Investigating the Effect of Contact Sports on the Brain's Responses to Sound

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1. Background

- The auditory system must prioritise relevant sounds filtering distractions, requiring efficient **sub-cortical** and **cortical** processing[1].
- Athletes with **sports-related head injuries** often struggle with, difficulty **ignoring distracting sounds** and **trouble understanding speech** in **loud environments**.[2]
- **Sub-cortical processing** initiates the auditory response from the ear to the brainstem[3], while **cortical** function is essential for the early detection and processing of sounds, especially in loud environments.[4]
- Investigating auditory response **amplitudes** at both **sub-cortical** and **cortical** levels **helps identify disruptions** in sound processing, such as reduced synchrony among neurons, potentially impairing an athlete's ability to process auditory information and understand speech in loud conditions.[5]

Research Question:
How do cortical and sub-cortical auditory neural responses differ between contact and non-contact sport athletes, and how are these differences influenced by type of auditory stimuli (quiet vs speech in noise)

2. Hypotheses

- H1: Contact athletes have smaller Fundamental Frequency (F0) amplitudes in sub-cortical auditory responses than non-contact athletes.
- H2: Speech in noise reduces F0 amplitude more contact athletes than non-contact athletes.
- H3: Contact athletes show diminished N100 amplitude in cortical auditory responses compared to non-contact athletes
- H4: In speech in noise condition, contact athletes will experience a more significant reduction in N100 amplitude in cortical auditory responses compared to non-contact athletes, resulting in a greater disparity between the two groups

3. Methods

Participants

- Participants must be; 1) between **18 – 30** years old and 2) **participate** and **compete** in a contact or non-contact **invasion-based** sport e.g., football, netball
- An a-priori power analysis was conducted using G*Power to determine sample size. A **medium effect size** (f=**0.25**) was chosen, with statistical **power** of **80%** and an **alpha** value of **0.0125.**
- **24 contact** sport athletes & **24 non-contact** sport athletes

Procedure

- Participants underwent EEG recording while listening to a 170ms /da/ syllable in two conditions: speech in quiet and speech in noise. Participants watched a silent nature documentary during the recording.
- In the noise condition, 6 (3M, 3F) multi-talker babble played continuously, with the /da/ sound presented at +10 dB SNR.

Experimental Variables

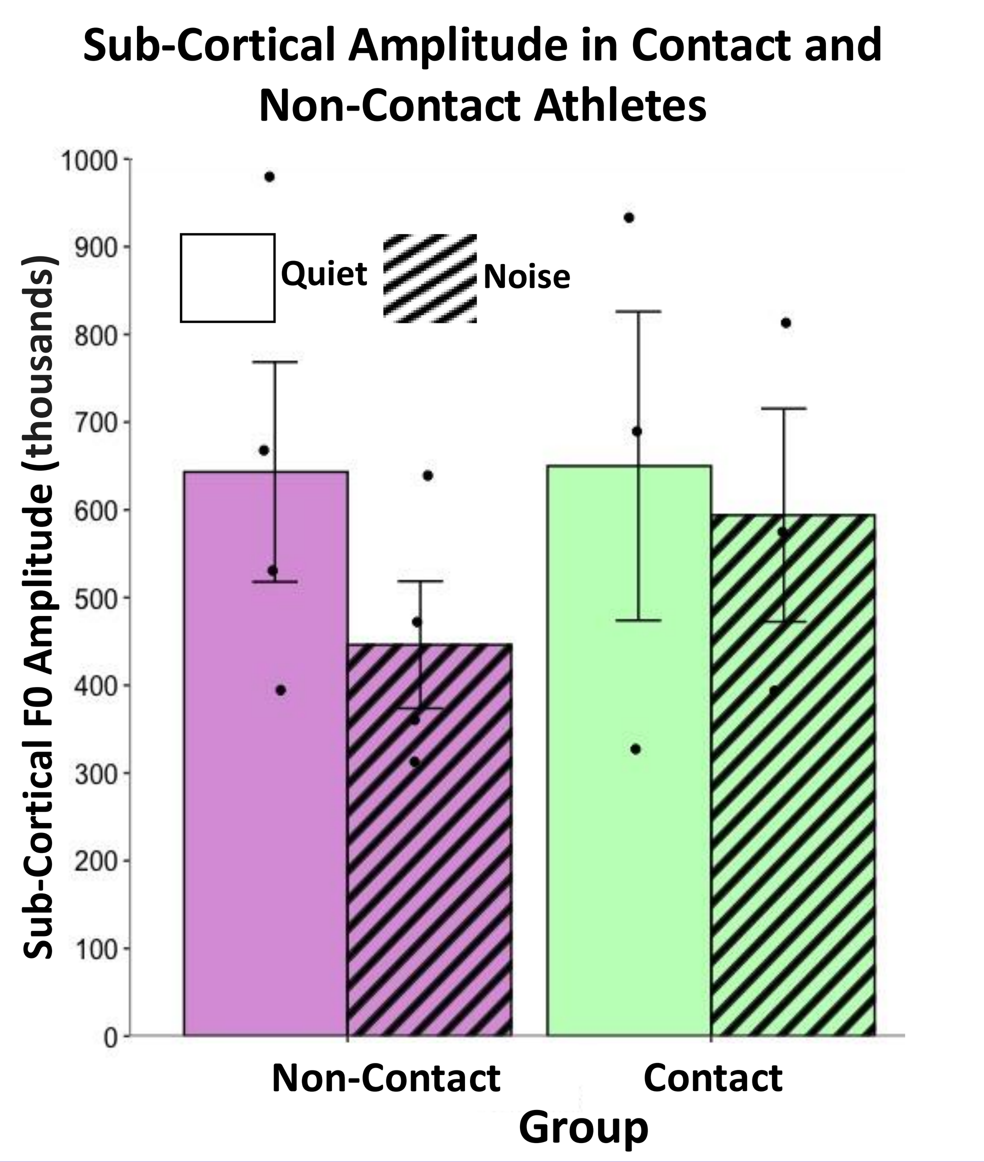
- Electroencephalogram (EEG) recordings of subcortical fundamental frequency (F0) amplitude and cortical N100 amplitude presented in both quiet and speech in noise

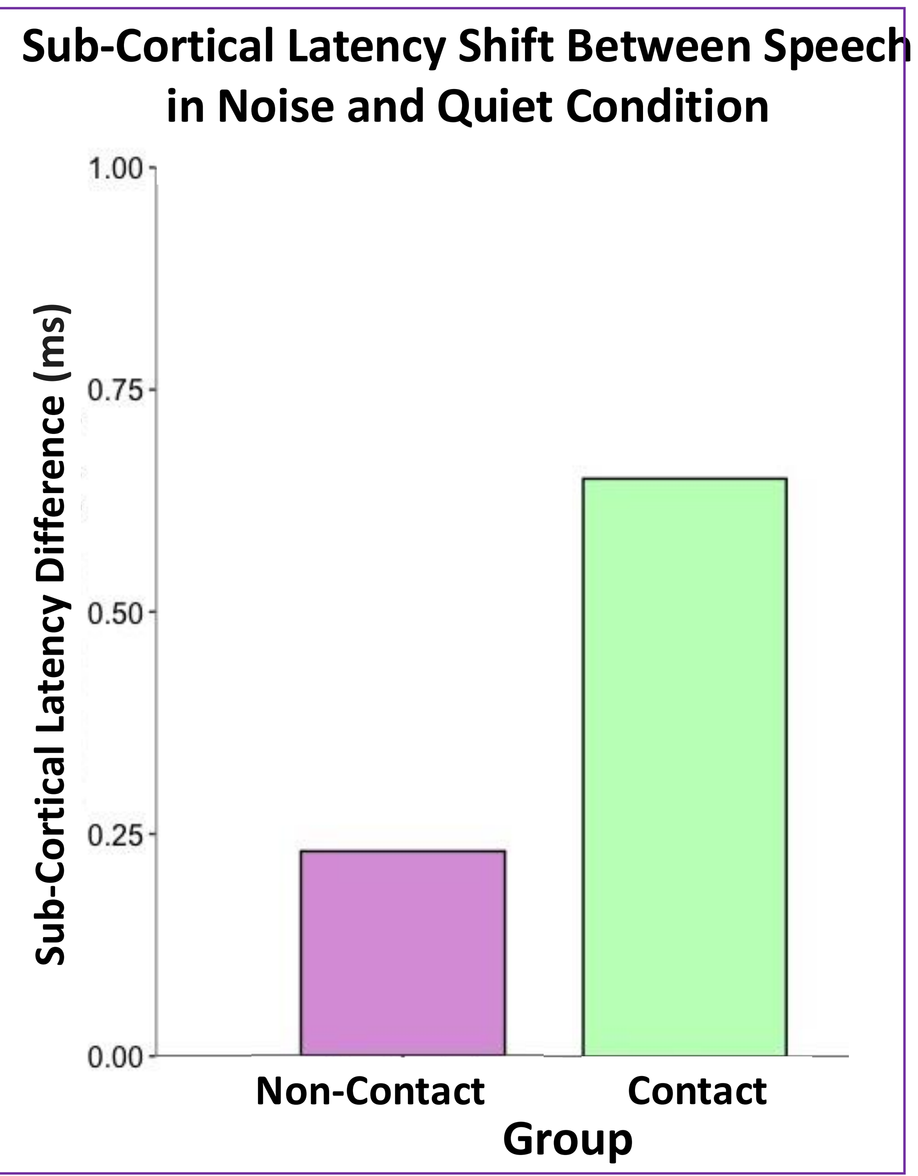
References

Contact Details

4. Preliminary Results

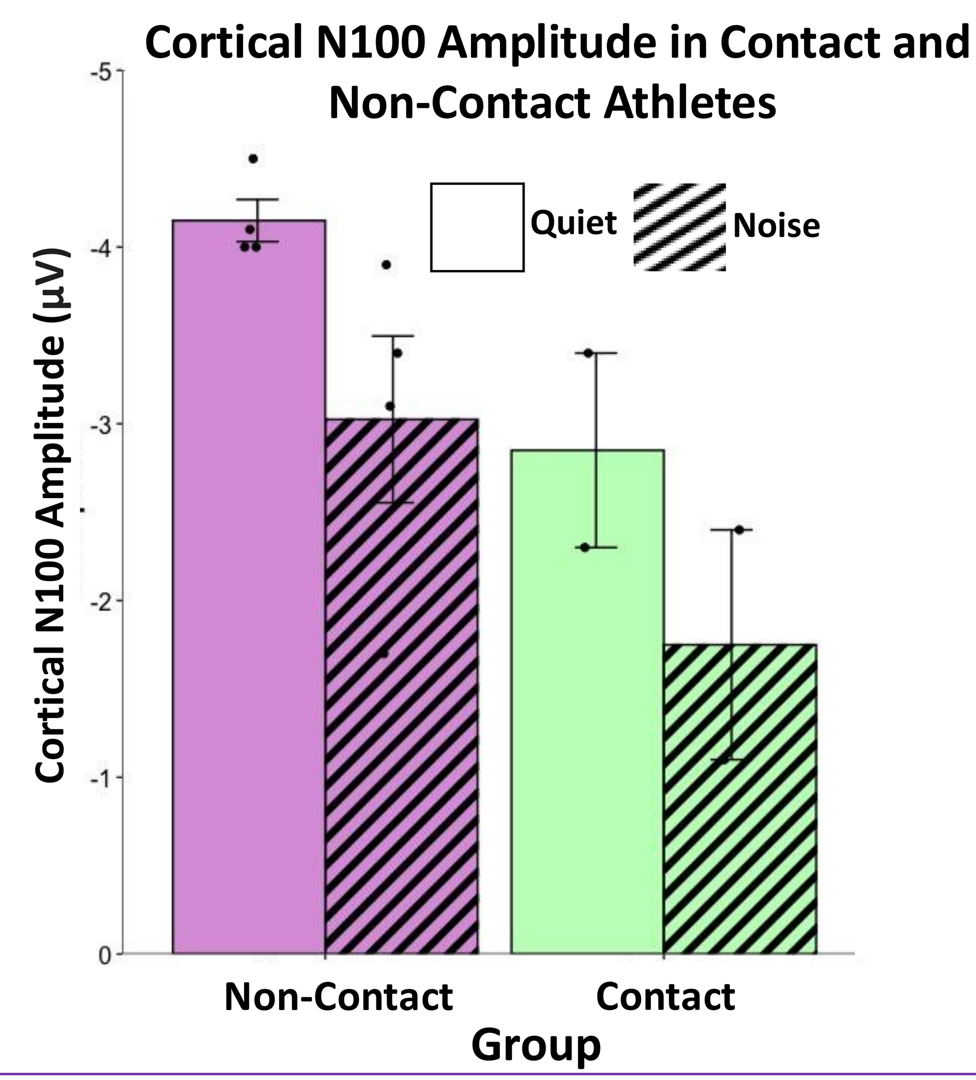
Sub-Cortical -

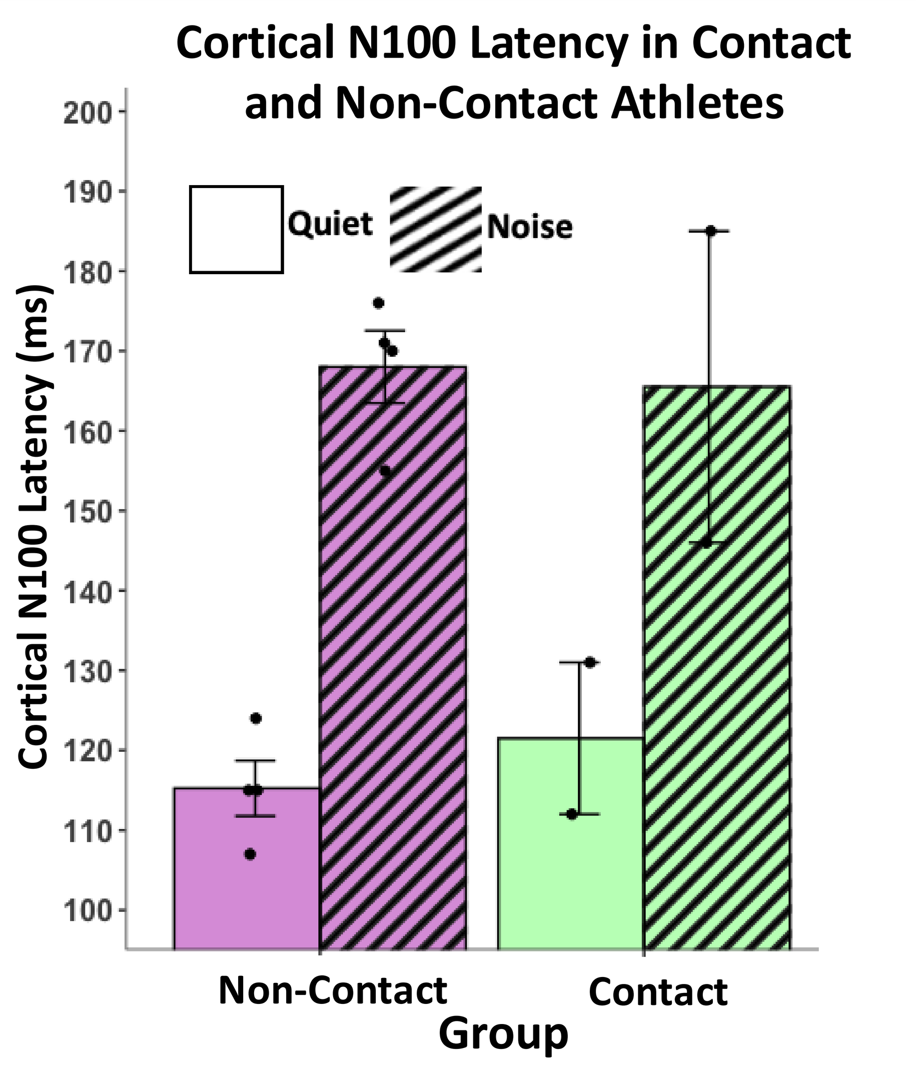




- F0 amplitude for non-contact athletes in quiet (M = 643.23K, SD = 250.58K) decreased in noise (M = 446.17K, SD = 144.92K). For contact athletes, the F0 amplitudes in quiet (M = 649.95K, SD = 304.89K) also reduced when in noise (M = 593.94K, SD = 210.40K). **Contact athletes showed slightly higher amplitudes in both conditions.**
- Latency differences were averaged across all peaks within the subcortical neural response, comparing speech-in-noise to speech-in-quiet conditions. Non-contact athletes showed a 0.39ms delay, while contact athletes exhibited a 0.65ms delay. These results indicate that **contact athletes have a longer latency in their overall subcortical speech response compared to non-contact athletes**
- Error bars represent the standard error of the mean.

Cortical -





- N100 amplitude for non-contact athletes in quiet (M= -4.10µV, SD = 0.23) to in noise decreased (M -3.03µV SD = 0.94). For contact athletes, the N100 amplitudes in quiet (M= -2.85µV, SD = 0.78) also further reduced when in noise (M= -1.75µV, SD = 0.91). **Meaning contact athletes showed smaller amplitudes.**
- N100 latency for non-contact athletes increased from quiet (M = 115ms, SD = 6.9) to noise (M = 168ms, SD = 9.0). For contact athletes, the N100 latencies also increased from quiet (M = 121ms, SD = 13.0) to noise (M = 165ms, SD = 27.0). **Latency increase was slightly less pronounced for contact athletes.**
- Error bars represent the standard error of the mean.

5. Discussion

This **preliminary** data is based on 6 participants, when full data collection is complete, we will be conducting a 2 x 2 mixed model ANOVA.

Potential Implications -

This study is the first, to our knowledge, to investigate both sub-cortical and cortical auditory processing in athletes with a focus on contact sports. By examining these areas together, it will provide valuable insights into how repetitive sub-concussive impacts may influence auditory processing, helping to better understand the effects of such impacts and identify potential early neural markers for auditory processing deficits