

Modelling and Improving Music Listening in Hearing Aids - Participant Information Sheet

Principal Investigator:

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Research team:

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You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish.

What is the purpose of the study?

The aim of this study is to investigate further the factors that contribute to perceived music audio quality in hearing aids. This is with a view to helping researchers improve the processing of music that takes place within hearing aid devices.

This study aims to investigate the following concepts:

- Components of audio quality – perceived audio quality in hearing aids has several contributing components, including distortion, loudness, harshness and spatial image. It is important to understand how these factors combine to generate an overall assessment of quality.
- Individual-level and broader-level preference profiles – there is evidence that hearing aid music quality assessments are significantly influenced by the individual preferences of listeners. A more comprehensive model of music quality in hearing aids needs to consider how individual hearing loss profiles and preference patterns influence judgements of sound quality.

To achieve this, this study intends to:

- Develop a substantial dataset of sounds scored on objective quality metrics and by individual preference. The sounds will come from a variety of musical sources and are processed with a simulated hearing aid using a variety of settings and degradations that are typically experienced with hearing aids.

This experiment serves as a stepping stone towards future advancements which include:

- Machine learning models of audio quality in hearing aids – findings could contribute to advanced models that take an audio input and provide hearing aid engineers with clear insight into what aspects of a sound need to be improved the most.
- Individualised music processing profiles in hearing aids – a greater understanding of how individual preferences interact with quality assessments could enable hearing aid parameters to be better matched to an individual and their requirements.
- Automatic tailoring of amplification strategies for music in hearing aids – developed models could be

used to create more advanced hearing aids that automatically monitor their output audio and, with user guidance, adjust their settings to achieve an optimal result. This represents a crucial step towards more natural and fulfilling music listening experiences in hearing aids.

This study is part of a PhD project that investigates how we can better model music listening in hearing aids, and use these models to drive improvements in the signal processing strategies that are deployed in hearing devices.

Why have you been invited?

You have been invited as you are over 18 years old, healthy, and without self-reported hearing loss. Up to 100 people will participate in this study. It is important that you understand that it is your choice if you take part in this study.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw without giving a reason. If you decide to withdraw, any data that you have contributed will be destroyed. You have up until one week after participating in the study to withdraw and all contributed data will be removed. After this point some anonymised data may no longer be able to be deleted. You may withdraw by contacting any member of the research team in person, by phone (details below), or via email at j.webb24@imperial.ac.uk

Time commitment and location

The study will involve a single test with a maximum duration of 1.5 hours. The test takes place remotely on a secure, online listening test platform, and can be taken in multiple sessions over several days with no loss of progress.

What will happen to me if I take part?

You will be sent a link via email to access the online testing platform. When you log in for the first time, you will be asked to digitally sign a consent form and share basic demographic data (age, gender). This will be facilitated by using a Google OAuth and the collection of Google ID and linked data. Further guidance will be presented detailing the full procedure in depth. Demographic data will be pseudonymised and never shared outside the research team.

During the test, you will be asked to use a pair of headphones connected to your personal computer. You will be presented with a series of pairs of sounds, and asked to select the one that you think sounds higher on a particular metric, such as loudness.

Possible disadvantages and risks

The study will not involve any activity that may pose a serious risk to your health.

You will be asked to make repeated judgements of pairs of sounds on a personal computer, which may be slightly uncomfortable or tiring. You may be exposed to loud sounds, although it will be ensured that the loudness is within a safe range. You will have to access an online listening test platform to make these comparisons. All reasonable steps to ensure the security of your data when accessing this platform have been taken. The platform will be hosted securely on a website managed by the Audio Experience Design group at Imperial (<https://www.axdesign.co.uk/>) The test platform will be hosted by Heroku, a leading platform as a service provider (<https://www.heroku.com/>). Secure access to the platform will be facilitated by Google OAuth.

What if something goes wrong?

Imperial College London holds insurance policies which apply to this study. If you experience harm or injury as a result of taking part in this study, you will be eligible to claim compensation without having to prove that Imperial College is at fault. This does not affect your legal rights to seek compensation.

If you are harmed due to someone's negligence, then you may have grounds for a legal action. Regardless of this, if you wish to complain, or have any concerns about any aspect of the way you have been treated during the course of this study then you should immediately inform the Principal Investigator.

(Lorenzo Picinali, l.picinali@imperial.ac.uk). If you are still not satisfied with the response, you may contact the Imperial College Research Governance Integrity Team (rgitcoordinator@imperial.ac.uk).

What are the benefits of taking part in the study?

This study will help researchers and developers of hearing-aid devices in creating better products. As a participant, you will have the opportunity to contribute to the advancement of hearing aid technology.

What will happen to the results of the research study?

The results of the study will be shared with the wider research community through scientific publications, and any relevant findings will be submitted for publication in a relevant scientific journal. Publication will occur between May 2025 to September 2028. You will be able to ask via email for a copy of these publications and of your personal data. Your personal data will not be identified in any report/publication.

Who is organising and funding the research?

Imperial College London is the study sponsor, the UKRI Engineering and Physical Sciences Research Council and Sonova are jointly funding this study.

Who has reviewed the study?

This study was given approval by the Head of Audio Experience Design Research Group of the Dyson School of Design Engineering and Research Governance and Integrity Team (RGIT) at Imperial.

Contact

If you have any questions concerning the study, please feel free to ask at any point. You are also free to contact the research team at the email provided above if you have questions now or at a later time. Jack Webb (j.webb24@imperial.ac.uk) and Lorenzo Picinali (l.picinali@imperial.ac.uk)

Thank you for taking part in this study.

Transparency Notice

Research Study Title: Modelling and Improving Music Listening in Hearing Aids

Study Number: 7735182

In this research study we (Imperial College London) will use information from you. We will only use information that we need for the research study. We will let very few people know your name or contact details, and only if they really need it for this study. These people will include Imperial Research Team members and support staff.

Everyone involved in this study will keep the data collated as part of this study, including your personal data, safe and secure. We will also follow all privacy laws and legislation that are relevant to the specifics of the study.

At the end of the study, we will save some of the data in case we need to check it or for future research.

We will make sure no-one can work out who you are from the reports we write. The following information pack tells you more about this.

How will we use information about you?

Imperial College London is the sponsor for this study and will act as the data controller for this study. Being a Data Controller means that we are responsible for looking after your information and using it appropriately plus are responsible for explaining this to you. Imperial College London will keep your personal data for:

- Ten years after the study has finished in relation to data subject consent forms.
- Ten years after the study has completed in relation to primary research data.

The study is expected to finish by September 2028.

For more information / confirmation regarding the end date please contact the study team, see '**Where can you find out more about how your information is used?**' for contact information.

Information to be collected

We will need to use information (including personal data and data created as part of the study) from you for this research project. This information will include your Google ID, name and contact details linked to your Google Account. Optionally it will include your age and gender if you chose to share this information.

People within Imperial College London and study team (see section 'Sharing your information with others') will use this information to do the research or to check your records (see information to be collected) to make sure that the research is being done properly and the information held (such as contact details) is accurate. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead. We will keep all information about you safe and secure.

- Data management plans have been created and reviewed in line with Imperial's Information Governance Policy Framework. This covers the collection, movement, processing and storage of the data.
- Data will be stored in a secure environment to underpin security measures.
- Robust pseudonymisation has been implemented to prevent identification.
- Access controls have been implemented to ensure only key personnel can access the data.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

Legal Basis

As a university we use personal information to conduct research that will either be in the public interest, or the legitimate interests of the C

ollege whose interests are to conduct world leading research and innovation aiming to deliver transformative impact for society. Our legal basis for using your information under the General Data Protection Regulation (GDPR) and the Data Protection Act 2018, is as follows:

Imperial College London - "performance of a task carried out in the public interest" or 'legitimate interests' held by the controller. Where special category personal information is involved (most commonly health data, biometric data and genetic data, racial and ethnic data etc.), Imperial College London relies on "scientific or historical research purposes or statistical purposes.

We will conduct scientific research in compliance with the law and the recommendations and guidance published by the UK Information Commissioners Office (ICO). This will follow similar rules to health and social care research but may not meet the definition of the College's public interest task or requirement. In such cases we will be holding and using your data for what are called our "legitimate interests" where, as previously stated, the College aims to conduct world leading research and innovation aiming to deliver transformative impact for society. Scientific research should serve the public interest, which means that we have to demonstrate that our research has societal impact serving the interests of society as a whole.

International Transfers

We may share data about you outside the UK for research related purposes to:

- Where necessary to share with a third-party organisation who are also involved in the study.
- Where data has been collected from outside the UK and requires additional transfer(s) as part of the study activity.

If this happens, we will only share the data that is needed. We will also make sure you can't be identified from the data that is shared where possible. This may not be possible under certain circumstances – for instance, if you have a rare illness, it may still be possible to identify you. If your data is shared outside the UK, it will be with the following sorts of organisations:

- Other research institutions, such as universities; hearing aid research companies, such as Sonova International, who are supporting this research.

We will make sure your data is protected. Anyone who accesses your data outside the UK must do what we tell them so that your data has a similar level of protection as it does under UK law. We will make sure your data is safe outside the UK by doing the following:

- The countries your data will be shared with have an adequacy decision in place. This means that we know their laws offer a similar level of protection to data protection laws in the UK.
- We do not allow those who access your data outside the UK to use it for anything other than what our written contract with them says.

Sharing your information with others

We will only share your personal data with certain third parties for the purposes referred to in this participant information sheet and by relying on the legal basis for processing your data as set out above.

- Other Imperial College London employees (including staff involved directly with the research study or as part of defined secondary activities which may include support functions, internal audits, ensuring accuracy of contact details etc.), College agents, contractors and service providers (for example, suppliers of printing and mailing services, email communication services or web services, or suppliers who help us carry out any of the activities described above). Our third-party service providers are required to enter into data processing agreements with us. We only permit them to process your personal data for specified purposes and in accordance with our policies.
- The following Research Collaborators / Partners in the study:
 - Sonova – collected response data will be shared as part of regular progress reports and in any publications. Data will be shared to facilitate their supervision of the PhD project. Response data

will be pseudonymized before it is shared with Sonova and they will not be able to identify you directly from the shared data.

- Data will also be temporarily held securely in the cloud in a Google account belonging to the Audio Experience Design research team. This is necessary to enable the online functionality of the listening test. All data will be removed from the cloud after the test is completed (September 2028) and transferred to a secure, password-protected drive within the Imperial College network for the duration of the required ten year retention period.

Potential Use of Study Data for Future Research

When you agree to take part in a research study, the information collected as part of the study may, with your consent, be provided to researchers running other research studies in this organisation and in other organisations. These organisations may be universities or organisations involved in research in this country or abroad. Your information will only be used by organisations and researchers to conduct research in accordance with all relevant legislation including the GDPR (UK GDPR and EU GDPR 2016/679), the Data Protection Act 2018.

This information will not identify you and will not be combined with other information in a way that could identify you, used against you or used to make decisions about you.

Commercialisation

Samples / data from the study may also be provided to organisations not named in this participant information sheet, e.g. commercial organisations or non-commercial organisations for the purposes of undertaking the current study, future research studies or commercial purposes such as development by a company of a new test, product, service or treatment. We will ensure your name and any identifying details will NOT be given to these third parties, instead you will be identified by a unique, anonymized study number.

Aggregated (combined) or anonymised data sets (all identifying information is removed) may also be created using your data (in a way which does not identify you individually) and be used for such research or commercial purposes where the purposes align to relevant legislation (including the GDPR) and wider aims of the study. Your data will not be shared with a commercial organisation for marketing purposes.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have. You have the right to ask us to remove, change or delete data we hold about you for the purposes of the study. We might not always be able to do this if it means we cannot use your data to do the research. If so, we will tell you why we cannot do this.

Where can you find out more about how your information is used?

You can find out more about how we use your information.

- by asking one of the research team
- by sending an email to j.webb24@imperial.ac.uk or l.picinali@imperial.ac.uk
- by ringing us on 07935870963.

Complaint

If you wish to raise a complaint about how we have handled your personal data, please contact the research team first by sending an email to j.webb24@imperial.ac.uk or by ringing us on 07935870963.

Following our response, if you are not satisfied please contact Imperial College London's Data Protection Officer via email at dpo@imperial.ac.uk, via telephone on 020 7594 3502 and/or via post at Imperial College London, Data Protection Officer, Faculty Building Level 4, London SW7 2AZ.

If you remain unsatisfied with our response or believe we are processing your personal data in a way that is not lawful you can complain to the Information Commissioner's Office (ICO) via www.ico.org.uk. The ICO does recommend that you seek to resolve matters with the data controller (us) first before involving them.