

## MEMORY

## Adapt and Overcome

*Can a single brain system compensate for autism, dyslexia and OCD?*

By Michael T. Ullman and  
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**The human brain possesses** an incredible capacity to adapt to new conditions. This plasticity enables us not only to constantly learn but also to overcome brain injury and loss of function. Take away one capability, and little by little we often compensate for these deficits.

Our brain may be especially well suited to overcome limitations in the case of psychiatric or neurological conditions that originate early in life, what clinicians call neurodevelopmental disorders. Given the brain's considerable plasticity during early years, children with these disorders may have particular advantages in learning compensatory strategies.

It now appears that a single brain system—declarative memory—can pick up slack for many kinds of problems across multiple neurodevelopmental disorders. This system, rooted in the brain's hippocampus, is what we typically refer to when we think of learning and memory. It allows us to memorize facts and names or recall a first grade teacher or a shop-

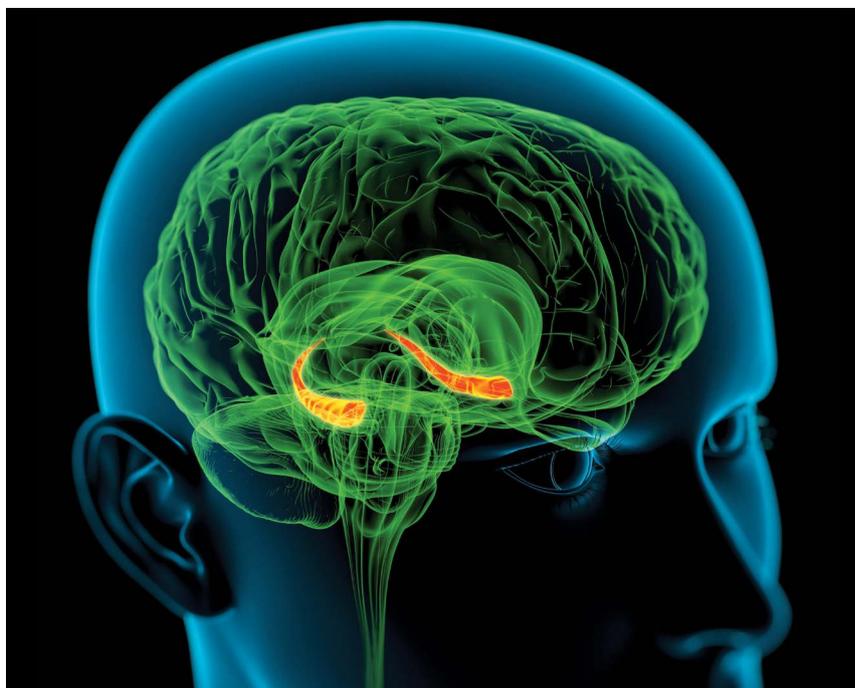
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ping list. Whereas other memory systems are more specialized—helping us learn movements or recall emotional events, for instance—declarative memory absorbs and retains a much broader range of knowledge. In fact, it may allow us to learn just about anything.

Given declarative memory's powerful role in learning, one might expect it to help individuals acquire all kinds of compensatory strategies—as long as it remains functional. Indeed, research suggests that it not only remains largely intact but also compensates for diverse impairments in five common conditions that are rarely studied in conjunction: autism spectrum disorder, obsessive-compulsive disorder (OCD), Tourette's syndrome, dyslexia and developmental language disorder (which is often referred to as specific language impairment, or SLI).

In 2015 we laid out this idea in a review article. We presented evidence suggesting that declarative memory enables people with OCD or Tourette's syndrome to learn to control compulsions and tics; it allows individuals with autism to memorize strategies that improve social interactions; and it helps people

with dyslexia or SLI overcome reading and language difficulties. Overall, we believe that a better understanding of declarative memory could yield new ways to both identify and treat people with neurodevelopmental disorders.

### Evaluating the Evidence

Multiple lines of evidence suggest compensation by declarative memory. One element supporting the hypothesis is the fact that many strategies for helping people with neurodevelopmental disorders involve consciously mastering a set of behavioral steps. Because declarative memory is the only brain system that supports such explicit learning, these strategies must depend on this system.

For instance, a popular and effective therapy called “social stories” is used to guide children with autism through specific types of social situations, such as how to behave at a birthday party. By practicing social scripts in this explicit manner, children on the spectrum can acquire behaviors that neurotypical children generally learn implicitly. Individuals with autism can also learn explicit strategies on their own. As Temple Gran-

din, the noted author with autism, has said, “You gradually get less and less autistic ... you keep learning how to behave. It’s like being in a play.”

Moreover, explicit learning supports habit-reversal therapy—a particularly effective approach for Tourette’s syndrome, according to a 2013 review by neurologists Madeleine Frank and Andrea Cavanna, both then at the University of Birmingham in England. This therapy, which can also benefit individuals with OCD, teaches people to consciously recognize a tic or compulsion as it occurs and to learn to explicitly perform a competing response to suppress the problem behavior. For example, learning to close one’s eyes for a few seconds when one feels an eye-blink tic coming on can suppress the tic.

Another compensatory strategy engaging declarative memory involves memorizing whole phrases or sentences. Typically developing kids generally combine individual words into phrases and sentences, but the grammatical deficits of children with SLI impair this process. Instead they often simply memorize phrases as chunks—that is, recalling a phrase such as “I like pie” as a single unit.

Evidence from brain imaging underscores the importance of declarative memory for compensation. A number of studies have found that people with autism, OCD or SLI (but not the control subjects) show activation in the hippocampus or other declarative memory brain regions when performing tasks involving social skills, planning or grammar. In some of these tasks, individuals with these disorders actually perform as well as the control subjects, suggesting that their compensation was highly successful.

Finally, if declarative memory underlies compensation, then those individuals with stronger declarative memory should compensate more effectively. Many studies have reported this kind of correlational evidence. In 2012 psychologist Jarrad A. G. Lum of Deakin University in Australia and his colleagues (including one of us, Ullman) examined 51 children with SLI and 51 children without language impairment. We gave the children several

tests, including an assessment of declarative memory, which incorporated tasks such as recalling pairs of words after a delay. In addition, by giving the children a grammar test, we discovered that, among those with SLI (but not among the unimpaired children), better declarative memory was indeed linked to better grammatical abilities. Similar links have emerged

ical system. Such an approach could stimulate and strengthen the dysfunctional circuitry. This method is akin to therapies that prevent stroke patients from using their good hand so that they are forced to use their bad one, which can increase its functionality.

Additionally, declarative memory’s role in neurodevelopmental disorders has

## DECLARATIVE MEMORY MAY HOLD THE KEY TO CONTROLLING TICS AND LEARNING SOCIAL STRATEGIES.

between this memory system and the ability to overcome difficulties in dyslexia, Tourette’s syndrome and OCD.

### Helping Patients

Recognizing the compensatory role of declarative memory could improve treatment in several ways. First, therapists can make greater use of techniques that rely on declarative memory, such as approaches that employ explicit knowledge. These treatments could also be combined with drugs such as acetylcholinesterase inhibitors, which can strengthen this memory system.

Paradoxically, another therapeutic option could involve approaches that *avoid* engaging declarative memory. For example, children with SLI might be presented with sentences whose grammatical structures are too complex to be learned as chunks, increasing the likelihood of engaging the impaired grammat-

implications for diagnosis. Many individuals might compensate so well that clinicians do not recognize their condition. This could help explain a major conundrum of these disorders: why they are diagnosed more commonly in boys than girls. Declarative memory seems to be better, on average, in girls and women than in boys and men. Thus, females are likely to compensate and even mask symptoms more successfully than males.

Given the power and flexibility of declarative memory, it could enable compensation in many other contexts. Evidence hints that it plays a part in ADHD, Parkinson’s disease, aphasia and even normal aging. On a larger level, the brain’s ability to replace the functionality of one system with that of another offers an important reminder to researchers: it is not only the deficits that matter. Sometimes we need to look beyond weaknesses and focus on strengths. **M**

### FURTHER READING

- **Probing Striatal Function in Obsessive-Compulsive Disorder: A PET Study of Implicit Sequence Learning.** Scott L. Rauch et al. in *Journal of Neuropsychiatry and Clinical Neurosciences*, Vol. 9, No. 4, pages 568–573; Fall 1997.
- **Working, Declarative and Procedural Memory in Specific Language Impairment.** Jarrad A. G. Lum, Gina Conti-Ramsden, Debra Page and Michael T. Ullman in *Cortex*, Vol. 48, No. 9, pages 1138–1154; October 2012.
- **A Compensatory Role for Declarative Memory in Neurodevelopmental Disorders.** Michael T. Ullman and Mariel Y. Pullman in *Neuroscience and Biobehavioral Reviews*, Vol. 51, pages 205–222; April 2015.

*From Our Archives*

- **The Mystery of the Missed Connection.** Claudia Christine Wolf; January/February 2013.
- **Taking Early Aim at Autism.** Luciana Gravotta; January/February 2014.