Supplemental Material S1. Additional analysis.

When examining the trajectories calculated without normalizing each trial, a small offset in the pre-response (< 100ms) window can be seen, particularly in the noisy session data, that slightly reduced the magnitude of the difference between sessions (Fig. S1).

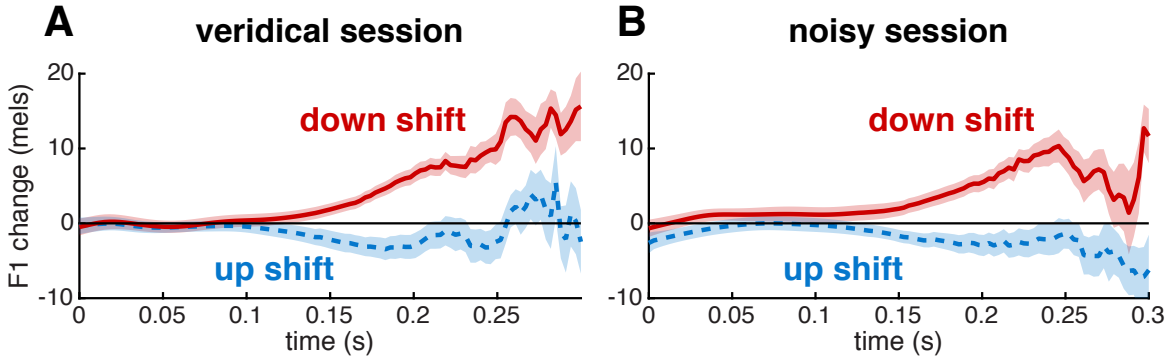

Figure S1: Compensation to F1 shifts (non-normalized). A,B: Change in F1 in the test phase of the veridical (**A**) and noisy (**B**) sessions.

In order to assess the consistency of compensation, we compared compensatory responses within the same session (Fig. S2) and across the two sessions, veridical and noisy (Fig. S3).

Within each session, we performed correlations between 1) the two shift directions, up and down, and 2) the first and second half of each test session, averaging across up and down responses. There was no significant correlation between compensation for upward and downward perturbations in either the veridical (Fig. S2A, r = .21, p = .18) or noisy session (Fig. S2B, r = .14, p = .40). There was, however, a significant correlation between compensation in the first and second halves of the veridical session (Fig. S2C, r = .47, p = .002), though the modest reliability of this correlation suggests a fairly substantial amount of noise in the compensation measure. There was no correlation between the first and second halves of the noisy session (Fig. S2D, r = .19, p = .23).

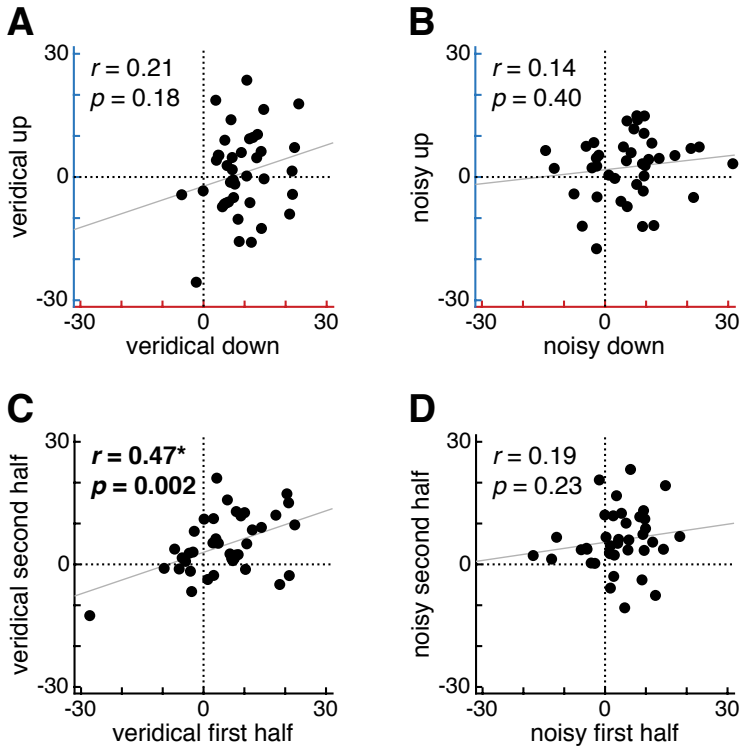

Figure S2: Within-session correlations. A,B: Comparison of compensatory responses to upward and downward perturbations in the veridical (**A**) and noisy (**B**) sessions. **C,D:** Comparison of compensatory responses in the first and second halves of the test phase in the veridical (**C**) and noisy (**D**) sessions.

We also correlated compensation across the two sessions, veridical and noisy, considering each shift direction separately as well as considering the average across the two shift directions. There was no relationship between compensation in the two sessions when considering only downward F1 perturbations, where significant compensation was observed (Fig. S3A, r = .10, p = .55), nor for the upward perturbation (Fig. S3B, r = .25, p = .12), nor for average compensation (Fig. S3C, r = .24, p = .14). Conversely, there was a strong correlation between the formant variability in the two sessions (Fig. S3D, r = .61, p < .0001 at vowel onset, r = .60, p < .0001 at vowel midpoint), as well as a significant correlation between the magnitude of centering in the two sessions (Fig. S3E, r = .37, p = .02).

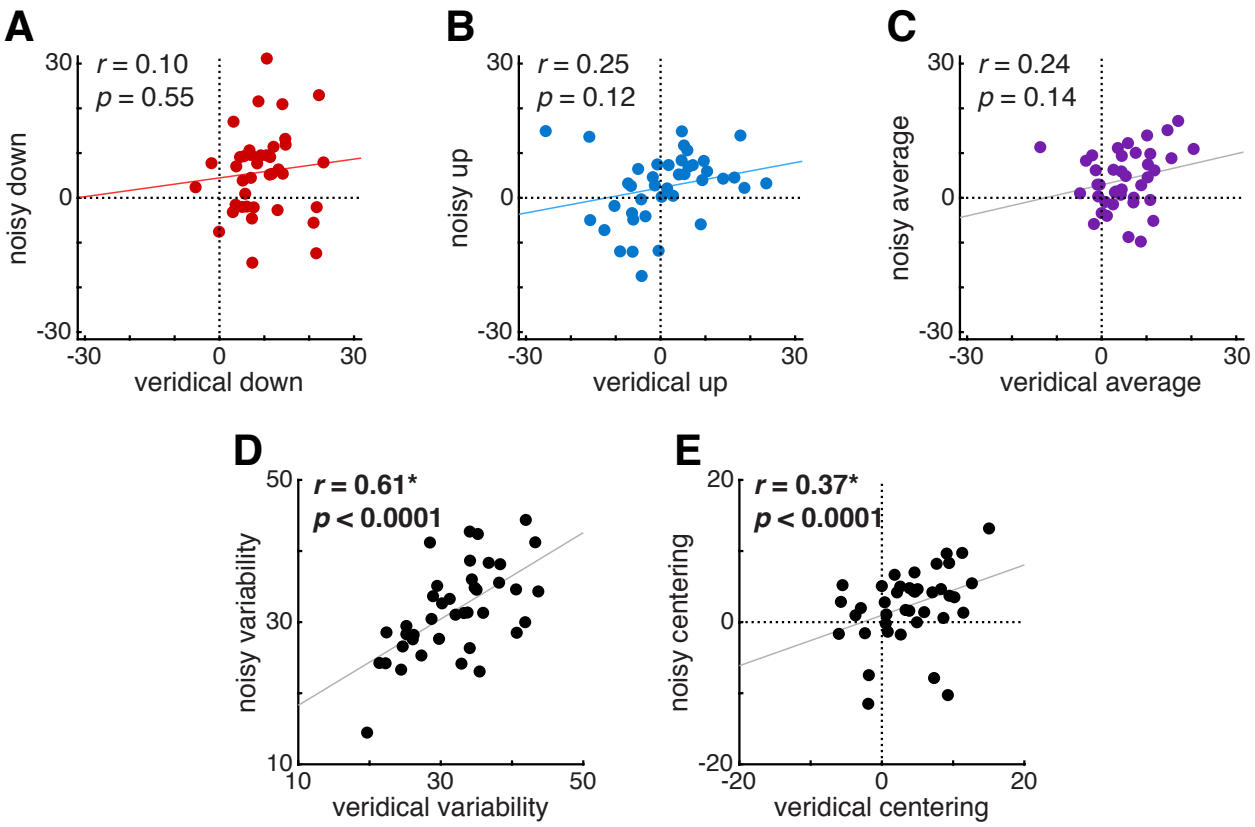

Figure S3: Cross-session correlations. A,B,C: Comparison of compensatory responses between the veridical and noisy sessions, considering downward perturbations (**A**), upward perturbations (**B**), and the average of the two (**C**). **D:** Variability is highly correlated between the two sessions. **E:** Centering is correlated between the two sessions.

Regarding the consistency of compensation across measurement approaches (Table S1), neither the average response nor by-trial method showed any significant relationship between responses to upward and downward perturbation within either session. However, restricting the analysis window to 200–300 ms after vowel onset resulted in a significant correlation in the magnitude of average compensation (average of upward and downward perturbations) across sessions. Significant correlations were also found when using the non-normalized compensation measure within the veridical session and across sessions, but not within the noisy session. Responses between the first half and second half of the veridical session showed moderate correlations of around .45 across all measurement approaches. Conversely, responses in the noisy session showed no significant correlations regardless of measurement.

Table S1: comparison of correlations across measurements.

	150–300 ms			200–300 ms		
	Average response	By Trial‡	Non-normalized	Average response‡	By Trial‡	Non-normalized
Compensation to upward and downward perturbations within session:						
Veridical	r = .21, p = .18	r = .28, p = .08	**r = .48, p = .002**	r = .16, p = .34	r = .14, p = .38	**r = .33, p = .04**
Noisy	r = .14, p = .40	r = .08, p = .63	r = .18, p = .28	r = .11, p = .50	r = –.06, p = .70	r = .05, p = .75
Compensation across sessions:						
Average	r = .24, p = .14	r = .23, p = .15	**r = .34, p = .04**	r = .30, p = .06	**r = .35, p = .03**	**r = .44, p = .005**
Up	r = .25, p = .12	r = .16, p = .31	r = .21, p = .18	**r = .33, p = .04**	r = .24, p = .12	r = .30, p = .06
Down	r = .10, p = .55	r = .04, p = .82	**r = .41, p = .008**	r = .19, p = .25	r = .12, p = .45	**r = .39, p = .01**
Compensation in 1st vs. 2nd half of each session, averaging across upward and downward perturbations:						
Veridical	**r = .47, p = .002**	**r = .43, p = .006**	**r = .45, p = .004**	**r = .58, p = .0001**	**r = .47, p = .002**	**r = .45, p = .003**
Noisy	r = .19, p = .23	r = .14, p = .40	r = .19, p = .23	r = .29, p = .07	r = .21, p = .19	r = .30, p = .06