

# Simulating Executive Function Deficits in ADHD Using Artificial Neural Networks

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Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by difficulty paying attention, impulsivity, and hyperactivity. Diagnosis of ADHD rose 42% from 2003–2004 to 2011–2012. In 2011, 3.5 million children were treated with drugs. Optimizing therapy can take a year, and may not be completely effective.

A clinical trial is currently being conducted of a device/drug combination using the computer game Minecraft, to determine how certain activities affect executive function, working memory, and restraint in patients diagnosed with ADHD. The human subjects' responses are being modeled using artificial neural networks (ANNs), an artificial intelligence method that can be utilized to interpret highly complex data. To use ANNs, data examples are first presented to the ANN during training in which the ANN learns how to properly classify them. The trained ANN can then be used to classify similar data presented later. We propose using ANNs to optimize drug and Minecraft therapy for individual patients based on the initial NICHQ Vanderbilt assessment scores. We are applying ANNs in the development of computational models for executive function deficiencies in ADHD. These models will then be used to develop a therapeutic video game as a drug/device combination with stimulants for the treatment of ADHD symptoms in Fragile X Syndrome.

As a preliminary step, a convolutional neural network was utilized to simulate working memory deficits in the identification of handwritten digits. A control network was trained with the standard procedure and achieved 100% correct classification of newly presented test images of handwritten digits, whereas an ADHD network paid poor attention in training and thus had a truncated set and achieved only 50% correct classification on test images. Furthermore, because both networks had an identical software structure, this deficit might be interpreted as the result of an environmental, rather than a genetic influence.