Chapter 2
Electroencephalogram (EEG) for Delineating Objective Measure of Autism Spectrum Disorder

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ABSTRACT

Autism spectrum disorder (ASD) is a developmental disorder that often impairs a child's normal development of the brain. According to CDC, it is estimated that 1 in 6 children in the US suffer from development disorders, and 1 in 68 children in the US suffer from ASD. This condition has a negative impact on a person's ability to hear, socialize, and communicate. Subjective measures often take more time, resources, and have false positives or false negatives. There is a need for efficient objective measures that can help in diagnosing this disease early as possible with less effort. EEG measures the electric signals of the brain via electrodes placed on various places on the scalp. These signals can be used to study complex neuropsychiatric issues. Studies have shown that EEG has the potential to be used as a biomarker for various neurological conditions including ASD. This chapter will outline the usage of EEG measurement for the classification of ASD using machine learning algorithms.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is characterized by significant impairments in social and communicative functioning as well as the presence of repetitive behaviors and/or restricted interests. According to CDC estimates, the prevalence of ASD (14.6 per 1,000 children) has nearly doubled over the last decade and has a costly impact on the lives of families affected by the disorder. It is estimated that 1 in 6 children in the US suffer from developmental disorders. And 1 in 68 children fall under Autism Spectrum Disorder. ASD is a neurological and developmental disorder that has negative impact in a person's learning, social interaction and communication. It is a debilitating condition that affects brain development from early childhood creating a lifelong challenge in normal functioning. Autism is measured in spectrum because of the wide range of symptoms and severity. The total lifetime cost of care for an individual with ASD can be as high as $2.4 million (Buescher et al. 2014). In the U.S., the long-term societal costs are projected to reach $461 billion by 2025 (Leigh and Du 2015).

One of the main contributing factors for ASD is known to be genetics. And so far, no suitable cure has been found. However, early intervention has been shown to reverse or correct most of its symptoms (Dawson 2008). And this can only be possible by early diagnosis. Therefore, early diagnosis is crucial for successful treatment of ASD. Although progress has been made to accurately diagnose ASD, it is far from ideal. It often requires various tests such as behavioral assessments, observations from caretakers over a period to correctly determine the existence of Autism. Even with this tedious testing often individuals are misdiagnosed. However, there remains promise in the development of accurate detection using various modalities of Biomedical Images, EEG, and Eye movements.

Efforts to identify feasible, low-cost, and etiologically meaningful biobehavioral markers of ASD are thus critical for mitigating these costs through improvement in the objective detection of ASD. However, the phenotypic and genotypic heterogeneity of ASD presents a unique challenge for identifying precursors aligned with currently recognized social processing dimensions of ASD. One approach to unraveling the heterogeneity of ASD is to develop neurocognitive measures with shared coherence that map onto valid diagnostic tasks, like the Autism Diagnostic Observation Schedule Second Edition (ADOS-2) (Gotham et al. 2007), that are the gold standard