

## INTRODUCTION

Electrocochleography (ECoChG) is the measurement of stimulus related cochlear potentials including the summing potential (SP) and the compound action potential (cAP) of the auditory nerve. It is an important measure in clinical practice that is often used to diagnose Meniere's disease as well as for surgical intraoperative monitoring. Horizontal montage is the current convention for ECoChG recordings. However, there has been minimal previous research that examines the use of a vertical montage on ECoChG components. As such, the purpose of this study is to add to the body of literature that supports a horizontal montage in ECoChG recordings, or to suggest that there is viable evidence for using a vertical montage as an alternative.

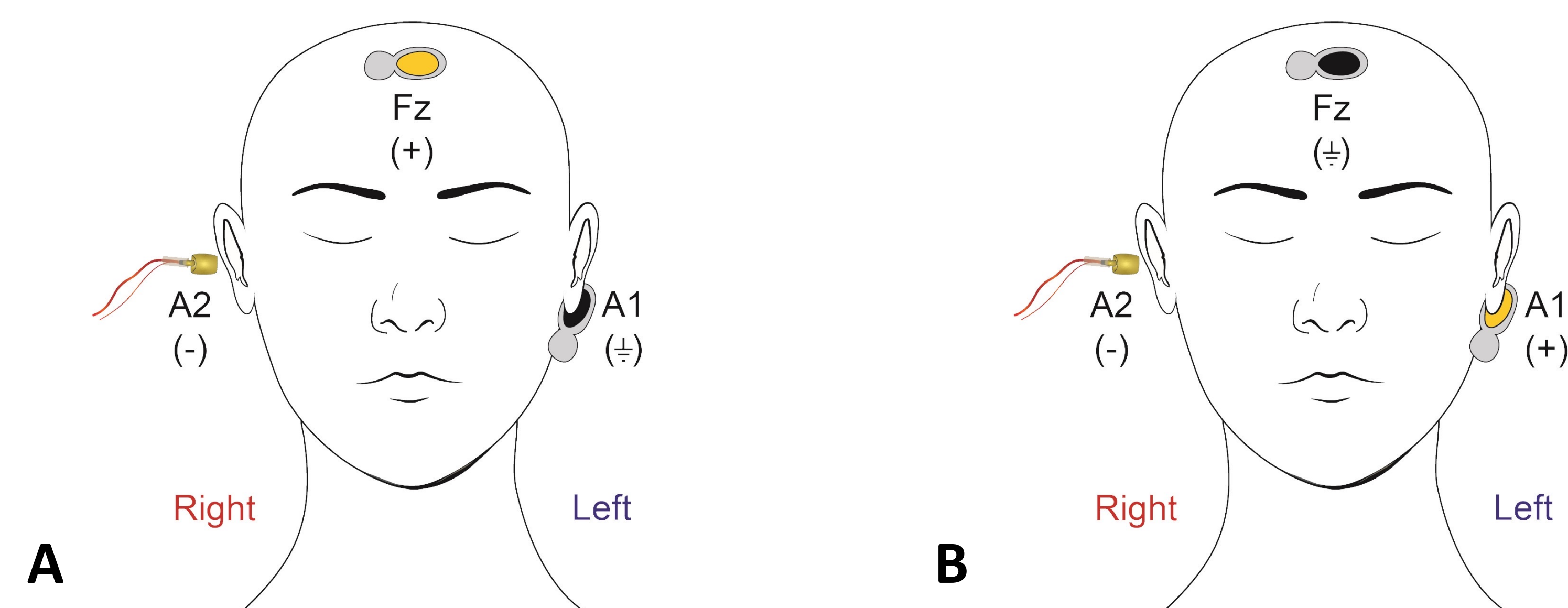
## METHODS

### Participants

The following analysis includes 35 adults (range 20-29, mean 23.2 years; 4 males). All subjects passed otoscopy, DPOAE screening, and a hearing screener ( $\leq 20$  dB HL 0.25-8kHz) in their right ear.

### Electrocochleography Recording

ECoChGs were recorded to a 100- $\mu$ s broadband click (90 dB nHL, alternating polarity) using either a vertical (A2-/Fz+/A1G) or horizontal (A2-/FzG/A1+) montage. A 10 mm gold foil tiptrode served as the reference electrode and stimulus transducer. At least two repeatable traces (1024 sweeps each) were recorded per participant, and an average of those sweeps was produced for each participant for analysis. Responses were collected and marked on the Intelligent Hearing Systems SmartEP platform. All marked components were checked for accuracy by two licensed audiologists.

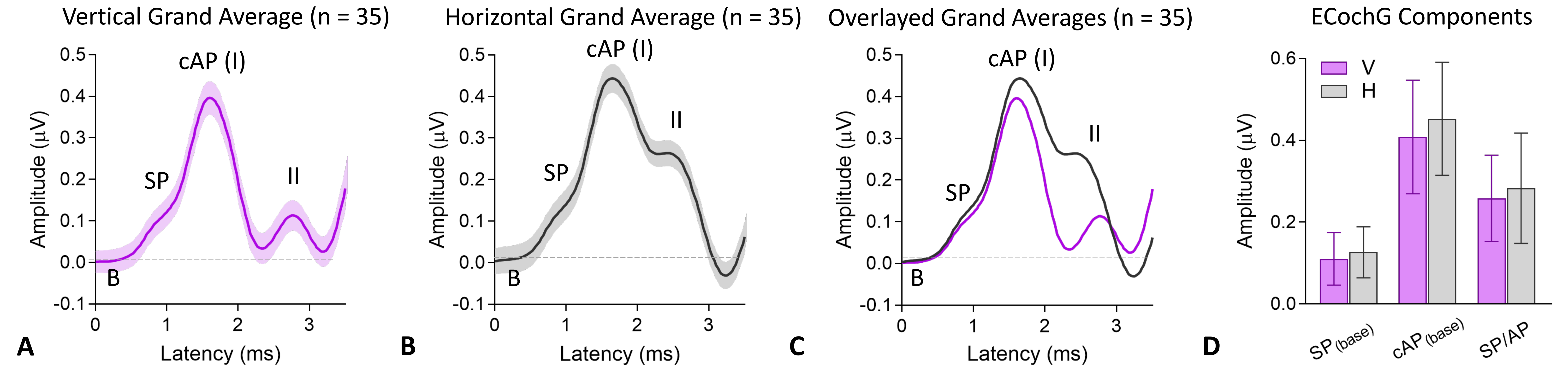


**Figure 1.** Schematic of **A)** vertical [A2-/Fz+] and **B)** horizontal [A2-/A1+] electrode montages. (-) = reference electrode, (+) = active electrode, A2 = right ear canal, A1 = left mastoid, Fz = high center forehead.

### Data Analysis

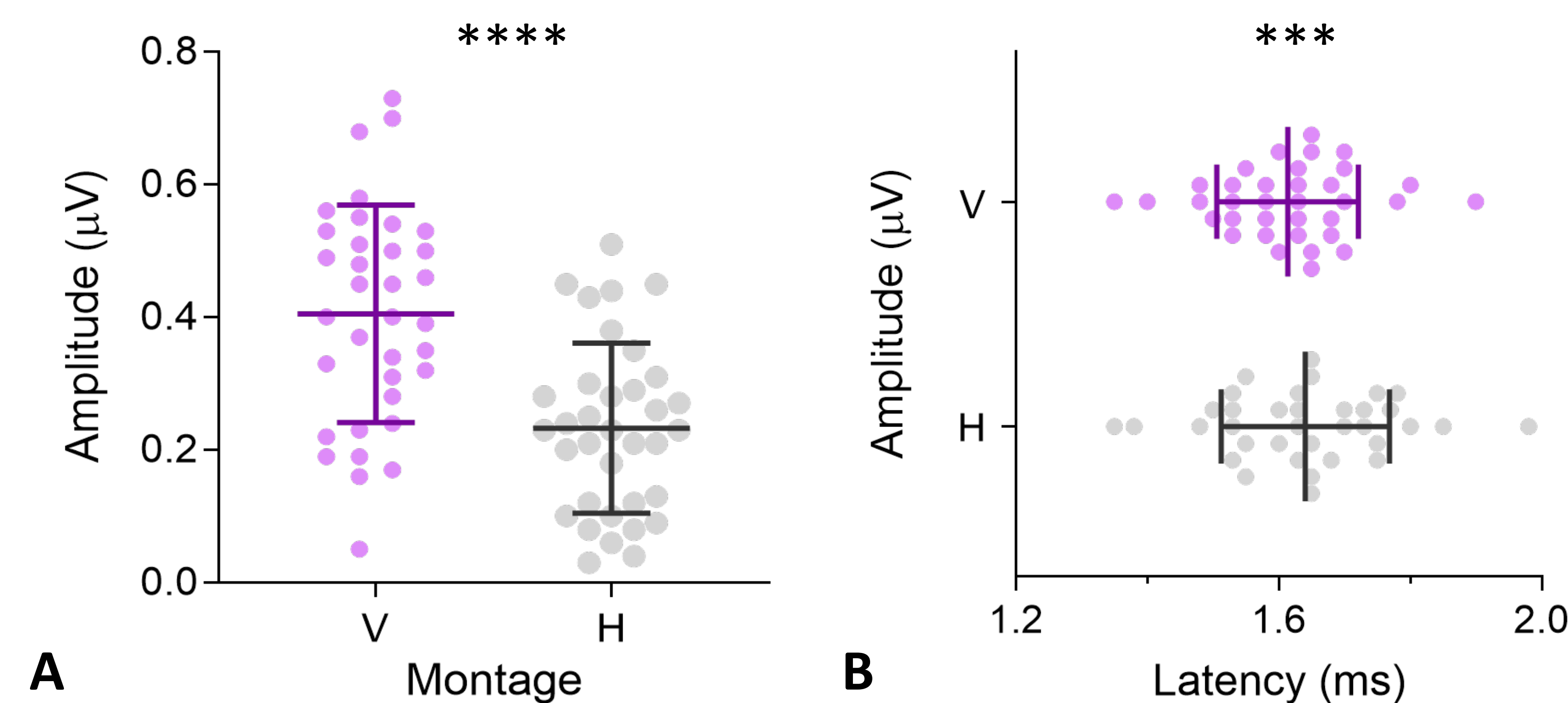
Seven variables were compared between montages using paired t-tests: SP amplitude (rel: baseline), cAP amplitude (rel: baseline), SP/AP amplitude ratio, cAP peak-to-trough amplitude and latency, and wave II peak-to-trough amplitude and latency. All statistics were performed using GraphPad by Prism version 8.0.2.

## HORIZONTAL AND VERTICAL MONTAGE GRAND AVERAGES



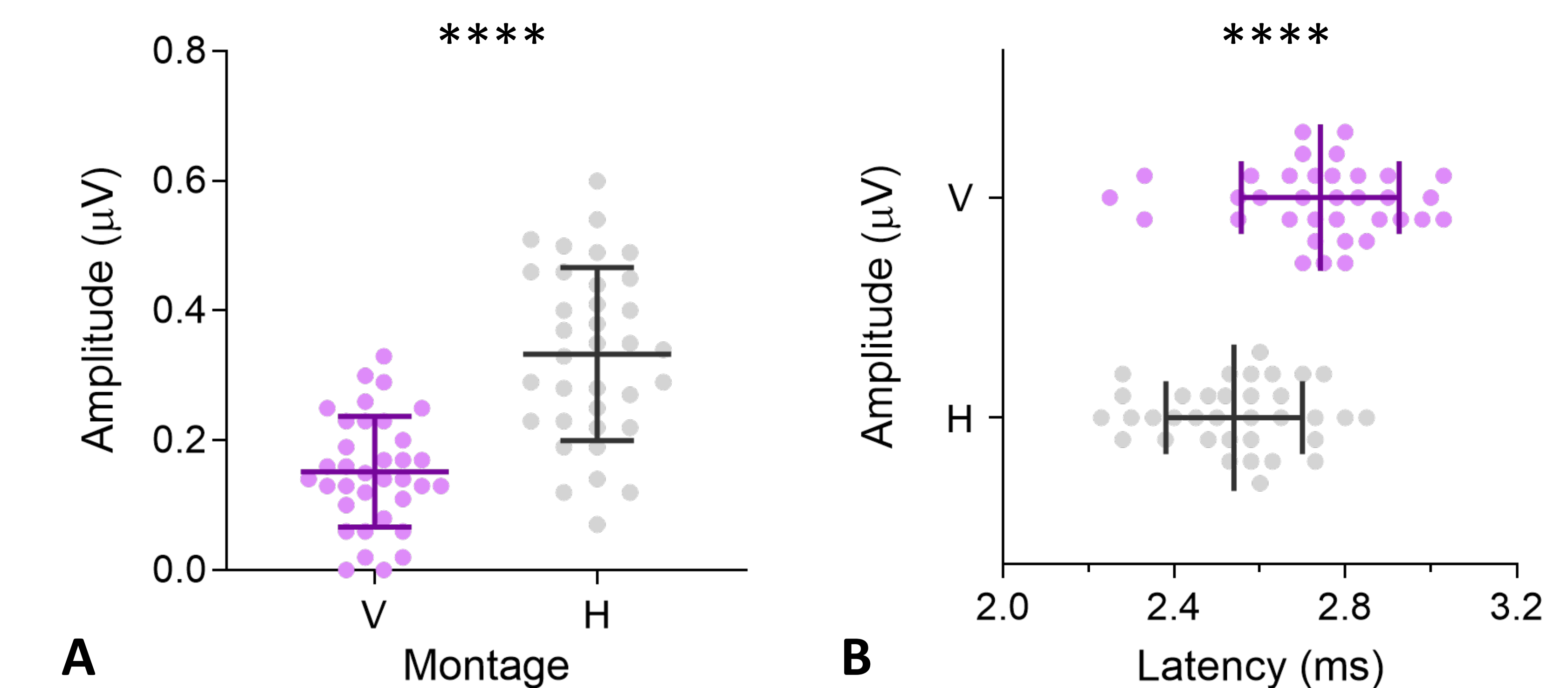
**Figure 2.** **A)** Grand average of participants' (n = 35) ECoChG traces using a vertical electrode montage. Shaded region = SEM. **B)** Grand average of participants' (n = 35) ECoChG traces using a horizontal electrode montage. Shaded region = SEM. **C)** Grand averages (n = 35) of horizontal and vertical ECoChG traces, overlaid for qualitative comparison. B/grey dashed line = baseline, SP = summing potential, cAP = compound action potential (also wave I), II = wave II. **D)** Means and 1 SD of ECoChG components: SP amplitude (rel: baseline), cAP amplitude (rel: baseline), and SP/AP amplitude ratio. Pink = vertical montage; Grey = horizontal montage. Paired t-tests did not reveal any significant differences between electrode montages across all three components (SP amplitude p = 0.26; cAP amplitude p = 0.1; SP/AP ratios p = 0.35.)

## cAP (Wave I)



**Figure 3.** **A)** cAP (wave I) peak-to-trough amplitude for each montage showed a significant difference (p < 0.0001). **B)** cAP (wave I) latency for each montage showed a significant difference (p = 0.002). Pink, V = vertical montage. Grey, H = horizontal montage. Lines = mean and 1 SD.

## WAVE II



**Figure 4.** **A)** Wave II peak-to-trough amplitude for each montage showed a significant difference (p < 0.0001). **B)** Wave II latency for each montage showed a significant difference (p < 0.0001). Pink, V = vertical montage. Grey, H = horizontal montage. Lines = mean and 1 SD.

## SUMMARY & CONCLUSION

Our results indicate that electrode montage may bear an effect for cAP (wave I) and wave II in ECoChG recordings. However, for ECoChG components used for diagnostic purposes, such as SP/AP ratio, there is no statistical difference and therefore no apparent quantitative advantage to using one electrode montage over the other. This would suggest that for clinical use, either vertical or horizontal montages can be used for ECoChG recordings. However, if later components are of interest (e.g., wave I peak-to-trough amplitude to survey neural synchrony at the cochlear nerve synapse), a vertical electrode montage may be optimal for producing more robust responses. Future directions include diversifying the sample to determine if these findings persist in a more generalized population as well as clinical populations. These results and conclusions are representative of ECoChG recordings using an ear canal electrode (tiptrode) and should not be generalized to recordings using other electrode locations (e.g., tympanic membrane, promontory, earlobe, or mastoid placements).

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