Infant Motor Screening via Parent-Led Video: Using a Machine Learning Regression-derived AIMS Salient Set

Conference:
AOTA INSPIRE 2022

Type Of Proposal:
Research

Session Format:
Poster

Primary Speaker:
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Early Markers

Additional Speaker:
Teresa Fair-Field
Baylor University

Abstract Synopsis:
In development of a population-level smartphone app that analyzes the motor skills of first-year infants, an NICHD-funded pilot indicates the need for an abridged assessment of motor items from currently available tools. The poster describes the development of a regressor and the first view of subjects assessed using the full 58-item AIMS versus the regressor's salient set. Use as a screening tool during parent-led floor play could significantly impact early identification and the EI pipeline.

Learning Objectives:
Identify the clinical utility and research need for an abbreviated (salient) set of motor items to expedite population screening for infant motor delays.

Recognize the role of the machine learning regressor when determining the salient set of motor items, and its use in a population screening approach.

Abstract:
The Alberta Infant Motor Scale (AIMS; Piper & Darrah, 1994) is used across clinical and research settings due to its short administration time, extensive cross-cultural validity, and its use of objects already found in the child's home. Our team
AIMS has examined AIMS for its development of a secondary screening tool during an infant's first year using EMMA: Early Markers Movement Analyzer (in progress). EMMA aims to gather video data from multiple brief parent-led motor play sessions which are uploaded to a smartphone app at the parent's convenience. The videos are then parsed for scorable motor movements and presented to an early interventionist (i.e. occupational therapist) for validation. Such a tool breaks free from constraints currently found in clinic and telehealth screening, including the need for synchronous sessions which are limited by a provider's availability and not necessarily conducive to the infant's best motor performance. These constraints contribute to long wait times in the early intervention (EI) pipeline. Delivered asynchronously, EMMA engages the parent in motor play at home and leverages advances in telehealth, mobile technology, and computer vision allowing automation to make home-based motor screening feasible and efficient.

Typical infants (n=61) in their first year were videotaped in facilitated floor play and manually coded for AIMS motor items (producing over 11,000 coded items) which were used to establish the 'ground truth' on which the machine learning models are trained. While examining the subjects on video, even our subject matter experts had difficulty in distinguishing between several closely resembling motor items within a subscale, making it unreasonable to expect a machine learning system to discern them. Our team identified and combined those 'tricky' pairs and re-examined the data to determine whether the identified items do, in fact, need to be distinguished from each other for the purposes of screening for motor delay. Does a salient set of AIMS motor items (combined for those not easily distinguished), acceptably predict motor delay in infants over the course of their first year? If so, what items would comprise that salient set?

Two different methods were used to determine salient sets in each subscale of the AIMS motor items (Prone, Supine, Sitting, Standing) using a Support Vector Machine Regressor (SVR). The first model used recursive feature elimination (RFE) and the second used an exhaustive search. Results indicate that salient sets determined by exhaustive search performed better than the RFE method in constructing SVRs that automatically predict AIMS scores. Using 'leave one out' prediction (SVRs trained on n-1 samples and tested on the remaining), if we use the 10th percentile score as the cutoff for clinical referral, and predicting AIMS scores using only 15 salient items (Prone:4, Supine:4, Sitting:5, Standing:2), we can achieve high sensitivity (95.2) and specificity (97.5) for the screening tool.

This initial presentation of salient sets of observed motor items produces results that indicate that salient sets may acceptably predict motor delay in infants within their first year. This paves the way for additional research and analysis using salient sets and automated extraction of said salient set from observational videos. The impact of this finding could allow early interventionists to complete efficient screening using videos collected from the child's natural environment, as well as other applications such as efficient community-based screening or family resource center kiosks, capturing an underserved population that may not be completing well-child visits or readily accessing early intervention services.

Research Area:

Assessment/Measurement

Research Type:

Quantitative

Practice Setting (broad area of concentration):
Schools, Early Intervention, and Community Education Settings

Focus Area (focused area of concentration):
Research

**Level of Material**

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**Advanced level** is geared to practitioners with a comprehensive understanding of the subject matter based on current theories and standards of practice as well as current literature and research. Focus is on recent advances and trends, and/or research applications. A high-level of participation by attendees is encouraged during this session.

Level Rational

While a broad audience will perform infant motor assessment, an advanced level practitioner or researcher is most likely to be interested in and comprehend high-level assessment design, inclusion and exclusion of test items, and machine learning regression modelling.

**References**

Reference 1:

Reference 2:

Reference 3:

Reference 4: