Comparing Automated Facial Coding to The Pain and Discomfort Scale

A Pilot Study in a Clinical Sample with Rett Syndrome

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Introduction

Rett syndrome (RTT) is a neurodevelopmental disorder primarily caused by mutations in the MECP2 gene resulting in severe language and motor impairments, as well as a range of potentially painful health conditions (e.g. seizures, musculoskeletal problems).[1]

Assessment of pain in this population is challenging due to a lack of spoken language in most affected individuals, and parents frequently report uncertainty regarding their children's pain experiences.[2,3] For these reasons, there is a need to develop valid methods to detect pain.

Previous studies of pain expression in RTT have relied on human-scored observational coding systems.[2] Many observational systems including coding facial expression, but are time and resource-intensive.

Several software packages are currently available that allow for the automated analysis of facial expressions. It is currently unclear, however, whether these software packages perform adequately with individuals with developmental disabilities such as RTT, when excessive movement may affect the analysis.

The purpose of the current study was to determine the degree to which results from an automated facial coding system would correspond to those obtained via human observers

Methods

Participants and Setting

- 5 females with RTT (mean age = 14, range = 6 - 35)
- Close up face videos recorded during the Physical Examination Procedure (PEP) during clinic visit.

Analysis

- A trained observer coded each participant's video using a set of standardized facial codes based on the Pain and Discomfort Scale (PADS; Bodfish et al., 2006), then processed them using iMotions© (2016) software with the Emotient automated facial action coding system (FACS) analysis package.
- Specific facial action units (FAU) corresponding to the PADS behavioral codes were identified for analysis.
- An automated FAU score was calculated by summing the number of frames in which the software indicated the presence of a relevant FAU (standardized by the total number of usable frames).
- 'Positive', 'Negative', and 'Neutral' valence scores generated by the software were also examined.
- Spearman correlations were used to examine relationships between the automated variables and PADS total scores.

IMOTIONS

BIOMETRIC RESEARCH PLATFORM

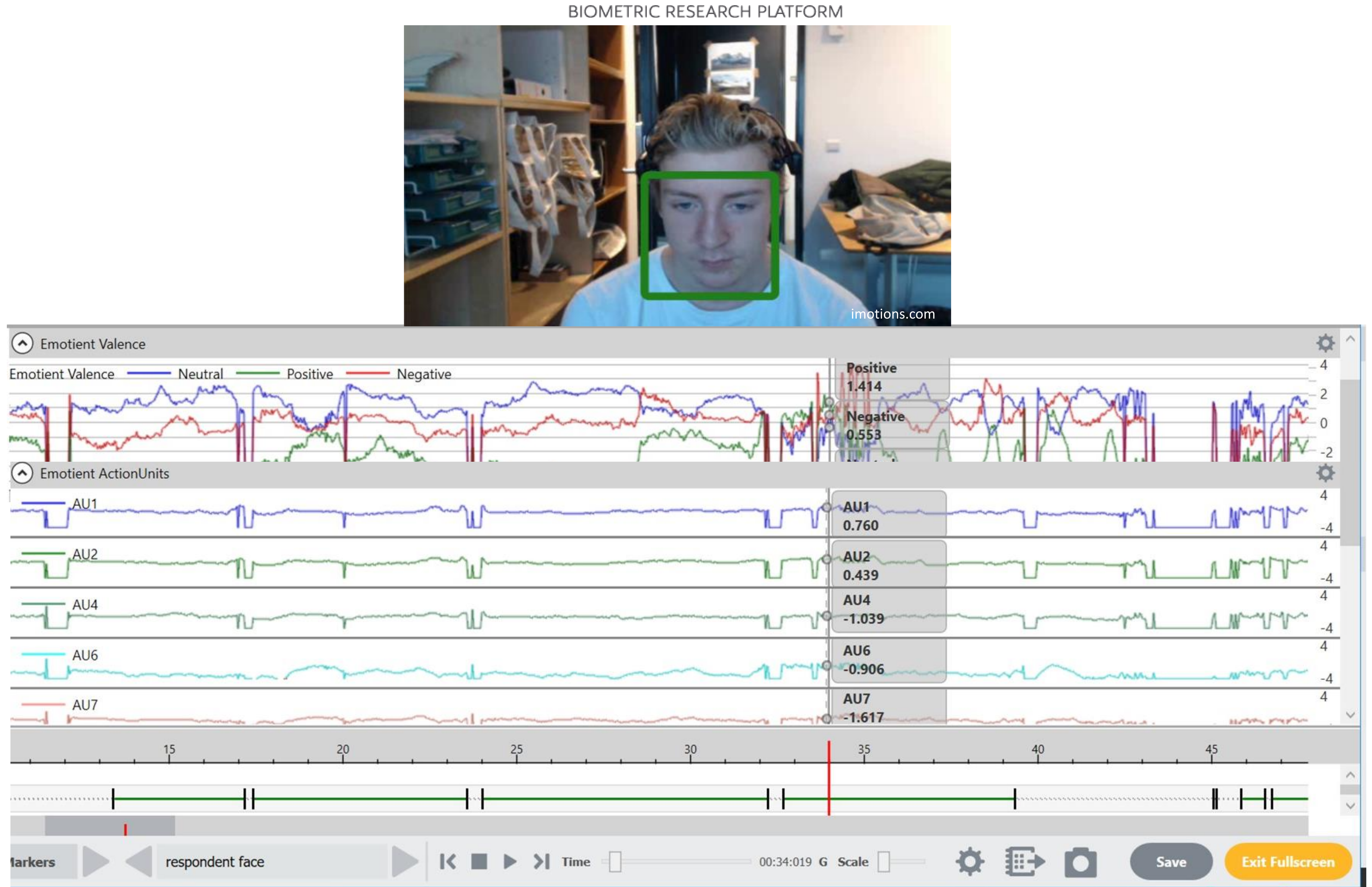

Figure 1. iMotions software analysis display from one participant across the recorded protocol. *Top*: Example of the face detection display from iMotions tutorial. *Bottom:* Display of the positive, negative, and neutral valences and individual FAUs scored by Emotient software for a study participant. Green segments below indicate segments of useable data (when a face was detected).

Automated System vs. Human Coders

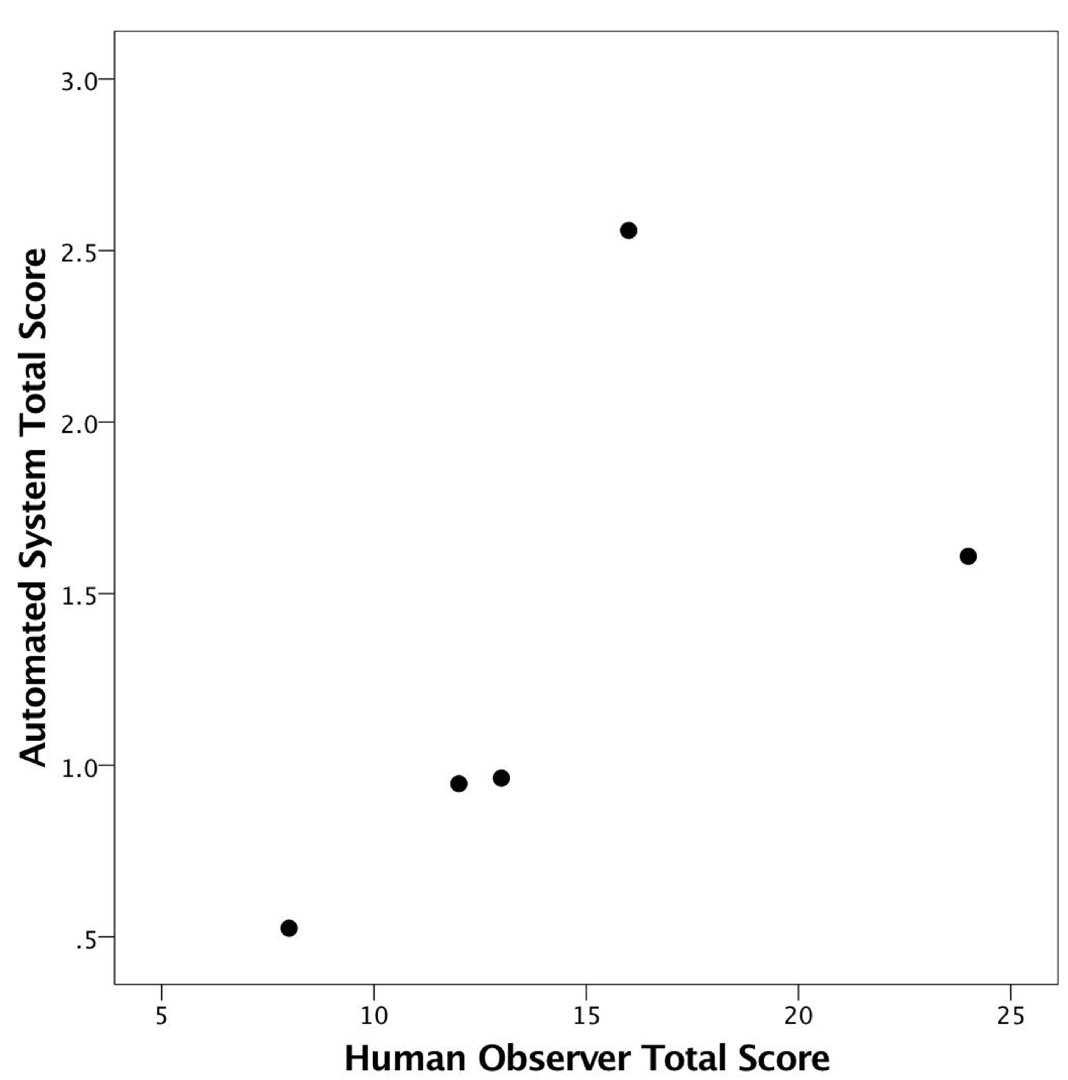

Figure 2. Automated AU score compared to human coder score (r = .90, p = 0.037).

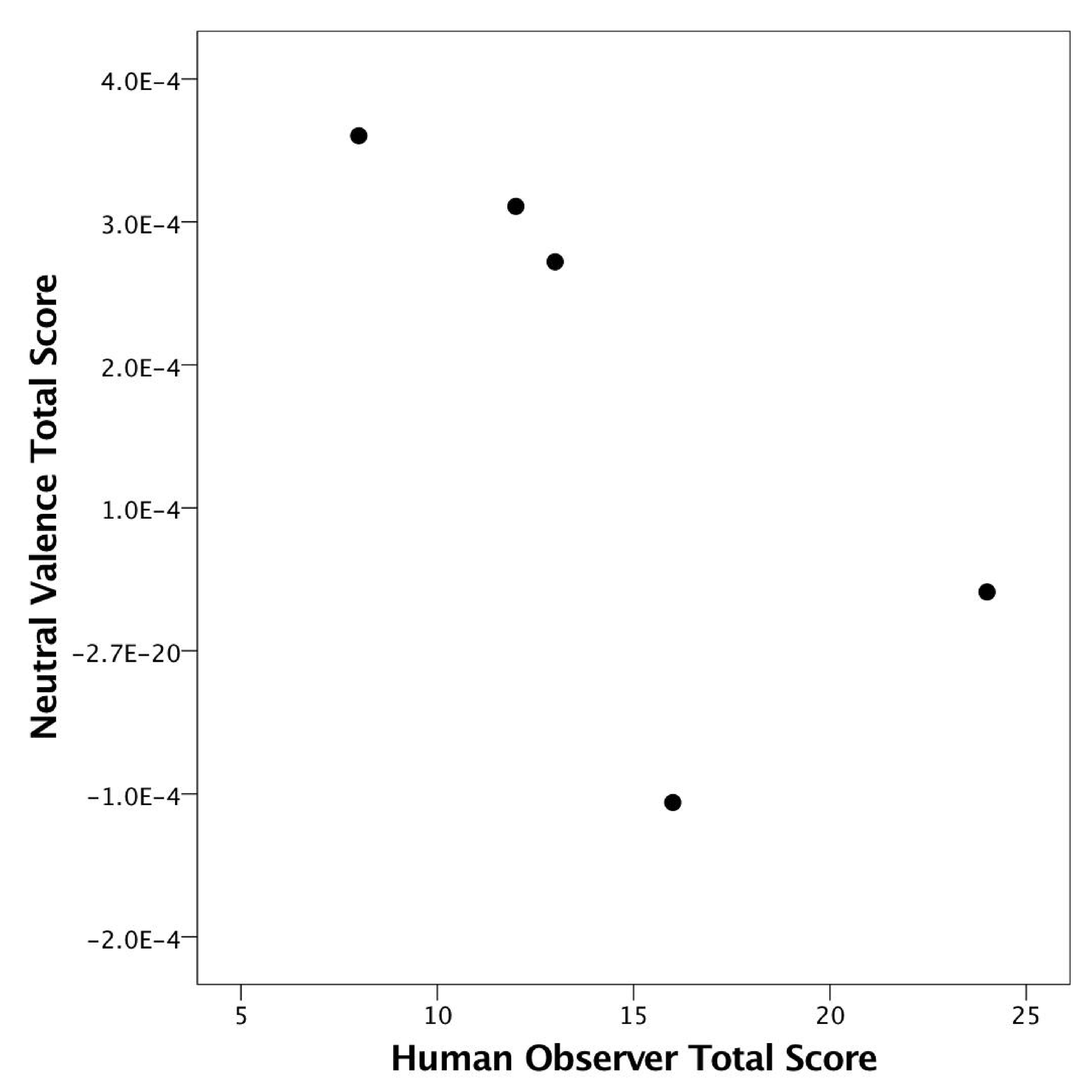

Figure 3. Neutral valence score compared to human coder score (r = .90, p = 0.037).

Results

- The automated analysis identified a face in an average of 59.4% of the video frames (range = 36 - 79%).
- The automated system detected the face for at least 5 continuous seconds for each segment of the range of motion exam for every participant.
- The FAU scores were positively correlated with the total observational scores (r = 0.90, p = 0.037).
- There was a strong, negative relationship between the Neutral valence scores and the total PADS scores (r = 0.90, p = 0.037).
- The PADS facial score was not related to any other emotional valence scores.

Discussion

The automated facial coding system scores were related to those of a human coder. The results of this preliminary study support the validity of automated facial expression analysis for use with individuals with RTT.

RTT is not associated with major dysmorphic features. Other syndromes, however, may have severe dysmorphic features, and it is unknown how successful automated facial coding would be in those populations.

Limitations

While the two methods were highly correlated, the automated software had several limitations. The software could not detect a face (and thus could not score) when the participant's head was slightly turned or when participants' hands were slightly blocking the mouth. Human coders, however, were still able to fully code facial expressions. Thus, automated coding scored less of the protocol than human coders, and may be unable to score during crucial points of study protocols.

In addition, the software would score the examiner's face in the video frame instead of the participant at times, missing the participant's facial responses and causing those segments to be discarded.

Future Directions

Future research will increase the sample size and expand comparisons to other protocols.

References

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