

Chapter 3

AI–Powered Breakthroughs: Revolutionizing Cognitive Psychology and Neuropsychology With Machine Learning

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ABSTRACT

This chapter examines how artificial intelligence (AI) is improving neuropsychological practice and how AI tools can be used to diagnose treat and rehabilitate cognitive disorders. Through a critical analysis of recent research and developing patterns the chapter emphasizes AIs potential for neuropsychology real-time interventions personalized care and early detection. It explores how artificial intelligence (AI) has advanced to create tools like virtual assistants chatbots and machine learning algorithms that have greatly enhanced neuropsychological testing and treatment. AI in neurorehabilitation shows encouraging results improving the precision and effectiveness of treatment regimens particularly for patients with brain injuries or cognitive decline. The chapter also examines the effects of AI on neuropsychological training and education with a focus on preparing the next generation of neuropsychologists for practice settings enhanced by AI.

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INTRODUCTION

Artificial Intelligence (AI) and Machine Learning (ML) as two revolutionary technological revolutions happen to shape neuropsychology and cognitive psychology as broader scientific disciplines. These fields, which focus on human thinking and actions, and even on human brain cognition, have historically used experiments and statistical reasoning to discover general principles of the human mind. AI and ML technologies which can analyse complex data and find out some features beyond human possibilities promote the change in the methods of study in these disciplines by researchers and clinicians. AI and ML are revolutionising the field of psychological and neuropsychological analysis and research by automating complex calculations, estimating the impact with accuracy, and finding models in immense amounts of data (Sharma & Sharma, 2024). In cognitive psychology that deals with things like memory, attention, language and decision making, artificial intelligence has brought about remarkable advancements in how human brain can best be understood. For instance, with the help of ML algorithms, fMRI data can be explored to identify connectivity profiles of the corresponding cognitive function. With the same amity, in neuropsychological which is the combination of the neural and psychological to study the functions of the brain and how it influences and determines behaviours AI has been helpful in increasing precision in diagnostic procedures and in carrying out therapy. For example, deep learning has been used to teach models how to look for markers of early neurodegenerative disease like Alzheimer's from changes in imaging or behaviour data that might be masked. These developments show that AI has not only supported calculation-intensive part of these disciplines but also reinvented their methodologies and applications (Zhao, Wu, & Li, 2023).

The incorporation of these technologies into these fields laid the foundation and has brought about both opportunities and marked difficulties. On the one hand, it means that AI systems can perform data acquisition and analyses with the data sourced from various modalities, including, but not limited to, brain imaging, behavioural experiments, wearables, etc. This capability allows the researchers to develop various sophisticated models of human cognition and behaviour than were possible before. For example, scientists may test theories about how the brain functions with the use of AI-powered neural network simulations, which provide a degree of experimental control that is not feasible in vivo. Clinically, ML algorithms help create customized treatment plans by evaluating patient data in real time, which enhances results and lessens the need for trial-and-error therapy. AI can also keep up with the constantly changing landscape of psychological research and treatment procedures because to its capacity for adaptation and learning from fresh data (Sharma & Sharma, 2024). These developments do have certain drawbacks, though. The possibility of bias in AI models is a serious worry. Because machine learning algorithms learn from

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