then at the grocery store, taking a visual tour of your house will provide you with cues to the grocery list (eg, bananas on the bed).

All of these internal memory strategies require repetition and practice to master. They must be used on a regular basis so that they become overlearned. Repetition is another internal strategy that provides additional opportunities for information to be encoded and transferred into memory stores. Most individuals have a memory limitation of five to nine pieces of information that they can hold in working memory. However, chunking allows an individual to encode information more efficiently by grouping related pieces of information together to form one new piece of information. Chunking allows an individual to group between one and four pieces of information into a single chunk, thus expanding one’s ability to recall large pieces of information more efficiently. For example, the number string “17762006” may be difficult to recall if you try to recall the individual numbers; however, if you chunk the items into more meaningful number arrays (eg, 1776 and 2006), then you are likely to be more successful in recalling the number series.

Although several observational studies have suggested that individuals who participate in activities that require cognitive stimulation such as reading, crossword puzzles, board games, and playing musical instruments have a lower risk of developing dementia, these cognitive stimulation exercises have not been rigorously and quantitatively evaluated in neurologically impaired populations.

Virtual reality (VR) training relies on the ability to learn automatic motor routines and implicit memory to retrain recall. VR training requires intact procedural memory, which often is left intact until later stages of many neurological diseases. Researchers have suggested that VR could be used as an external stimulus to create mental images to explore motor plans. For example, a patient in a VR environment may be able to practice mental rotation in everyday life situations, such as automobile driving, or it could be used to help PD patients facilitate their gait movements or motor sequences. In a small study using VR in daily living situations (eg, eating or using the bathroom), two PD patients demonstrated mild difficulties on tasks measuring object pointing, incidental memory, and orientation in the VR environment. The PD patients were also significantly slower during all the trials, particularly in narrow virtual spaces, when compared to 10 non-neurologically compared controls. With further development and evaluation, VR training programs may offer new methods to aid PD patients with both cognitive and motor rehabilitation.

External memory strategies include using compensatory devices to try to circumvent memory impairments. These compensatory devices include memory notebooks/personal reminders, to-do lists, electronic paging systems, sticky notes, and medication timers. These external aids can help improve a particular cognitive function or compensate for a specific deficit. These techniques rely on intact functioning in at least one cognitive

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**Sidebar 4-4: Cognitive Rehabilitation Strategies**

**Internal**
1. Mnemonics
2. Acronyms
4. Repetition
5. Chunking
6. Virtual reality

**External**
1. Memory notebooks
2. Personal reminders
3. To-do lists
4. Electronic paging systems
5. Sticky notes
6. Medication timers