Title: A Clinical and Behavioral Protocol for Obtaining Electrophysiological Data with Children with Low Language and Cognitive Ability

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Introduction: Neuroscience research conducted with individuals with autism spectrum disorder (ASD) has historically been limited to those with age-appropriate cognitive abilities and considered “high functioning” cohorts. Children who are nonverbal or have intellectual disability have frequently been excluded from research given numerous barriers such as tolerating the loud sounds associated with magnetic resonance imaging and remaining still during an imaging exam (South, Herrington, & Paterson, 2013). Including individuals with lower intellectual and language abilities in neuroimaging research is needed to obtain a more complete understanding of ASD (and other associated disorders). As such, there is a need for approaches to: 1) improve data quality across age and performance range; and 2) identify non-pharmacological, non-sedative, and awake recording strategies. Identifying new approaches for individuals previously excluded from neuroimaging research is a critical step in understanding the genetic expression of ASD as well as language development (Tager-Flusberg et al., 2017). The goal of this study was to develop and implement a clinical and behavioral protocol for obtaining electrophysiological data using magnetoencephalography (MEG) with minimally verbal or nonverbal children with ASD (8-12 years).

Method: Participants were 21 children with ASD (mean age=9.8 years, SD=1.4; Nonverbal IQ mean=55.6, SD=13.9) meeting the study definition of minimally verbal or nonverbal (i.e., expressive vocabulary of fewer than 30 words/phrases used spontaneously, flexibly, and communicatively). With the support of the newly developed MEG Protocol for Low-Language/Cognitive Ability Neuroimaging (MEG-PLAN), all participants completed MEG protocols using a 275-channel CTF MEG system. Paradigms were short (five to fifteen minutes) and were passive and thus did not require task performance. Data are presented from a pure tone paradigm. 150 trials each of interleaved 500Hz and 1000Hz tones were presented at a pseudo-randomized interstimulus interval (ISI) in the range of 1500 to 2000 ms (approximately 5 minute acquisition).

Result: Based on stakeholder feedback, MEG-PLAN was developed as an interdisciplinary protocol to integrate clinical/behavioral (presented here) and technical components that can be implemented by a team of clinicians, scientists, and MEG technicians. Clinical and behavioral components focus on using parents as partners and strategies based on the principles of applied behavior analysis, including systematic desensitization and habituation, differential reinforcement, visual supports, and individual tailoring. MEG-PLAN is implemented in three parts via (1) initial assessment, (2) plan and preparation for the family and team, and (3) in vivo support at the MEG Visit. Using MEG-PLAN a 75% success rate for obtaining evaluable MEG data was achieved. Moreover, results were reproducible; based on data from eight participants who were scanned twice, M50 latency values were found to be reliable (interclass correlation coefficient = 89%).

Discussion: Results indicate that children with ASD who are minimally verbal or nonverbal, and often have co-occurring intellectual ability in the range of intellectual disability, can be effectively and comfortably supported to complete neuroimaging paradigms that yield valid and reproducible results. MEG-PLAN is a protocol that can be disseminated and implemented across research teams, and likely adapted across technologies to collect neuroimaging data in a previously understudied group of individuals.

References/Citations: