). An embedded-processes model of working memory. In A. Miyake & P. Shah (eds.), *Models of Working Memory: Mechanisms of active maintenance and executive control*. Cambridge, U.K.: Cambridge University Press. (pp. 62-101)
- Cowan, N. (2000/01). Processing limits of selective attention and working memory: Potential implications for interpreting. *Interpreting*, 5, 117-146.
- Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences*, 24, 87-185.
<http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=84441&fulltextType=RA&fileId=S0140525X01003922>
- Cowan, N. (2005). Working-memory capacity limits in a theoretical context. In C. Izawa & N. Ohta (eds.), *Human learning and memory: Advances In theory and applications. The 4th Tsukuba international conference on memory*. Erlbaum. (pp. 155-175)
- Cowan, N. (2008). The rest of the story: The size of thought. *Scientific American Mind*, June/July, 32-35.
- Cowan, N. (2008). Working memory storage capacity and efficiency. *Mind Matters*. (This is a web publication by *Scientific American*.) Posted January 28, 2008
- Cowan, N. (2008). Working memory. In N.J. Salkind (ed.), *Encyclopedia of Educational Psychology*, vol. 2. London: Sage. (pp. 1015-1016)
- Cowan, N. (2009). Working memory from the trailing edge of consciousness to neurons. Review of T.

- Klingberg, The overflowing brain: Information overload and the limits of working memory. *Neuron*, 62, 13-16.
- Cowan, N. (2010). The magical mystery four: How is working memory capacity limited, and why? *Current Directions in Psychological Science*, 19, 51-57.
- Cowan, N. (2012). Working memory: the seat of learning and comprehension. In Della Sala, S., & Anderson, M. (eds), *Neuroscience in education: The good, the bad, and the ugly*. Oxford, UK: Oxford University Press. (pp. 111-127)
- Cowan, N. (2013). Working memory. In H. Pashler (ed.), *Encyclopedia of the mind*. Sage.
- Cowan, N. (2015). Sensational memorability: Working memory for things we see hear, feel, or somehow sense. In C. LeFebvre, P. Jolicoeur, & J. Martinez-Trujillo (eds.), *Mechanisms of Sensory Working Memory: Attention and Performance XXV*. Elsevier. (pp. 5-22)
- Cowan, N. (2016). *Working memory capacity*. Psychology Press and Routledge Classic Edition. New York: Routledge. [Original edition 2005. New Foreword to the Classic Edition.]
- *Cowan, N. (2016). Working memory maturation: Can we get at the essence of cognitive growth? *Perspectives on Psychological Science*, 11, 239-264.
- Cowan, N. (2017). The many faces of working memory and short-term storage. *Psychonomic Bulletin & Review*, 24, 1158–1170.
- Cowan, N. (2017, updated 2024). Working memory, the information you are now thinking of. In J. Wixted (ed.), *Learning and Memory: A Comprehensive Reference*, 2nd edition. Elsevier. (pp. 147-161). 3rd edition J.H. Byrne (ed.). <https://doi.org/10.1016/B978-0-443-15754-7.00029-8>
- *Cowan, N. (2017). Mental objects in working memory: Development of basic capacity or of cognitive completion? *Advances in Child Development and Behavior*, 52, 81-104.
- Cowan, N. (2018). Working memory. In B. Frey (ed.), *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*.
- Cowan, N. (2019) Short-term memory based on activated long-term memory: A review in response to Norris (2017). *Psychological Bulletin*, 145, 822-847.
- *Cowan, N. (2022). Working memory development: A 50-year assessment of research and underlying theories. *Cognition*, 224, 105075. doi.org/10.1016/j.cognition.2022.105075
- *Cowan, N. (2022). Working memory development in childhood. In Courage, M.L., & Cowan, N. (eds) (2022). *The development of memory in infancy and childhood*. 2nd Edition. Routledge.
- *Cowan, N. (2023). Working memory and child development with its windfalls and pitfalls. In Logie, R.H., Wen, Z., Gathercole, S., Cowan, N., Engle, R. (Eds.), *Memory in Science for Society: There is nothing as practical as a good theory*. Oxford University Press.
- Cowan, N., Bao, C., Bishop-Chrzanowski, B.M., Costa, A.N., Greene, N.R., Guitard, D., Li, C., Musich, M.L., & Ünal, Z.E. (2024). The relation between attention and memory. *Annual Review of Psychology*, 75, 183-214. <https://doi.org/10.1146/annurev-psych-040723-012736>
- *Cowan, N., Elliott, E.M., & Sauls, J.S.. (2002). The search for what is fundamental in the development of working memory. In R. Kail & H. Reese (Eds.), *Advances in Child Development and Behavior*, 29, 1-49.
- Cowan, N., & Sauls, J.S. (1995). Memory for speech. In H. Winitz (ed.), *Human communication and its disorders*, Vol. 4. Timonium, MD: York Press. (pp. 81 - 170)
- Cowan, N., Kane, M.J., Conway, A.R.A., & Ispa-Cowan, A.J. (2006). Stupid brain! Homer's working memory odyssey. In A. Brown, *The psychology of the Simpsons: D'Oh!* Dallas: BenBella Books. (pp. 49-64)
- Cowan, N., Morey, C.C., & Chen, Z. (2007). The legend of the magical number seven. In S. Della Sala (Ed.), *Tall tales about the mind & brain: Separating fact from fiction*. Oxford, U.K.: Oxford University Press.
- Cowan, N., Morey, C.C., & Naveh-Benjamin, M. (2021). An embedded-processes approach to working memory: How is it distinct from other approaches, and to what ends? In R.H. Logie, V. Camos, and N. Cowan (eds.), *Working Memory: State of the Science*, Oxford University Press. (pp. 44-84)
- Cowan, N., Morey, C.C., Chen, Z., & Bunting, M.F. (2007). What do estimates of working memory capacity tell us? In N. Osaka, R.H. Logie, & M. D'Esposito (eds.), *The cognitive neuroscience of working memory*. Oxford, U.K.: Oxford University Press. (pp. 43-58)
- Cowan, N., Morey, C.C., Sauls, J.S., Chen, Z., & Gilchrist, A.L. (2008). Theory and measurement of working memory capacity limits. In Ross, B.H. (ed.), *The psychology of learning and motivation*, 49, 49-104.

- Cowan, N., Sauls, J.S., & Brown, G.D.A. (2004). On the auditory modality superiority effect in serial recall: Separating input and output factors. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 30, 639-644.
- *Forsberg, A., Adams, E.J., & Cowan, N. (2021). The Role of Working Memory in Long-Term Learning: Implications for Childhood Development. *Psychology of Learning and Motivation*, 74, 1-45.
- Gargya, S., Blume, C.L., Naveh-Benjamin, M., & Cowan, N. (2018). Memory. In M.H. Bornstein (ed.), *SAGE Encyclopedia of Lifespan Human Development*. (pp. 1375-1379)
- Gilchrist, A.L., & Cowan, N. (2010). Conscious and unconscious aspects of working memory. In I. Winkler & I. Czigler (eds.), *Unconscious memory representations in perception: Processes and mechanisms in the brain. Advances in Consciousness research*. Vol. 78. Amsterdam: John Benjamins. (Pp. 1-35)
- Greene, N., Forsberg, A., Guitard, G., Naveh-Benjamin, M., & Cowan, N. (2024). A lifespan study of the confidence-accuracy relation in working memory and episodic long-term memory. *Journal of Experimental Psychology: General*, 153, 1336–1360. <https://doi.org/10.1037/xge0001551>
- Logie, R.H., & Cowan, N. (2015). Perspectives on working memory: Introduction to the special issue. *Memory & Cognition*, 43, 315-324.
- Logie, R.H., Wen, Z., Gathercole, S.E., Cowan, N., & Engle, R.W. (2023). Introduction: When applying memory theory does, and does not work. In Logie, R.H., Wen, Z., Gathercole, S., Cowan, N., Engle, R. (Eds.), *Memory in Science for Society: There is nothing as practical as a good theory*. Oxford University Press.
- Morey, C.C., & Cowan, N. (2018). Can we distinguish three maintenance processes in working memory? *Annals of the New York Academy of Science*, 1424(1), 45-51. doi: 10.1111/nyas.13925.
- Morey, C.C., Rhodes, S., & Cowan, N. (2020). Co-existing, contradictory working memory models are ready for progressive refinement: Reply to Logie. *Cortex*, 123, 200-202.
- *Naveh-Benjamin, M. & Cowan, N. (2023). Age-related changes in working memory: Roles of attention, executive function, and knowledge. *Nature Reviews Psychology*, 2, 151-165. <https://doi.org/10.1038/s44159-023-00149-0>. Viewable Link: <https://rdcu.be/c39GP>
- Oberauer, K., Lewandowsky, S., Awh, E., Brown, G.D.A., Conway, A., Cowan, N., Donkin, C., Farrell, S., Hitch, G.J., Hurlstone, M., Ma, W.J., Morey, C.C., Nee, D.E., Schweppe, J., Vergauwe, E., & Ward, G. (2018). Benchmarks provide common ground for model development. Reply to Logie (2018) and Vandierendonck (2018). *Psychological Bulletin*, 144(9), 972-977. doi: 10.1037/bul0000165
- Oberauer, K., Lewandowsky, S., Awh, E., Brown, G.D.A., Conway, A., Cowan, N., Donkin, C., Farrell, S., Hitch, G.J., Hurlstone, M., Ma, W.J., Morey, C.C., Nee, D.E., Schweppe, J., Vergauwe, E., & Ward, G. (2018). Benchmarks for models of working memory. *Psychological Bulletin*, 144(9), 885-958. doi: 10.1037/bul0000153
- Rhodes, S., & Cowan, N. (2018). Attention in working memory: Attention is needed but it yearns to be free. *Annals of the New York Academy of Science*, 1424, 52-63. doi: 10.1111/nyas.13652
- Rhodes, S., & Cowan, N. (2019). Flexible representations in visual working memory and interactions with long term learning: Commentary on the special issue. *British Journal of Psychology*, 110, 449-460.
- Ricker, T.J., & Cowan, N. (2018). Cognitive load as a measure of capture of the focus of attention. In R. Zheng, ed., *Cognitive load measurement and application: A theoretical framework for meaningful research and practice*. New York: Routledge. (pp. 129-146)
- Ricker, T.J., AuBuchon, A., & Cowan, N. (2010). Working memory. In L. Nadel (Ed.), *Wiley Interdisciplinary Reviews: Cognitive Science*, 1, 573-585.
- *Superbia-Guimarães, L., & Cowan, N. (2023). Disentangling processing and storage accounts of working memory development in childhood. *Developmental Review*, 69, 101089. <https://doi.org/10.1016/j.dr.2023.101089>
- *Towse, J., & Cowan, N. (2005). Working memory and its relevance for cognitive development. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian (eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind*. Mahwah, NJ: Erlbaum. (pp. 9-37)
- Vergauwe, E., & Cowan, N. (2015). Theories of short-term memory. In J.D. Wright, editor in chief, *International Encyclopedia of Social & Behavioral Science* (second edition, Vol. 21). Oxford, UK: Elsevier.

(pp. 901-908)

See under **books**, Cowan (1995), *Attention and memory, and integrated framework*

See under **books**, Cowan (2016), *Working memory capacity*.

Latent Structure of Working Memory ([Top of Document](#))

Conway, A.R.A., Cowan, N., Bunting, M.F., Theriault, D.J., & Minkoff, S.R.B. (2002). A latent variable analysis of working memory capacity, short-term memory capacity, processing speed, and general fluid intelligence. *Intelligence*, *30*, 163-183.

Cowan, N., Elliott, E.M., Saults, J.S., Morey, C.C., Mattox, S., Hismjatullina, A., & Conway, A.R.A. (2005). On the capacity of attention: Its estimation and its role in working memory and cognitive aptitudes. *Cognitive Psychology*, *51*, 42-100. PMC2673732

Gray, S., Green, S., Alt, M., Hogan, T., Kuo, T., Brinkley, S., & Cowan, N. (2017). The structure of working memory in young school-age children and its relation to intelligence. *Journal of Memory and Language*, *92*, 183-201.

Gray, S., Levy, R., Alt, M., Hogan, T.P., & Cowan, N. (2022). Working memory predicts new word learning over and above existing vocabulary and nonverbal IQ. *Journal of Speech, Language, and Hearing Research*, *65*, 1044–1069. https://doi.org/10.1044/2021_JSLHR-21-00397