**Supplementary materials**

In these Supplementary Materials, we provide a detailed description of the process used for building the subject-specific prognostic model and the cross-validation used for predicting the ALSFRS-R speech subscores. We provide tables and figures summarizing the validation study of articulatory precision and the prediction accuracy of the prognostic model.

Supplementary Table 1 summarizes the findings from the analytical and clinical validation of articulatory precision. Additionally, we included the longitudinal decline of the ALSFRS-R bulbar subscale, per reviewer’s request.

Supplementary Table 2 provides the growth curve parameters for the articulatory precision longitudinal model.

Supplementary Figures 1 a-e show the plots associated with the analyses of the analytical and clinical validation of articulatory precision. Supplementary Figure 1f shows the longitudinal plot of the ALSFRS-R bulbar subscale, per a reviewer’s request.

Supplementary Figures 2 a-f show the plots associated with the results from the evaluation of the prediction accuracy of the prognostic model.

**Prognostic model**

The prognostic model was built in the following manner:

1. For each participant, a model calibration period starting at day *S* was created. The first model calibration period was initiated at the first day of data collection for the given participant.
2. A linear regression was fit where the predictor was the number of days since the beginning of the window and the outcome was articulatory precision.
3. Using the coefficients from the linear regression, an articulatory precision value was predicted after a waiting period of *X* days after the last day in the model calibration period.
4. A new model calibration period starting at *S*+1 was created, and steps 1-3 were repeated.

Once the articulatory precision prediction values were obtained, these were used to estimate the predicted ALSFRS-R speech subscore using 10-fold cross-validation.

1. The participants were divided into 10 folds such that the data from each participant was contained within a single fold to avoid information leakage.
2. Using 9 training folds, a model was estimated to predict ALSFRS-R speech based on articulatory precision obtained from the participants’ observed data (not the output from the prognosis model).
3. This model was used to estimate the ALSFRS-R speech subscore on the prognosis predictions of the 10th (cross-validation) fold of participants.

**Results Tables and Figures**

*Supplementary Table 1. Results of the analytical and clinical validation*

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| --- | --- | --- | --- |
| Analysis | Result | 95% C.I. | p-value |
| Correlation with clinical ratings of articulatory precision | r = .90 |  |  |
| Test-retest reliability | ICC = .97 |  |  |
| Correlation with ALSFRS-R speech | r = .82 |  |  |
| Correlation between articulatory precision and ALSFRS-R speech subscore longitudinal slopes | r = .37 |  |  |
| Correlation between articulatory precision and ALSFRS-R bulbar subscore longitudinal slopes | r = .41 |  |  |
| Longitudinal change of articulatory precision (units per day) | Slope = -.004 | [-.0045, -.0026] | < .05 |
| Longitudinal change of bulbar subscore (units per day) | Slope = -.003 | [-.0047, -.0011] | < .05 |

Note: Longitudinal change refers to the fixed-effects slope parameter from the growth curve model. It indicates the expected change per day. Slope = -.004 indicates that on average articulatory precision declined .004 units per day in this sample.

*Supplementary Table 2. Growth curve model parameter estimates*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Estimate | Standard error | 95% C.I. | p-value |
| Fixed effects intercept | 6.29 | 0.21 | [5.88, 6.70] | < .05 |
| Fixed effects slope | -0.004 | 0.0004 | [-.0048, -.0032] | < .05 |
| Random effects intercept standard deviation | 2.23 |  |  |  |
| Random effects slope standard deviation | 0.004 |  |  |  |
| Residual standard deviation | 0.441 |  |  |  |

*Supplementary Figures 1 a-f. Plots for the analytical and clinical validation results. The plots in this figure show the results of the analytical validation of articulatory precision. a) Algorithmic measures and clinical measures of articulatory precision were highly correlated. b) Articulatory precision was highly reliable, as shown in the test-retest reliability plot. c) Articulatory precision correlated with the ALSFRS-R speech subscores. d). On average, articulatory precision declined longitudinally. e) Most participants had negative articulatory precision longitudinal slopes. f) Per a reviewer’s request, we included a plot showing the longitudinal decline of the ALSFRS-R Bulbar subscore.*

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*Supplementary figures 2 a-f. Results of the evaluation of the prognostic model. Lower MAE, lower MAE %, and higher correlations between predicted and observed values indicate better performance.*

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