Supplementary material for Halliwell ER, et al. 2015. Effect of input compression and input frequency response on music perception in cochlear implant users, *International Journal of Audiology*, 54, 401–407.

Appendix 1: Spectrograms and average spectra of the classical B music clip, comparing the original clip and the version with a falling frequency response

The additional numbers above the x-axis in the spectra plots are the approximate electrode numbers corresponding to the centre frequencies of the simulated implant processor that was used to produce the electrodiagrams of Appendix 2. It can be seen that the original clip had a majority of the energy contained in the region below 1 kHz (corresponding to electrode 16), with contributions dropping off sharply at higher frequencies.

Appendix 2: Example electrodiagrams: Classical genre, clip B

The electrodiagrams were produced via MatLab ToolBox NIC software using a standard ACE map with 10 maxima and standard microphone response and the original and processed clips used in Experiment 1.

The first electrodiagram is the simulated output of the original unprocessed version, followed by that for the flattened frequency response version (using the acoustic signal with the falling frequency response applied). The high-frequency emphasis of the microphone is evident by much greater activity on the more-basal electrodes in the first electrodiagram than would be predicted from the spectrogram in Appendix 1 alone. If the microphone response was discounted, there would be very few selections of electrode numbers more basal than 16 (corresponding to around 1 kHz). The second electrodiagram, using the falling frequency response to offset the rising microphone response, has restored the balance of energy in the low and high frequencies. Although the original version electrodiagram output has information across a greater spectral range, the output has distorted the overall timbre of the original music signal which was dominated by energy in the low-frequency region, as illustrated by the acoustic spectrograms and average spectra shown in Appendix 1.

Left panel: Unprocessed music clip; Right panel: Flattened frequency response

Appendix 3: Example electrodiagram, using processing as in Experiment 2

This electrodiagram shows the simulated output using the original unprocessed version (including standard microphone response), but with the channel gains of the simulated speech processor adjusted as in Experiment 2. It can be seen that the effect of changing the channel gains is similar to, but not as severe as the effect of the acoustic filtering in Experiment 1.

Appendix 4: Pre-experiment questionnaire to record music listening habits and experience of participants in Experiment 2.

Please answer the following questions.

1. Year of birth:

2. Have you ever had any musical training? (Please give details)

None ☐

Limited ☐

Moderate ☐

Good ☐

Extensive ☐

Details:.....

3. Prior to receiving your cochlear implant, how often did you listen to music, on average?

0–2 hours per week ☐

3–5 hours per week ☐

6–8 hours per week ☐

9 or more hours per week ☐

4. Prior to receiving your cochlear implant, did you enjoy listening to music?

Yes ☐

No ☐

Unsure ☐

5. Since receiving your cochlear implant, how often do you listen to music, on average?

0–2 hours per week ☐

3–5 hours per week ☐

6–8 hours per week ☐

9 or more hours per week ☐

6. Since receiving your cochlear implant, has your musical listening experience been satisfactory?

Yes ☐

No ☐

Unsure ☐

7. How important is music enjoyment to you, personally?

Highly ☐

Moderately ☐

Not at all ☐

8. What is your preferred type of music? (e.g. Classical)

.....

Appendix 5: Preference rating sheet for each listening experience in Experiment 2 for participants who wear only a cochlear implant.

Listening experience number (please circle):

1 2 3 4 5 6 7 8 9 10

PLEASE NOTE:

If you listen to music with a lead feeding into your cochlear implant speech processor from an mp3 player,

PLEASE DO NOT USE THIS LEAD anytime while listening to music for the purpose of this study.

Please complete this task on TEN separate occasions.

Please follow the procedure below to fully evaluate your listening experience.

Start listening to music.

Switch your cochlear implant speech processor to Program 3.

Listen to music for a few minutes, as desired.

Continue to listen to the same piece of music.

Switch your cochlear implant speech processor to Program 4.

Listen to music for a few minutes, as desired.

If desired, switch between Programs 3 and 4 further times.

Please answer the following questions and consider your overall listening experience with each program.

1. Which program provides the most satisfactory music-listening experience?

Program 3 ☐ Program 4 ☐

2. Do you have any other comments?

.....

.....

.....

Please answer the following questions about the music in this listening experience.

1. For how long did you listen to music, approximately?

Less than 5 minutes ☐ 5 to 30 minutes ☐ Longer than 30 minutes ☐

2. What type of music did you listen to? (Please give details, e.g. Classical, violin solo; Rock, e.g. Rolling Stones song).

.....

3. Did the music contain lyrics?

Yes ☐ No ☐

4. Was the music new or familiar to you?

New ☐ Familiar ☐

5. Was there any interfering background noise?

Yes ☐ No ☐

6. From where did you listen to music?

Radio ☐ Television ☐ Computer ☐

Live ☐

Other (Please specify):.....

7. Please specify any other details of your listening environment which you feel important.

.....

Thank you.

Appendix 6: Preference rating sheet for each listening experience in Experiment 2 for the participants who usually wear a cochlear implant and a hearing aid.

Listening experience number (please circle):

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

PLEASE NOTE:

If you listen to music with a lead feeding into your cochlear implant speech processor from an mp3 player, PLEASE DO NOT USE THIS LEAD anytime while listening to music for the purpose of this study.

Please complete the following questions concerning your music-listening experience WITHOUT WEARING your hearing aid.

Please complete this task on TEN separate occasions.

If, after completion of the first ten listening experiences without wearing your hearing aid, you have time to complete the task on ten further occasions, please do so WEARING BOTH hearing devices turned on (experience numbers 11 to 20).

Please follow the procedure below to fully evaluate your listening experience.

Start listening to music.

Switch your cochlear implant speech processor to Program 3.

Listen to music for a few minutes, as desired.

Continue to listen to the same piece of music.

Switch your cochlear implant speech processor to Program 4.

Listen to music for a few minutes, as desired.

If desired, switch between Programs 3 and 4 further times.

Please answer the following questions and consider your overall listening experience with each program.

1. Which program provides the most satisfactory music-listening experience?

Program 3 ☐ Program 4 ☐

2. Do you have any other comments?

.....

.....

.....

Please answer the following questions about the music in this listening experience.

3. For how long did you listen to music, approximately?

Less than 5 minutes ☐ 5 to 30 minutes ☐ Longer than 30 minutes ☐

4. What type of music did you listen to? (Please give details, e.g. Classical, violin solo; Rock, e.g. Rolling Stones song).

.....

.....

5. Did the music contain lyrics?

Yes ☐ No ☐

6. Was the music new or familiar to you?

New ☐ Familiar ☐

7. Was there any interfering background noise?

Yes ☐ No ☐

8. From where did you listen to music?

Radio ☐ Television ☐ Computer ☐

Live ☐

Other (Please specify):.....

9. Please specify any other details of your listening environment which you feel important.

.....

.....

Thank you.