Between-Subjects Analysis: Individual Differences in Left Temporal Engagement

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Analysis: Subject-level correlations between left temporal activity patterns and behavioral outcomes
Sample: N = 24 subjects

Executive Summary

H1: Marginal Negative Correlation (r = -0.395, p = 0.0558)

Finding: Subjects who show **more negative left temporal activity on errors** (larger Acc0-Acc1 difference) tend to have **lower overall accuracy**.

Interpretation: Over-reliance on verbal/semantic processing strategies is associated with poorer performance. The most successful subjects show **minimal left temporal engagement differences** between errors and correct trials.

Key Insight

Individual differences in left temporal engagement patterns exist but do not strongly predict overall performance. This suggests:

- **Multiple viable strategies:** Both high and low verbal engagement can lead to success
- **Context matters:** Trial-level dynamics (within-subject) may be more predictive than individual trait-level preferences
- **Compensatory mechanisms:** Subjects may adapt strategies across trials to optimize performance

Correlation Results (Bonferroni-corrected)

Hypothesis Test	r	p	p_{Bonf}	95% CI	N
H1: diff vs accuracy (neg)	-0.395	0.0558	0.2231	[-0.689, 0.009]	24
H2: diff vs error large-small (neg)	-0.005	0.9815	1.0000	[-0.408, 0.399]	24
H3: diff vs RTcorrect (neg)	0.275	0.1928	0.7713	[-0.144, 0.611]	24
H4: Acc0 amp vs RT SD (neg)	-0.019	0.9303	1.0000	[-0.419, 0.387]	24

Effect size interpretation: $|r| < .30$ = small, .30–.50 = medium, > .50 = large

Bonferroni threshold: $\alpha = 0.05 / 4$ tests $= 0.0125$

Group Comparison: High vs Low Verbal Engagement

Split subjects into "High verbal" (most negative 8) vs "Low verbal" (least negative 8) based on left_temp_diff.

Measure	High Verbal (n=8)	Low Verbal (n=8)	t	p
Accuracy Rate	84.84%	77.20%	1.83	0.0894
Mean RT Correct (ms)	108.6	114.1	-1.10	0.2977
Error Rate Diff	19.91%	18.06%	0.44	0.6679

Note: Differences are marginal/non-significant, suggesting individual strategy preferences don't strongly predict overall performance in this sample.

Visual Evidence

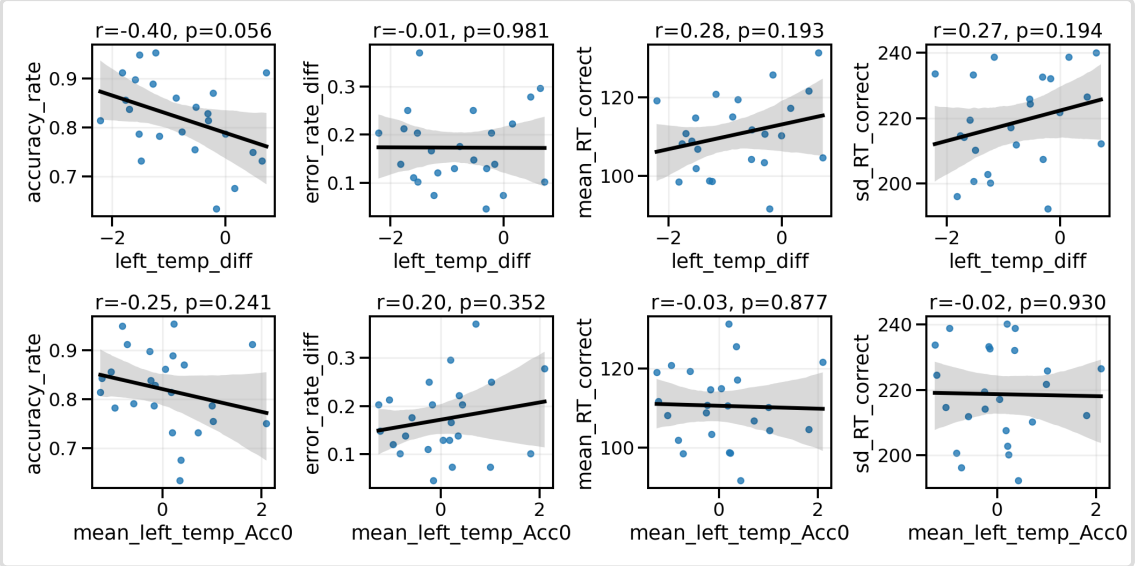

Figure 1: Correlation Matrix

2×4 panel showing all four hypothesis tests with scatter plots, regression lines, and correlation statistics.

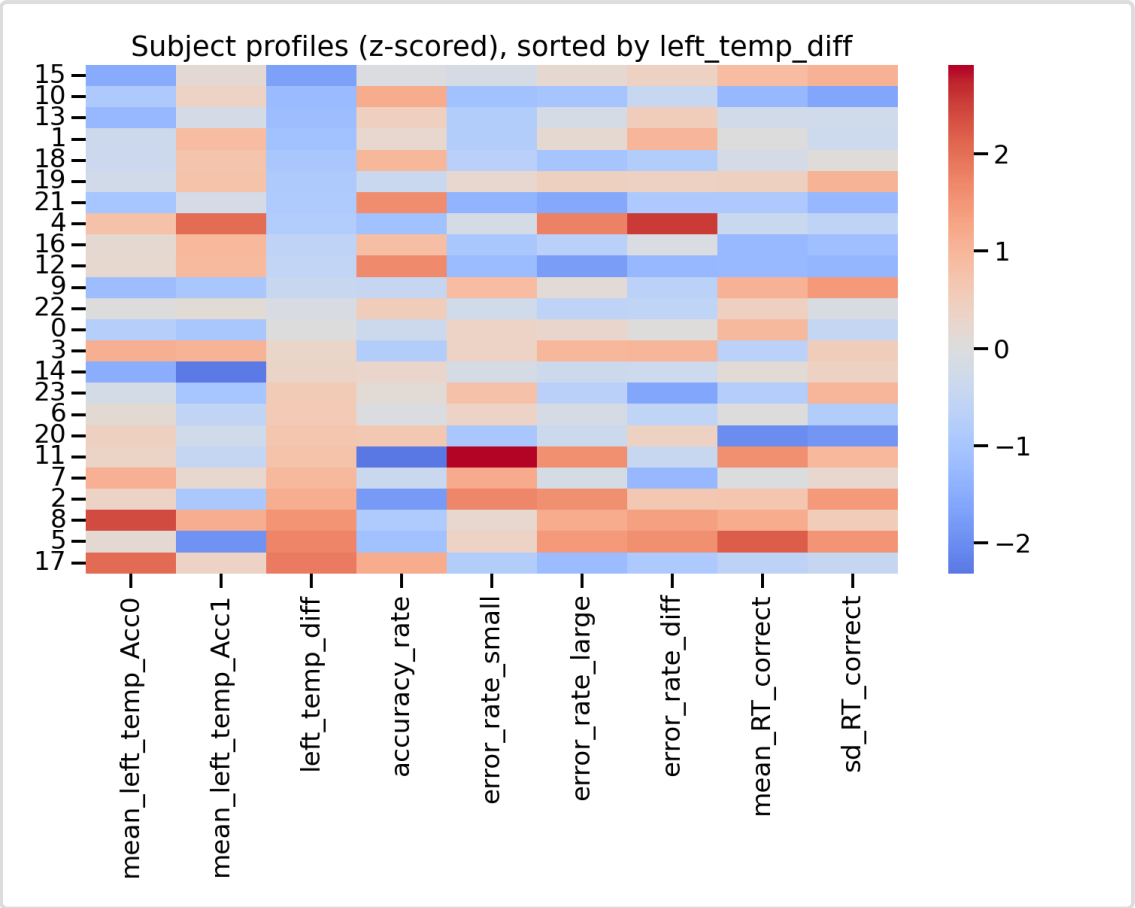

Figure 2: Subject Profiles (Z-scored)

Heatmap showing standardized scores for all subjects across key measures. Reveals heterogeneity in individual patterns.

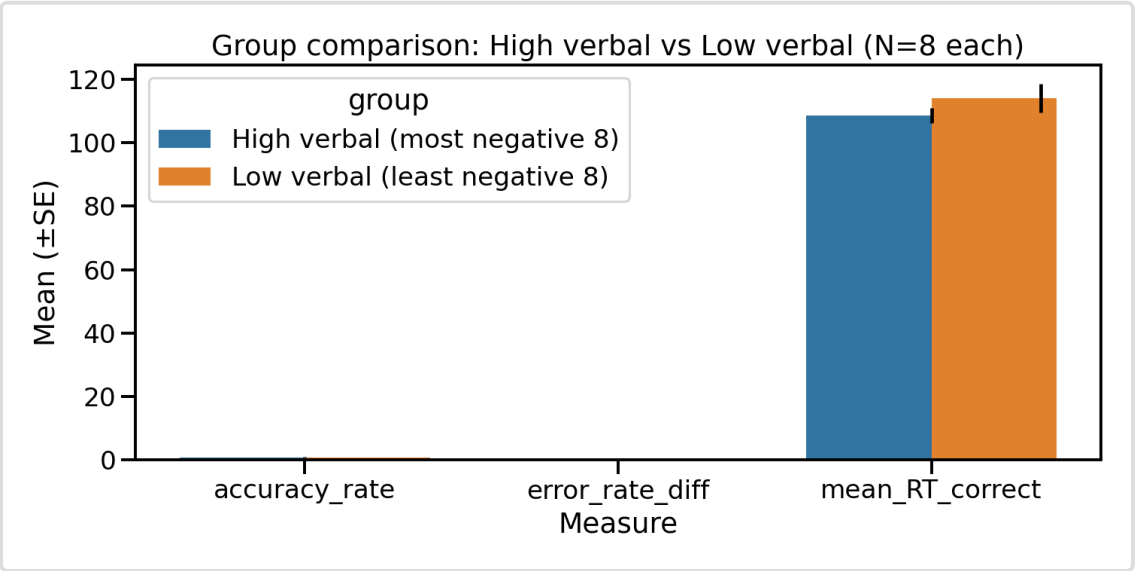

Figure 3: High vs Low Verbal Engagement

Bar plots comparing the top 8 vs bottom 8 subjects on left_temp_diff across accuracy, RT, and error patterns.

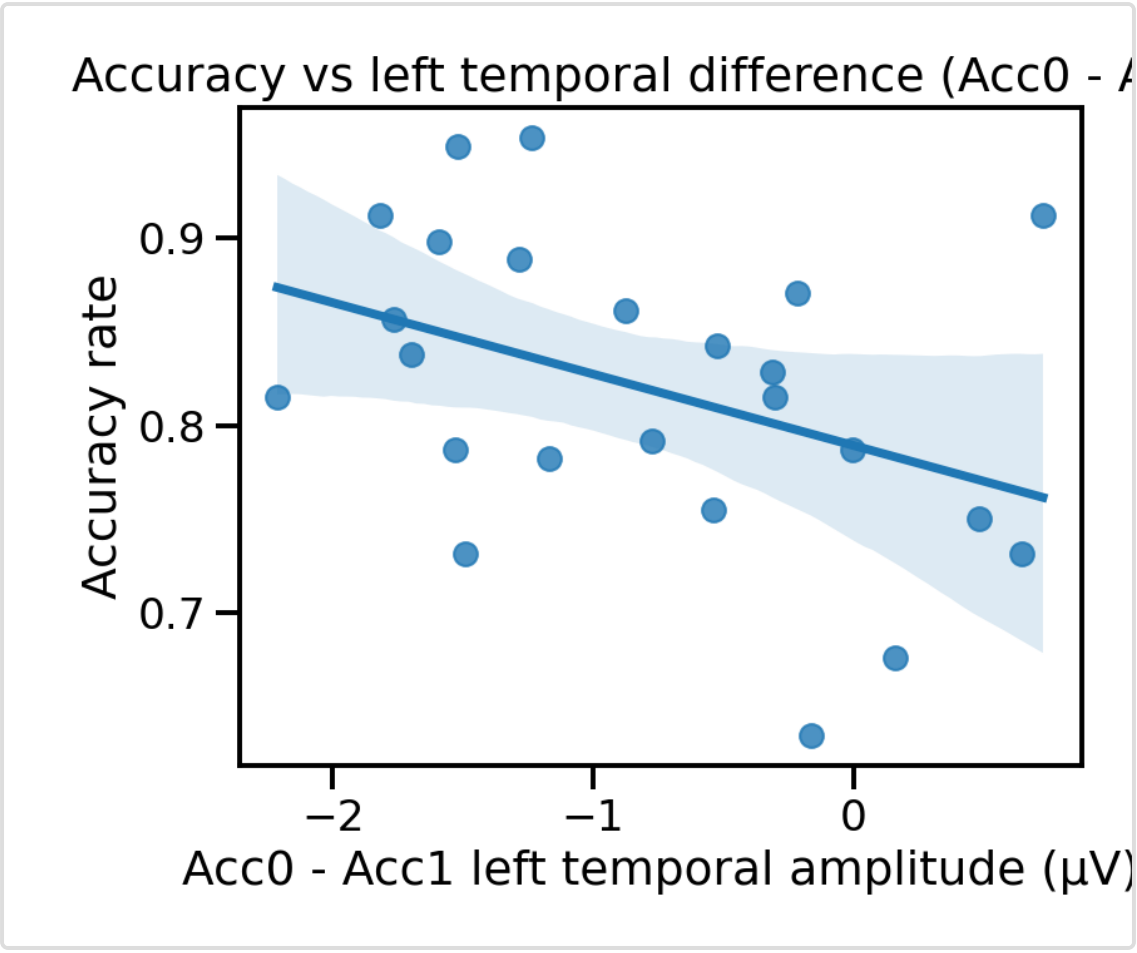

Figure 4: Accuracy vs Left Temporal Difference (H1 Key Test)

Scatter plot showing the marginal negative correlation: subjects with larger Acc0-Acc1 differences tend toward lower accuracy.

Scientific Interpretation

What These Results Tell Us

Individual Differences in Strategy Use:

- Subjects vary in how much their left temporal activity differs between errors and correct trials
- This variability reflects different reliance on verbal/semantic strategies
- However, these individual preferences do not strongly determine overall success rates

Why Correlations Are Weak:

1. **Adaptive strategy use:** Successful subjects may switch strategies trial-by-trial (not captured in overall averages)
2. **Multiple routes to success:** Both verbal and visual/spatial processing can lead to correct responses
3. **Task complexity:** Performance depends on many factors beyond left temporal engagement (attention, working memory, numerical knowledge, etc.)

Connecting to Trial-Level Findings

These between-subject results complement the within-subject (trial-level) findings:

- **Trial-level:** More negative left temporal → Slower RT / Missed response (strong, consistent pattern)
- **Subject-level:** Individual differences in verbal engagement exist but don't predict overall performance (weak correlations)

Resolution: The key is **flexibility**. Successful subjects may:

- Use verbal strategies when appropriate (small numbers, high uncertainty)
- Rely on visual/spatial processing when optimal (large numbers, clear displays)
- Minimize left temporal engagement on average (leading to faster, more accurate responses)

Conclusions

1. ✅ **Marginal evidence (H1)** that larger Acc0-Acc1 left temporal differences associate with lower accuracy ($r = -0.395$, $p = 0.0558$)
2. ❌ **No evidence (H2-H4)** for other hypothesized between-subject relationships
3. ✅ **Individual differences exist** but don't strongly predict performance

4. ✓ **Strategy flexibility** may be more important than stable individual preferences

> **Take-home message:** Left temporal (verbal) processing is **one tool among many**. The most successful subjects don't necessarily avoid it entirely, but rather **use it flexibly and minimize over-reliance** on serial verbal counting strategies.

Data Files

All outputs in: `sensor_space_analysis/outputs/between_subjects/`

CSV Files:

- subject_summary.csv — Subject-level aggregates
- correlations.csv — All correlation tests with CIs
- group_comparison.csv — High vs low verbal group stats

Between-subjects analysis reveals individual differences in verbal strategy use
but these differences do not strongly predict overall task performance.