Guest editorial

Education and communication about memory: Using the terminology of cognitive neuroscience

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Although memory is one of the most important aspects of cognition, educating medical students about memory has been impeded by confusing and contradictory terminology. Struggling with discordant definitions contributes to student frustration and presents barriers to efficient and effective reading of relevant literature. General clinicians and many neurologists use terms for bedside memory testing and description of deficits that are based on timeframes, such as "short-term" and "long-term" memory. These inexact terms are defined very differently by most physicians versus cognitive neuroscientists (Table 1).[1-4]

The contradictory terminology of memory causes additional ill effects. Reports of neuropsychological testing often appear to be at odds with memory testing performed in a mental status examination, adversely affecting communication with patients and their families. For example, the family of a patient with Alzheimer's disease might attest to poor short-term memory (meaning that the patient does not recall things that happened in the past hours, days, or weeks), but good long-term memory (meaning better recall of what happened many years ago). This would be largely at odds with formal testing described in the terms of cognitive neuroscience (Table 2), which will likely indicate that the patient is most impaired in episodic memory (a form of long-term memory) and less impaired in working memory (also called short-term memory). While the family's meaning is conveyed, its language can be reconciled with that of cognitive neuroscience only by a process of translation.

What is the scope of this problem of conflicting terminology? To describe current clinical understanding and usage, we drew on six complementary data sources, including surveys of neurologists and house officers, reviews of inpatient charts, relevant textbooks and online sources, and published neurological clinicopathologic conferences (CPCs). First, to ascertain what timeframes general neurologists assigned to types of memory, such as "short-term" and "long-term" memory, in 2002 we surveyed 30 neurologists attending a national educational colloquium, of whom only two defined "short-term" memory correctly as lasting seconds or less than a minute. "Short-term memory" was typically equated with "recent" memory, signifying minutes to weeks or months. None recognized that "long-term" memory, as defined in cognitive neuroscience, includes minutes (such as "three objects at five minutes") to hours, days, months, and years. "Long-term" memory was generally equated with "remote" memory, meaning years to decades.

Second, in a subsequent survey of 2003 attendees, only one of 19 neurologists was close to being accurate

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Table 1. Common clinical vs. cognitive neuroscience terms		
Term	**Common, traditional, clinical usage**	**Cognitive neuroscience usage[1]**
Explicit (declarative) memory	Not used	Conscious memory (vs. unconscious, "implicit" memory)
Short-term memory	Minutes, hours, days (recent)	Same as working memory
Working memory	Not used	Information retained "in mind" while being manipulated
Long-term memory	Months, years, decades (remote)	Many seconds (e.g., more than 30) to minutes, to remote
Episodic memory	Not used	Memory for specific events
Semantic memory	Not used	General knowledge of the world; facts unrelated to any specific memory

in defining all of the common cognitive neuroscience terms listed. Correct definitions were written by seven neurologists for "explicit" memory, three for "declarative" memory, six for "implicit" memory, seven for "working" memory, six for "episodic" memory, and three for "semantic" memory. Our survey of neurologists supports the contention that even most of these specialists do not have the knowledge to teach and "translate" modern memory terms. The relatively small sample surveyed may not be representative, but the neurologists who were interested in education and willing to respond probably had an average knowledge of this subject.

Third, informal assessment of 28 medical house officers during group didactic conferences in 2003 revealed that none had knowledge of this terminology except for two who had previously studied cognitive psychology. These non-neurologic house officers who graduated from a wide distribution of medical schools not more than four years before the surveys were not taught or else did not remember these terms.

Fourth, concurrent review of 120 inpatient charts of neurologic patients from 2003 to August 2004 revealed no instance of use of this terminology by house officers, medical attendings, or neurologists in describing or interpreting the results of mental status testing.

Table 2. A simplified, clinically useful classification of memory, explicit memory (declarative, conscious)			
Type of memory	**Working (short-term memory)**	**Episodic (long-term memory)**	**Semantic (long-term memory)**
Practical definition	"In mind" for seconds while being manipulated	Related to a specific event	General knowledge, facts unrelated to any specific memory
Test	Digit span (e.g., repeat immediately seven numbers in order)	Recent: Three objects at five minutes; brief story Remote: Verifiable, personally experienced remote event	Previously learned general information (e.g., "Who was the first President of the United States?")
Anatomy	Prefrontal/parietal association cortex	Hippocampal-medial temporal lobe; required until memory is consolidated over time	Multiple neocortical areas (e.g., left inferior lateral temporal lobe for naming)

Fifth, a review of textbooks (latest editions) revealed that cognitive neuroscience terms appeared in some, but sources of confusion and contradiction were not adequately explained, with rare exceptions.[5] Medical and neurologic textbooks have been surprisingly slow to introduce these terms and generally still do not explain them sufficiently or relate them to interpretation of neuropsychologic testing results. Internet resources, including textbook accounts and scholarly articles, are being increasingly accessed by students and also by patients, their families, and providers. Thus, confusion and frustration over contradictory terminology may become more widespread and affect all levels of communication about impaired memory.

Finally, we scrutinized 115 neurologic CPCs, including cases from 1995 to 2002, and found that the discussants did not use cognitive neuroscience terms (detailed analysis of memory was generally lacking, even in cases with severe memory impairments). Even the CPC discussants, including behavioral neurologists, did not capitalize on this opportunity to educate readers about memory.

These informal surveys clearly demonstrate the existence of major deficits in knowledge and usage of the terms of cognitive neuroscience related to memory. We interpret these deficits as detrimental to education and communication among clinicians and with patients. The impetus for this project came from one of us (THG) teaching for 15 years about memory and learning in a neuroscience course for second-year medical students. As a recent example of the educational burden of conflicting terminology, all seven students in a neuroscience tutorial, when quizzed about memory on their final examination, reverted to using "short-term" and "long-term" memory in the traditional sense. We suspect that the explanation for their performance lies, at least in part, in the lack of correspondence of their cognitive neuroscience learning with the concurrent teaching of the mental status examination by psychiatrists, internists, and general neurologists who do not themselves know or use the modern terminology. Although we did not formally survey the knowledge of psychiatrists and primary physicians, it is likely that their knowledge of memory is similar to that of neurologists. Thus, up-to-date learning about memory has been impeded not only by the contradictions in terms, but by the larger clinical context in which this learning takes place.

The resolution of this problem would be easier if the dominant terminology of cognitive neuroscience was more descriptive and transparent: these terms do not readily suggest their meanings to the clinician. Nonetheless, we suggest that it is time for these terms to enter the clinical mainstream. As in the clinical application of any branch of science, learning and usage should be accurate and up-to-date. Clinical neuropsychologists, general and behavioral neurologists, psychiatrists, neurology and psychiatry residents, and all others who teach and practice mental status assessment should become familiar with the new terminology, teach it, and explain its relationship to the older terms in common clinical use. A recent review may be helpful in this regard.[6] In the future, we would hope for more accessible and descriptive terms that are anchored in the anatomic and physiologic bases of the different memory systems (e.g., a "medial temporal lobe system"). In the meantime, students, residents, and practitioners need to understand the correspondence of the terms of cognitive neuroscience to clinical, bedside terms and be prepared to translate them so as to enhance continued learning and effective communication with patients, colleagues, and experts.

Note

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