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Exploring Long-Term Treatment-Related Changes in Individuals with Aphasia

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Introduction

Stroke patients with chronic aphasia are often told to expect their recovery will “plateau” within 6 to 12 months after stroke; however, recent studies (Holland et al., 2017; Hope et al., 2017; Johnson et al., 2019), have shown that individuals with chronic aphasia experience continued improvement in language function, even years beyond stroke onset.

Here, the effects of treatment on longitudinal change are examined. The current study evaluated N=38 participants at least one-year after they completed six weeks of speech and language therapy, with the goal of classifying long-term ‘improvers’ versus those who either remained stable or declined (‘non-improvers’).

Due to circumstances pertaining to the COVID-19 Pandemic, neuroimaging analyses are ongoing; this presentation reports results from exploratory data analyses.

Methods

- 39 Participants were recruited from a pool of individuals with chronic aphasia who had completed an aphasia treatment study at least one year prior to the current study. One was a control participant, and subsequently excluded from analyses (*due to COVID-19, testing of additional controls was suspended*)
- Treatment included six weeks of therapy (three phonologically-focused and three semantically-focused).
- Participant characteristics are presented in Tables 1-2. Group lesion overlay presented in Figure 1.

Table 1

	variable	average	standard deviation
Number Enrolled	n=39 (38 PWA)	--	
F:M Ratio	9F/29M	--	
Age at Follow-Up	60.95	11.54	
MPO at Follow-Up	82.95	63.72	
Follow Up Interval (Months)	16.26	6.9	
Baseline AQ	56.84	22.51	
Follow-up AQ	58.82	23.34	
AQ Change	1.98	5.37	

Figure 1

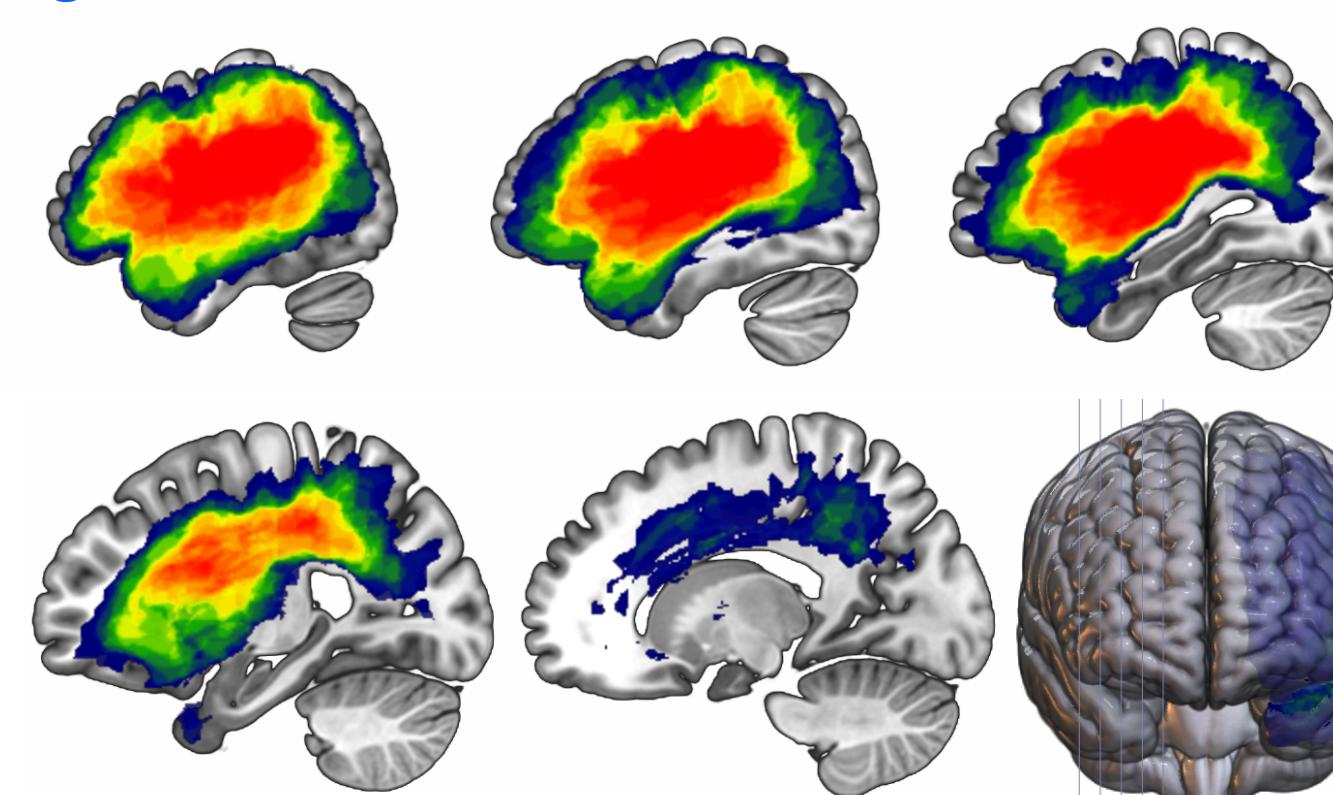


Table 1: Participant characteristics, whole study sample.

Table 2: Participant characteristics, grouped by change in aphasia severity. See also Results Panel 1.

Figure 1: Lesion overlay for all participants.

- All participants received the same baseline and neuroimaging battery as completed as part of the parent study (details in Basilakos et al., revisions submitted)
- Follow-up scores were evaluated for clinically meaningful changes in aphasia severity (WAB-AQ). A series of analyses were conducted to determine factors that may be associated with change in aphasia severity.
- These include: Demographic factors, severity of baseline leukoaraiosis and progression, speech-language-cognitive factors, and genetics.

1. Who changes, and to what extent?

- A clinically meaningful change in aphasia severity was defined as a $\geq |3|$ point change on the Western Aphasia Battery (WAB; Holland et al., 2017). Panels 2-5 report a series of analyses to investigate factors that predict significant changes.
- Overall change in severity was significant: $t(37)=2.3$, $p=.03$.

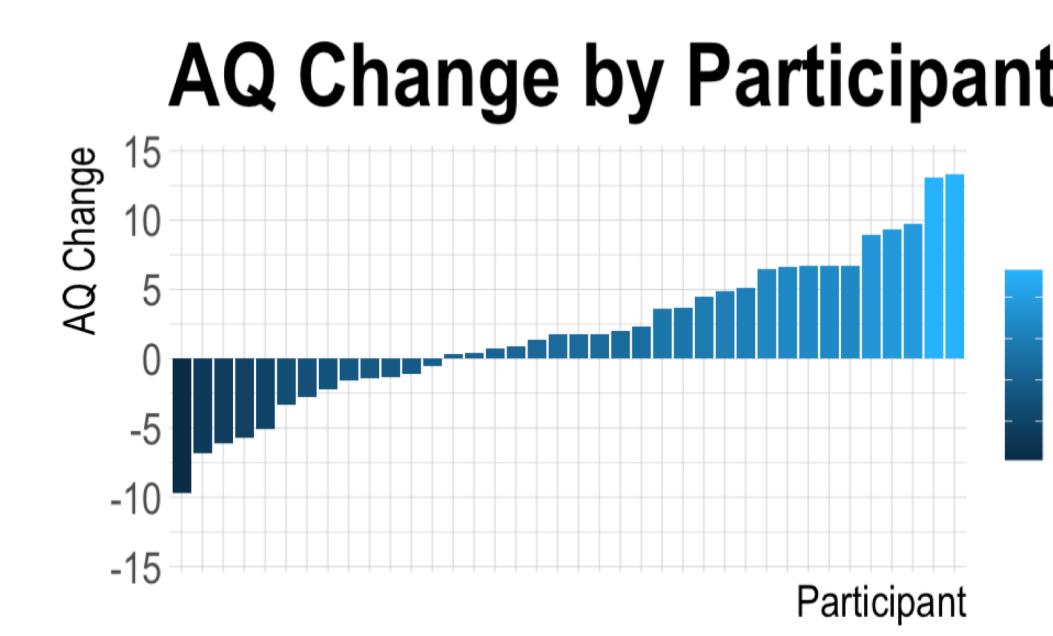


Fig. 2: Change by participant.

4. What is the role of brain health?

- Fazekas scores were obtained for all participants at baseline and follow-up (see Methods in Basilakos et al., 2019).
- There was a significant increase in Fazekas scores at follow-up: paired, one-sided t-test: $t(37) = 5.5$, $p=1.5e-06$
- Baseline, but not follow-up, Fazekas scores were negatively correlated with AQ Change: $r_s=-.32$, $p=.02$, indicating more severe leukoaraiosis at baseline is related to a decline in aphasia severity
- Figure 5 displays an example of moderate-severe leukoaraiosis (i.e., higher Fazekas scores). PVH=3, DWMH=2.

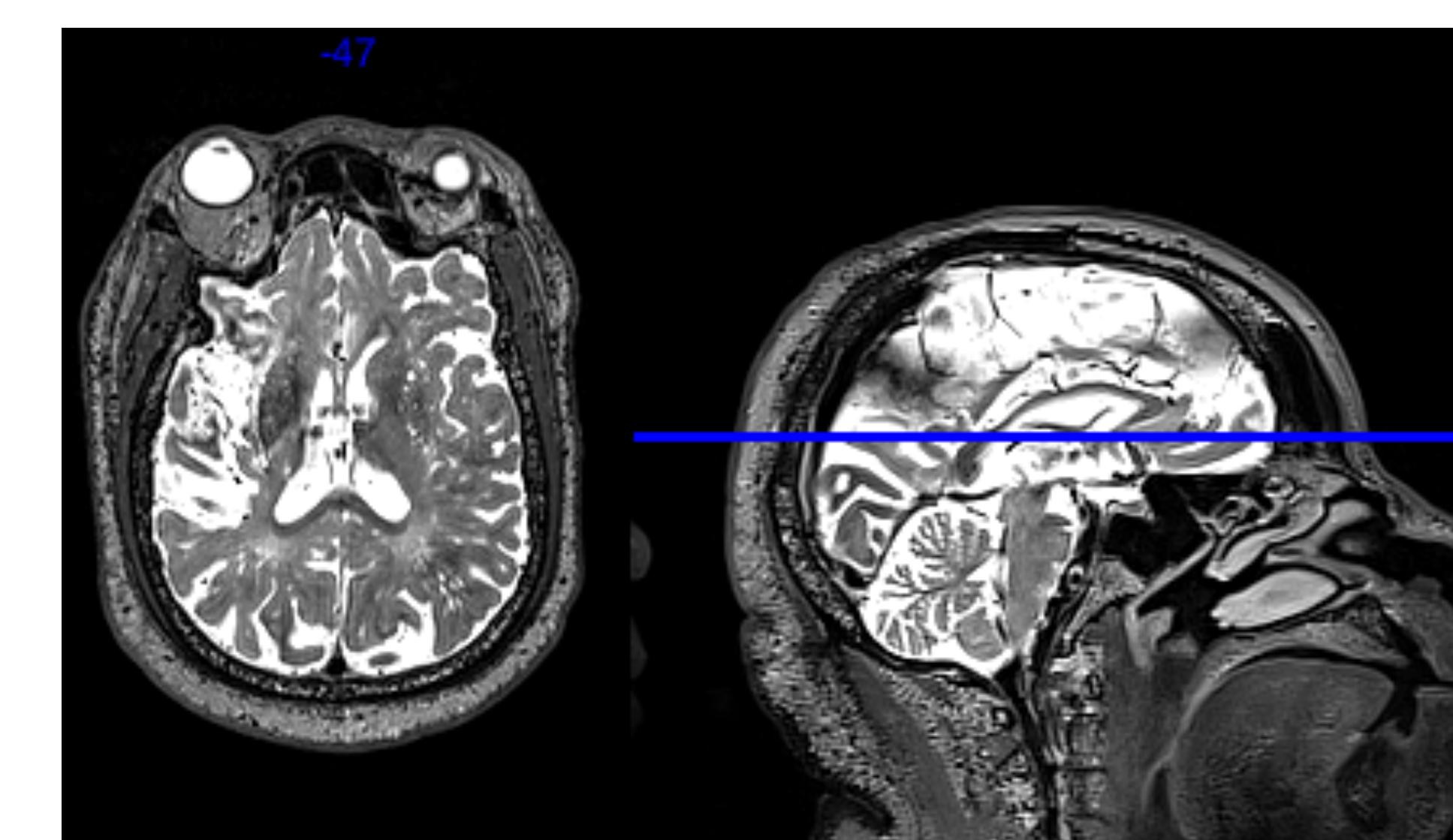


Fig. 5: T2-weighted MRI showing moderate-severe leukoaraiosis.

2. How important are baseline and demographic factors?

- Correlations between baseline factors and change in WAB-AQ were not significant, $p > .05$ for all
- TALSA rhyme judgment with non-words scores were correlated with AQ change, $r=.38$, $p=.02$.
- Figure 3 presents a scatterplot relating TALSA rhyme judgment scores to AQ Change. A correlation matrix with additional factors can be found in the companion data report (linked below).

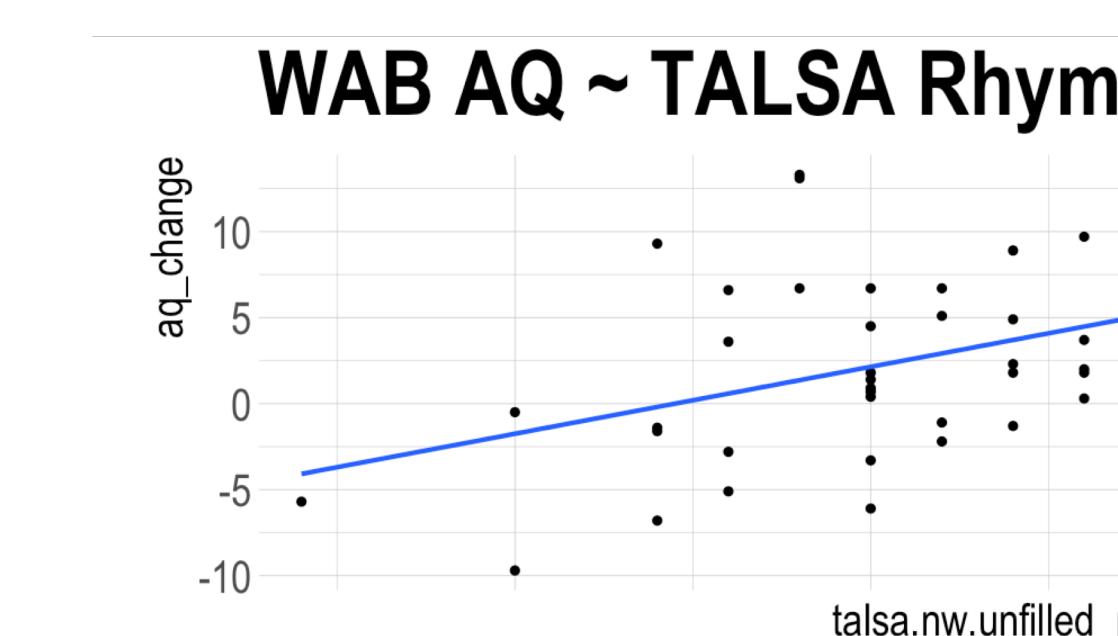


Fig. 3: Scatterplot of Talsa scores and AQ change.

Brain health, continued...

- Figure 6 presents correlations between WAB scores, Fazekas scores at baseline and follow-up, as well as other factors related to brain health and cognitive reserve (WAIS, Education).

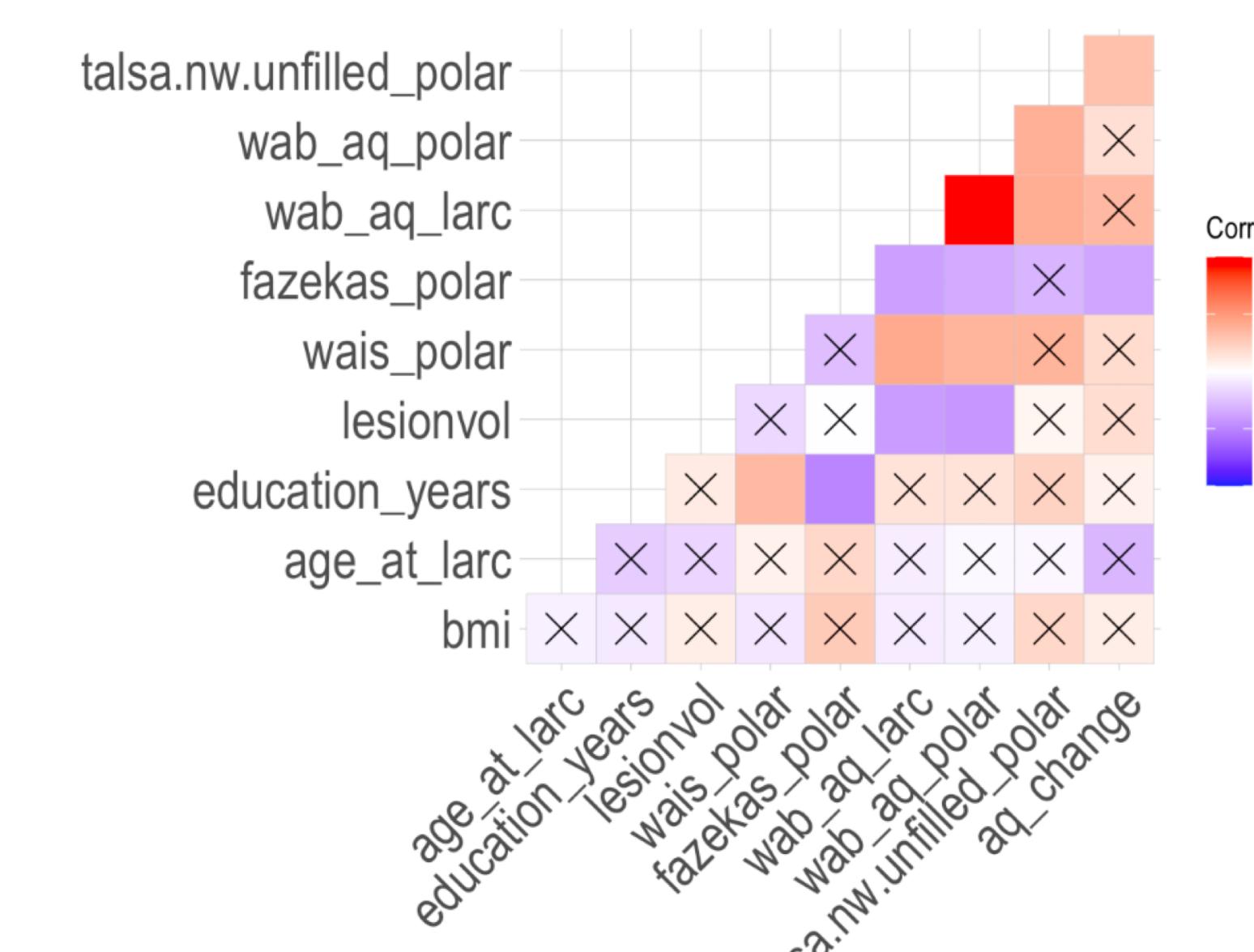


Fig. 6: Correlation matrix

- To explore which independent variables predicted worsening Fazekas scores, an LME model was utilized, including variables that have been associated with leukoaraiosis (e.g., age, BMI, education, and diabetes).
- Higher education was significantly correlated with less change; diabetes was associated with increased leukoaraiosis (see data supplement for details).

Results

3. What role do genetics play?

- The BDNF gene may be important in treated recovery. Here, we investigated Met allele carriers were more likely to decline.
- Given unbalanced groups (+/- Met allele), participants were matched with propensity scores. N=22 were matched on baseline Fazekas and Talsa scores.
- There was a significant difference in outcome by Met allele ($\chi^2 = .8.9$, $p=.006$); Figure 4 presents AQ change by group, and outcome by allele is presented in Table 3)

AQ Change by MET Allele



Fig. 4: AQ change by presence/absence of Met allele.

Table 3: Outcome by allele.

Outcome	Met	-Met
Decline	0	4
Improve	4	6
Stable	7	1

5. (Initial stages of) building a model

- Factors related to change were entered into a series of SVR analyses, as follows:
- Analysis 1: predict “improve” vs. “not improve”, where those who improved demonstrated ≥ 3 -point change on the WAB-AQ. Those labeled “non-improvers” included participants who demonstrated decline, or those who remained stable.
- Analysis 2: As above; however, those who declined were removed from the sample. “Improvers” were compared to “stable” participants.
- Dependent variables included the baseline Fazekas scores and the TALSA rhyme judgment.
- Contingency tables showing prediction accuracy for each of the models is presented below (Tables 4,5).
- Table 4: PPV = 76%; NPV = 69%
- Table 5: PPV = 85%; NPV = 68%

Table 4: Results including “decliners”

	Pred Stable/Dec	Pred Improve
Actual Stable/Dec	19	6
Actual Improve	4	9

Overall accuracy = 74% (poor within class Prediction for improvers)

Table 5: Results excluding “decliners”

	Pred Stable	Pred Improve
Actual Stable	11	2
Actual Improve	6	13

Overall accuracy = 75% (better within class prediction)

Discussion

- Aphasia severity is often the greatest predictor of therapeutic success and outcome in aphasia. Although aphasia severity was related to treatment performance (see data supplement), it was not related to change in aphasia severity in a long-term follow-up. These results suggest brain health and cognitive performance may be important predictors when it comes to understanding long-term change in chronic aphasia.
- However, these results also show that there is a lot of individual variability in change (e.g., Fig 2).
- Future directions will focus on analysis of neuroimaging data to relate Fazekas scores to objective measures of white matter integrity, as well as to predict which baseline neuroimaging factors may predict worsening leukoaraiosis over time. Future analysis will also implement model validation (e.g., out of sample prediction).

References linked in companion data report, which can be found here: https://github.com/abasilkennedy/analyses_for_SNLI2020

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