

Chapter 11

Assistive Technology for Cognition: An Updated Review

Catherine Best
University of Stirling, UK

Brian O'Neill
Brain Injury Rehabilitation Trust, UK

Alex Gillespie
London School of Economics, UK

ABSTRACT

Assistive Technology for Cognition (ATC) is the use of technology to extend human mental capacity. The present chapter reviews the use of assistive technology in health and social care for people with cognitive impairment. This review updates the authors' previous reviews (Best, O'Neill, & Gillespie, 2013; Gillespie, Best, & O'Neill, 2012) on this topic and reflects on how their conceptualization of ATC in terms of function (reminding, alerting, micro prompting, distracting, storing and displaying, navigating, and biofeedback), as opposed to the type of technology (mobile phone, desk-top computer, etc.), fits with recent developments in this field. The authors highlight the growing number of context-aware prompting devices and the move to train people with cognitive impairment to use everyday technology such as mobile phones. They also make a distinction between ATC, which augments or supplants cognitive functions, and outline avenues for future research.

INTRODUCTION

Assistive technologies extend human capability (Lawson, 2010). For example walking sticks and wheelchairs are assistive technologies that enhance mobility (McLuhan, 1964). 'Assistive technolo-

gies for cognition' (ATC) are a subset of these devices that relate to mental functions (Lopresti, Mihailidis, & Kirsch, 2004). Humans are "natural born cyborgs" (Clarke, 2003, p.1), inextricably bound to their material and symbolic technologies (Gillespie & Zittoun, 2010). Cognitive supports

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are ubiquitous, being used to aid memory (e.g., notebooks, diaries, and ledgers), calculation (e.g., abacus, pen and paper, and electronic calculators), prospective memory (e.g., diaries, alarm clocks and notices), and sequencing complex tasks (e.g., recipes and manuals). Historically, it is high functioning individuals who have used ATC to extend their ability. The present chapter reviews high-tech ATC which aim to augment impaired cognition.

Ever since personal computers became mainstream technology more than thirty years ago, researchers and clinicians have seen the potential for technology to extend the capabilities of people with cognitive impairments. Computer functions, such as 'memory,' are the very ones that are lost when people have a brain injury. Therefore it was a short step to try and employ these technologies to replace or augment impaired cognitive functions.

In cognitive rehabilitation, technology has been employed in two distinct ways. The first way is as *remediation*. Remediation aims to restore lost or damaged cognitive functions. This can be achieved by using technology to deliver training exercises and other therapies. An example of technology as remediation is the 'BrightBrainer' which is game software designed to be used on a laptop. The games are intended to improve attention, memory and executive function and the device has been used by nursing home residents with dementia (Burdea et al., 2014). Another example is the Ubiquitous Spaced Retrieval-based Memory Advancement and Rehabilitation Training (USMART) program which is memory rehabilitation presented on a lap top for people with Mild Cognitive Impairment (Han et al., 2014).

The other important way that technology is used in cognitive rehabilitation is as *compensation*. That is, rather than altering the individual, compensatory strategies change the environment to facilitate task performance. For example someone with a prospective memory impairment listening to time-activated voice messages to remind them to perform activities of daily living is a method of compensation. This review focuses on technology

used as compensation that is, as a prosthetic or orthotic support to a lost or damaged cognitive function.

BACKGROUND

The earliest review of cognitive prosthetics was by Cole (1999). Cole's review, built on the work of Kirsch and colleagues (Kirsch, Levine, Fallon-Krueger, & Jaros, 1987) to refine the conception of assistive technology as a method of environmental compensation for cognitive impairment. Cole's view was that cognitive prosthetic software should be purpose built, designed to assist in the functional performance of tasks and tailored to the needs of the individual. In the review Cole refers to the work of seven research groups highlighting how relatively small the field of research was at that point. The next major review of assistive technology for cognition was by LoPresti and colleagues in 2004. This review gave an overview of assistive technology for cognition and highlighted how much more diverse it had become. However many of the interventions reviewed by LoPresti and colleagues were at the design stage and had not been substantively tested with people with cognitive impairment. LoPresti's definition of ATC included devices designed for mainstream use (i.e. not solely designed for the purpose of cognitive rehabilitation in contrast to Cole). LoPresti and colleagues' review excluded devices designed to support language and communication (Augmentative and Alternative Communication) and devices designed to support education i.e. to support the acquisition of reading and writing skills, as both these areas had such a proliferation of devices that they were judged to be separate field of research in their own right and have before and since been the subject of comprehensive reviews e.g. (Beukelman, Fager, Ball, & Dietz, 2007). More recent reviews of assistive technology for cognition have narrowed their scope still further, for example by focusing on efficacy (e.g. de Joode, van Heugten, Verhey,

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