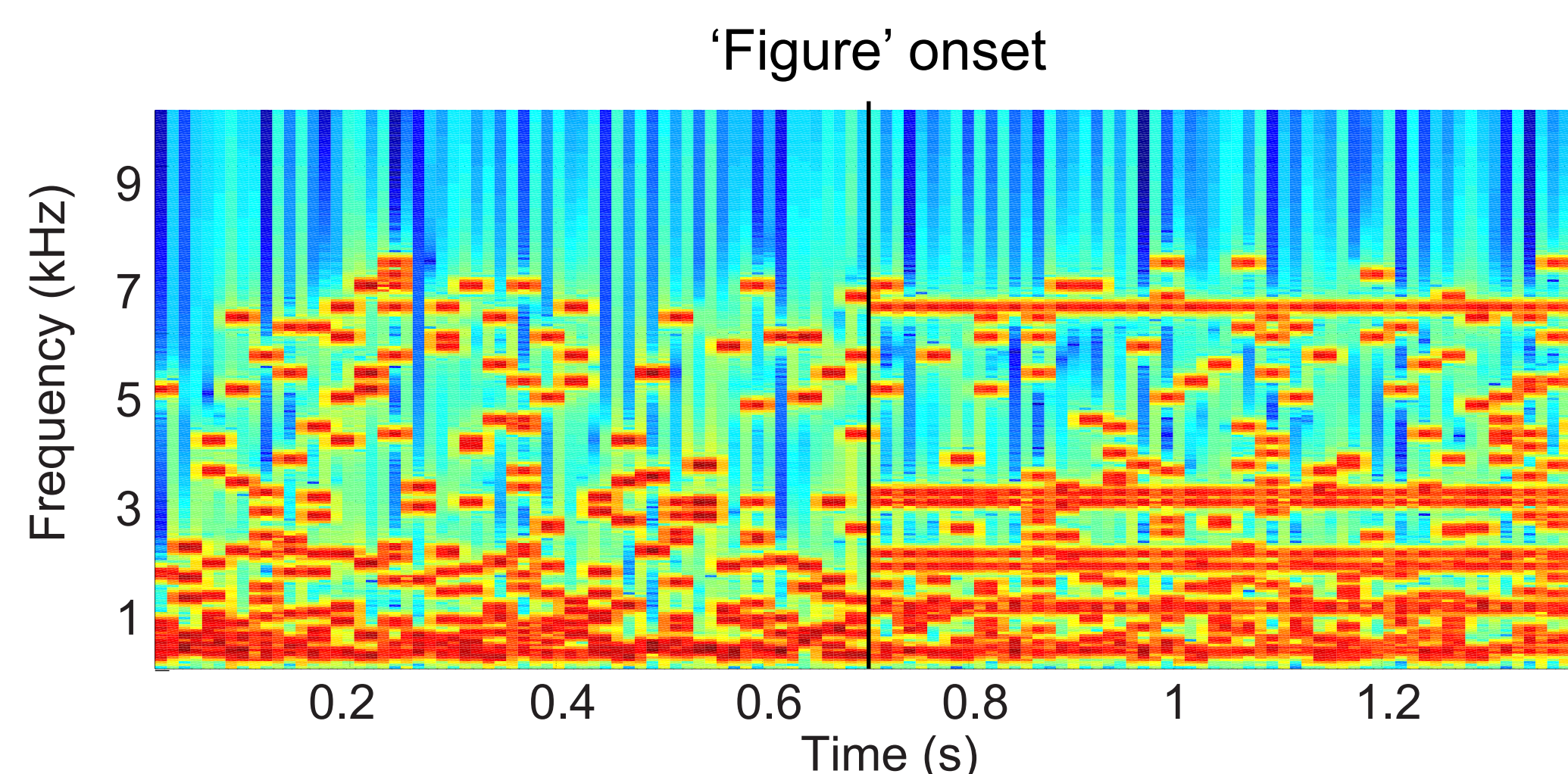


1 Introduction/Background

- We have designed a figure-ground task that requires subjects to group elements over frequency-time space to form a perceptual object, and defined brain mechanisms for this process
- Speech-in-noise (SIN) recognition also requires grouping of elements across frequency-time space, like the figure-ground task, in addition to semantic attribution not required by the fundamental task
- We tested the hypothesis that the two tasks correlate
- We did this in two groups:
 - Normal listeners in which the relationship is likely to be central, although it is possible that cochlear damage ('hidden hearing loss') could be a common source of variance in both tasks
 - Hearing impaired listeners in which cochlear damage is likely to be a common source of variance

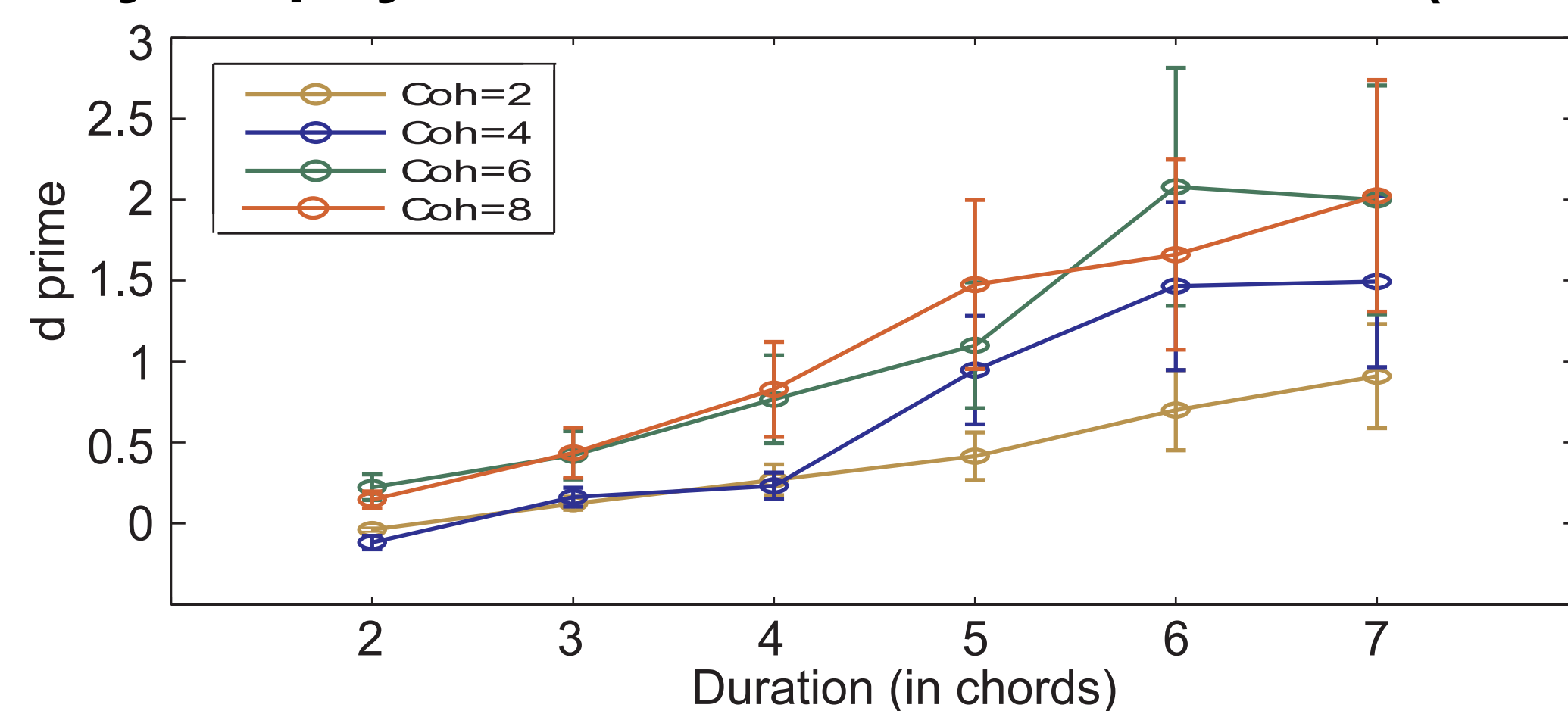
Stochastic Figure-Ground stimulus

Time-frequency representation of coherence 8 stimulus



The stimulus to the left consists of a sequence of 25ms-long chords containing a random set of pure tone components. The transition from random background is to eight coherent chords, which begin at 700ms and last for 700ms (horizontal stripes on the time-frequency plot). Different versions of this stimulus were adopted for normal and hearing impaired listeners in which the chord segment duration, number of chords, and stimulus coherence were varied between groups.

Psychophysical functions of coherence (Teki et al. 2013)

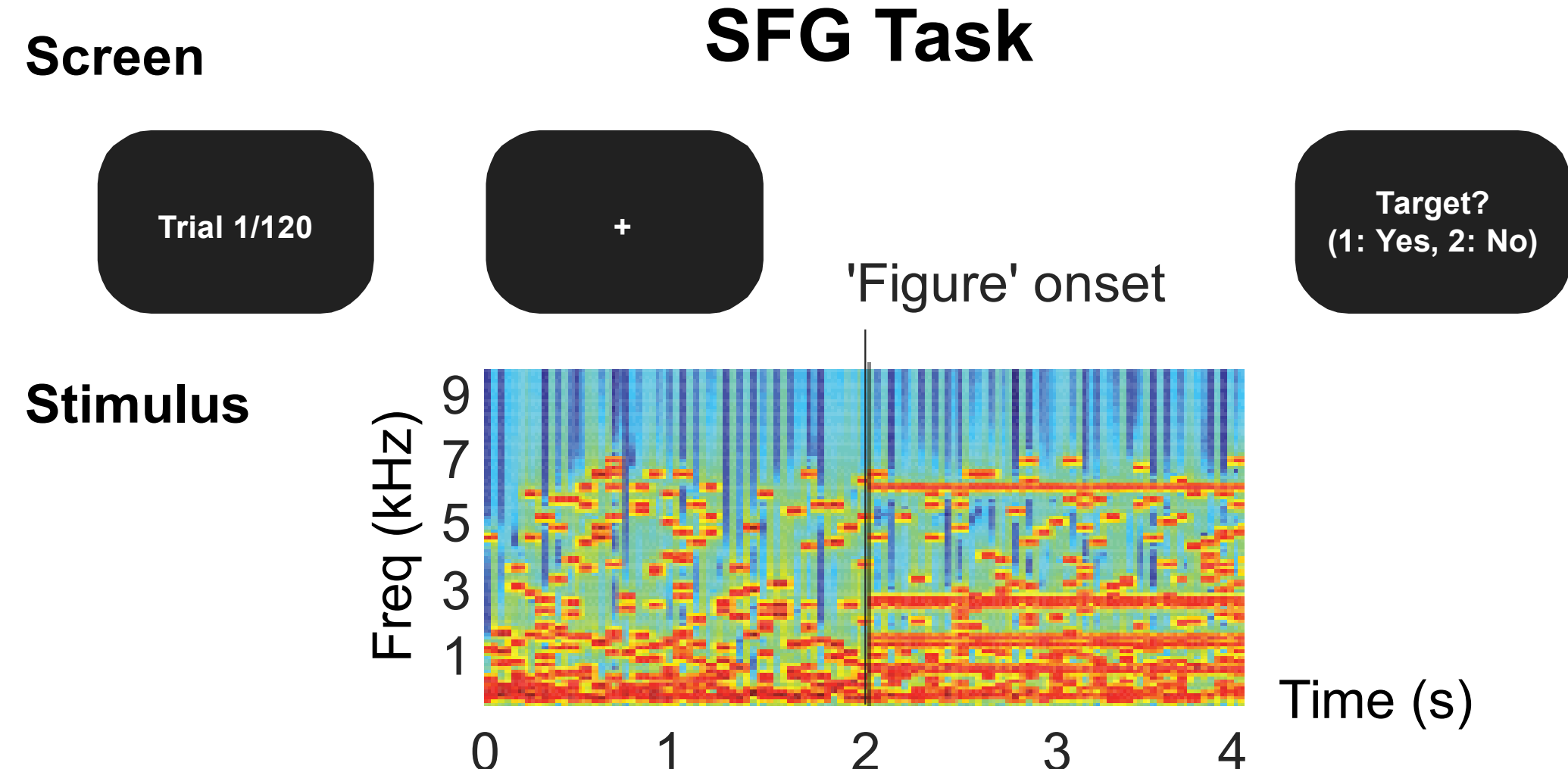


The figure to the left is taken from Teki et al. 2013. d' is shown for chord duration of 25ms plotted as a function of the duration of the figure (in terms of number of 25ms-long chords). The coherence of the different stimuli is colour coded according to the legend (inset). Error bars signify one standard error of the mean.

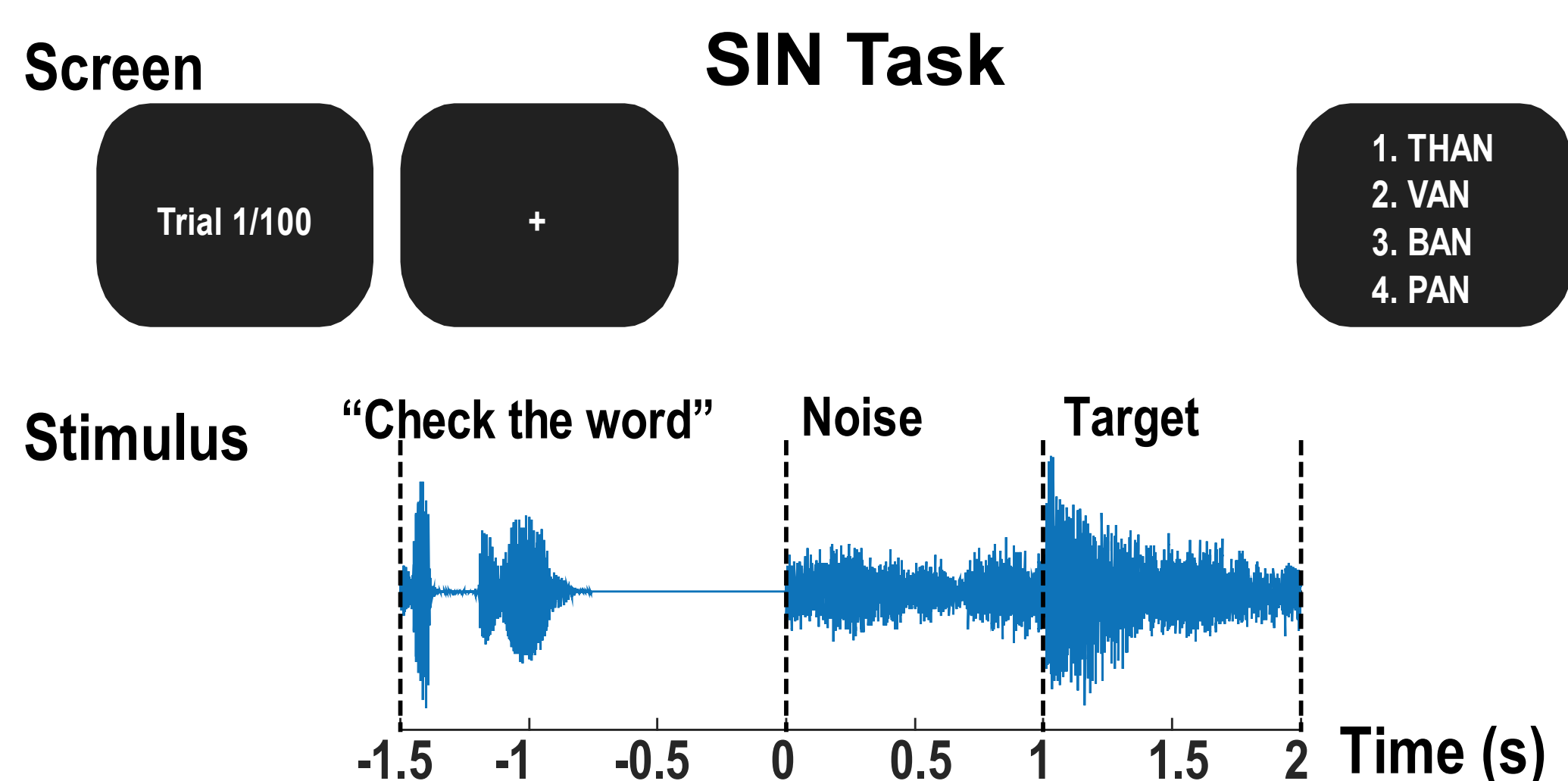
2 Methods

- We used a stochastic figure-ground (SFG) stimulus [1] in a single-interval detection task; each trial consisted of either background-only or background + figure; Background was heard first and comprised a sequence of random complex tones; On half the trials (figure-present) specific tones remained constant after a transition
- The SIN measure adapted the California Consonant Test [2] 4AFC CVC word recognition task, embedding the words in multi-talker babble at two SNR values. Hearing impaired listeners included a group of 10 hearing aid users and 43 cochlear implant users. Normal listeners had no audiological symptoms and passed a screening hearing test at 0.5, 1, 2, and 4 kHz.

Auditory object detection and speech-in-noise tasks

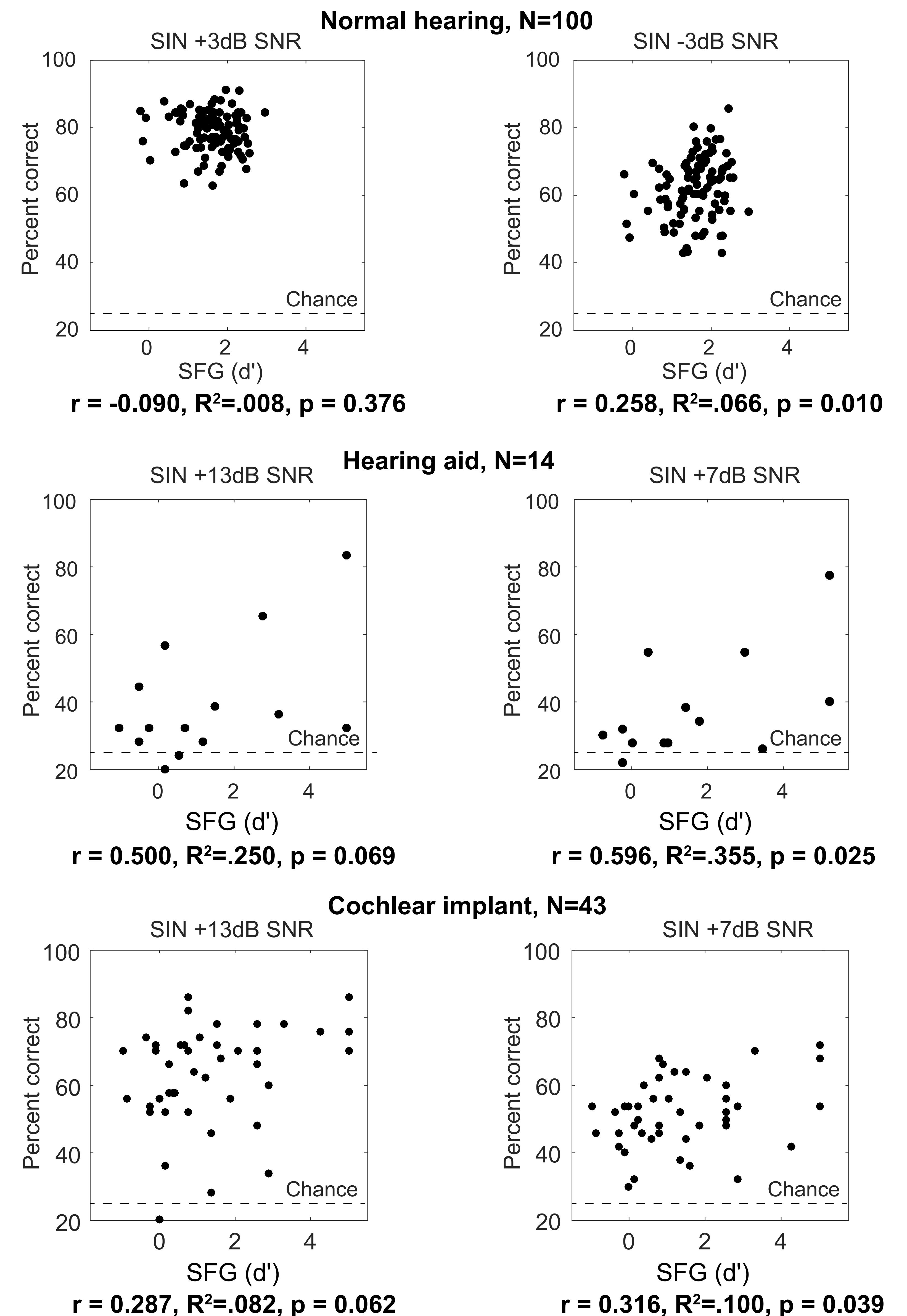


Trial example for the cochlear implant group, showing a 4-second-long SFG stimulus with segments across the frequency range (100-7500Hz). After 2s, 6 segments are randomly chosen to remain fixed for 2s. On a no-object trial, segments are randomized for the duration of the stimulus.



The SIN stimulus is heard 1s after the onset of a multi-talked babble. Noise is presented at +13dB (high) or +7dB (low) SNR for hearing impaired listeners and +/-3dB for normal hearing listeners. After the target word, four CVC words (including the target) are displayed until the subject provides a response on a keypad.

3 Behavioural correlations between SFG and SIN in all groups



4 Conclusions

- Normal listener data support the idea that a common source of variance in both tasks is central; we cannot entirely rule out a contribution from hidden hearing loss which will be tested in future work
- Normal hearing data show 7% of variance in SIN is explained by figure-ground segregation
- Hearing impaired data show a stronger correlation we suggest due to common peripheral and central variance which we will test in future work
- Hearing impaired data show 36% (hearing aid) and 10% (cochlear implant) of variance in SIN explained by figure-ground segregation
- We also plan to investigate which speech elements best correlate with the SFG task

References

- Teki S, Chait M, Kumar S, Shamma S, Griffiths TD (2013) Segregation of complex acoustic scenes based on temporal coherence. *eLife* 2:e00699.
- Owens E, Schubert ED (1977) Development of the California Consonant Test. *J Speech Hear Res* 20:463-474.

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Contact information

phillip-gander@uiowa.edu