

# The Interface Between Cognitive Impairments and Access to Information Technology

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## ***What are the cognitive impairments that can cause functional difficulties specifically in relation to interaction with information technology systems?***

Many different types of cognitive impairments can result in functional difficulties:

- With impairment of information-processing speed, the person's response time will be slow. The person will take longer to process and respond to visual, verbal and/or written information. Not just language, but instead all information-laden stimuli, will be processed slower. Thus, the person may still be processing one piece of information, when the next (and the next) "intrude".
- With impairment of attention, the person will have difficulty paying attention to verbal and/or visual information. Attention span may be brief, and, thus, the person may have difficulty sustaining attention for the time needed to process the information that is provided. Brief "messages" will be processed better than those that are lengthy, i.e., attention-demanding.
- With impairment of language, the person may have a variety of difficulties, e.g., in understanding what is said to them, in expressing themselves and/or in retrieving words that they wish to speak or write.
- With impairment of visual perception, the person may have difficulty seeing the entire visual field or differentiating visual information. Thus, part of what is on a "page", e.g., the whole left side, may not be seen at all.
- Impairment of memory is a common cognitive impairment. Typically, memory loss is more pronounced for new information than it is for historical or old information. Memory loss can be the result of impaired attention, as it is difficult to recall information that is not encoded or to which insufficient attention is paid.
- With impairment of executive functions, the person may have difficulty responding to complex task demands, problem solving or conceptualizing information. Thus, the person has a diminished ability to "put together" all the separate informational pieces of a situation and "run with them" appropriately.
- Cognitive impairments act as a barrier to the learning of new information. While new information can be learned, with such impairments, learning is often slow and tedious. This often implies the need for repetition of what is being learned, over a much lengthier period than for non-impaired people.

With impairment of the basic cognitive functions delineated above, impairment of intelligence is likely, as intelligence is considered the aggregate of all cognitive functions. The functional consequences will be diverse, depending on the level and types of intelligence required in any specific situation. Thus, information that might have easily been processed prior to impairment may require a level of intelligence the person no longer has.

Cognitive impairments can present themselves in a variety of manifestations, as a person may have difficulty in only a single domain or in multiple domains of cognitive function, and the severity of the consequences of impairment may vary across domains of cognitive function. Thus, an individual may have only slight challenges in terms of visual perception, but have severe memory problems.

The functional implications of cognitive impairments are diverse. For example, one person may require instructions to be printed in large type or to be subdivided into multiple steps. Another person may need blocks of information to be brief. Some people may have difficulty processing text that is fully justified, as the variations in spacing between words create confusion in their visual processing. A person may not be able to attend to and/or process all the information that is presented, for example, when the “page” of information is highly complex, as on many website pages. Some individuals may be unable to understand the information he/she is being asked to process, as it is too complex or requires basic information as a “prerequisite”. If addressing multi-step tasks, people with an impairment of memory may not recall what they have already done or what they have yet to do. And, most challenging for others trying to help, the person may be unable to explain the difficulties that they are having, as some may be unaware that they are having difficulties, while others may not be able to pinpoint the nature of the problem.

The relationship between the severity of cognitive impairment and use of technology has never been empirically studied. However, it seems logical to assume that those with deteriorating conditions like Alzheimer’s Disease and other types of dementia are not good candidates on which to base technological developments. If one prioritized needs for adaptations of technology, those with stable impairments and those who live with impairments for longer life periods would argue that the impact of improved technology would be greatest for them (see below).

### ***What are the causes or conditions that lead to such impairment symptoms?***

Many types of medical conditions can result in cognitive impairment. For example, traumatic brain injury (TBI) results in cognitive impairments. TBI is the result of a blow to the head in which there is an alteration in mental status. In other words, the person becomes dazed, confused, disoriented and even loses consciousness for a period of time that can be brief (seconds or minutes) or long (hours, days, weeks). Usually the durations of the period of altered mental status or the period during which the person has no spontaneous recall of events (post-traumatic amnesia) serve as indicators of the severity of the cognitive impairments that result. However, individuals who sustain even a brief period of altered mental status can suffer from debilitating cognitive impairments that act as barriers to employment and community function. People who sustain a TBI often

spontaneously recover function for a period of time following their injury. In addition, their ability to improve continues as they learn new ways of approaching tasks and to compensate for their impairments. Thus, one of the defining features of TBI is impairment that either stays the same or gets better with time. It does not get worse. The cognitive impairments that result from aneurysms in the brain or from brain tumors are quite similar to those that are secondary to TBI, as long as the person does not experience a recurrence of the tumor or suffer from the effects of further intervention, e.g., chemotherapy or radiation therapy. Thus, these conditions result in impairments that, after an initial period, are relatively stable, i.e., the person stays the same and does not deteriorate or get worse.

Multiple sclerosis (MS) and Parkinson's disease (PD) can also result in cognitive impairments. MS is a medical condition that results from the demyelization of neurons in the spinal cord and the brain. It more frequently occurs in women than in men, and it is most likely to strike when the individual is age 20 to 40. The course of MS can be relatively slow and impairments become worse over time. PD is a disease of the elderly and results from an alteration in the production of dopamine, a neurotransmitter, within the brain. Like MS, it is a deteriorating condition that gets worse over time. In its later stages, PD can result in dementia.

Other medical conditions that result in cognitive impairment include stroke, Alzheimer's disease and the various types of dementia. These conditions are primarily found in the elderly. Stroke usually results in cognitive impairment, which is relatively stable; the nature of the impairments depends on the side of the brain that has been damaged. For example, those with right hemisphere strokes are likely to have perceptual difficulties, while those with left hemisphere strokes are likely to have diverse impairments in understanding language and in expressing themselves. Alzheimer's disease and the various types of dementia are deteriorating conditions, the time course of which can be slow.

Many other medical conditions can result in cognitive impairments. For example, epilepsy can result in cognitive impairment, when seizures are severe or as a result of neurosurgical interventions to remove areas of the brain that are sources of excess neuronal activity. Substance abuse can also result in cognitive impairments, depending on the substance used and the frequency and duration of the abuse. In addition, cognitive impairments may result from medical interventions or treatments, such as chemotherapy or radiation therapy or from exposure to toxic substances such as lead, organophosphates or certain types of molds, e.g., stachybotris.

### ***What are the prevalence rates of the causes of cognitive impairment?***

The prevalence rates of many types of cognitive impairment are not known. For example, while it is estimated that 5+ million people in the United States have experienced TBI, this number is an underestimate of the actual numbers, because it only includes those who have sought medical attention in a hospital emergency room. Frequently cited prevalence data do not include those who seek medical attention in the office of a physician or those who do not seek medical attention at all, e.g., victims of assault or domestic violence, those with concussions or those whose altered mental status may be overlooked while other more obvious medical needs are being attended to, e.g., sports-

related injuries or falls. However, research suggests that about 7% of the population may experience impairments as a result of blows to the head, leading to a very different estimate of 19+ million. Similarly, the number of people with cognitive impairments secondary to medical interventions or to toxic exposure is not known.

For other conditions, such as stroke, where a more significant proportion of those who experience the condition are hospitalized, prevalence data are more reliable. For example, 5.4 million people are known to be living with the consequences of stroke, about 1.5 million with PD and about 400,000 with MS.