

# Hearing Industry Research Consortium

# Request for Proposals (RFP) 2019:

# The joy of hearing: the impact of hearing loss and hearing aids on the affective state of the listener

## Brief Description of Purpose and Opportunity

The Hearing Industry Research Consortium wishes to support pre-competitive research that advances understanding of the impact of hearing loss and hearing aids on the emotional processing of hearing impaired listeners.

Researchers may suggest perspectives to improve the generic design and provision of hearing aids, but should not be concerned with the development of specific features of hearing-aid systems.

The funding pool for this RFP is 300,000 US Dollars, and the period for execution of projects under this RFP is between two and three years from 1 January 2020. Proposals for two-year projects are preferred. It is expected that one or two project proposals will be funded. In case of submissions for the full amount of 300’000 USD we encourage submissions to be structured such that they could be partially funded and co-funded with other submissions.

A detailed description of the application procedure, as well as the guidelines for research under this scheme and the proposed research area, can be found in the following sections.

# Research Area 2019

When considering brain emotional systems, what we like and what we want comes from two distinct reward-related systems (Panksepp, 1998; Berridge and Robinson, 1998). ‘Liking’ is mediated by the hedonic hotspots in the brain, which are involved in amplifying sensory pleasure in response to specific inputs, e.g. sweetness (Pecina et al., 2006). ‘Wanting’ is linked to a neuroanatomical system which proactively spurs us into action and engagement (such as going to the shop and buying chocolate).

‘Liking’ and ‘wanting’ rewards are both psychologically and neurobiologically dissociable, and although they often go together, they can also operate independently (Berridge et al., 2009).

Apart from cognitive processes linked to speech understanding, hearing also activates the emotional systems of the brain. This results in both pleasure and the engagement of motivational aspects of hearing. In particular, it can be assumed that hearing loss affects both reward systems; the pleasure of hearing (e.g. hearing one’s grandchild laugh) and the motivation of hearing (e.g. switching on the hearing aids so as to engage in the communication with the grandchild).

Traditionally, hearing-aid industry research has had a strong focus on improving hearing-aid benefits in areas such as speech understanding and noise mitigation. By contrast, research into the effect of hearing impairment and/or hearing-aids on emotion processing has been sparse and slow in coming (Husain et al. 2014; Picou 2016). A recent HEART workshop (Picou et al. 2018), with a goal of raising awareness of the importance of emotion in audiology, identified two general categories of emotion perception that may play a significant role in hearing impairment: a.) Inter-individual emotion perception, which comprises emotion recognition and identification (e.g. the ability of hearing-impaired listeners to recognise emotion in the speech signal), and b.) Intra-individual emotion perception, which relates to the perception of oneself’s emotional responses to external stimuli, e.g., sounds.

The purpose of this RFP is to stimulate research into the positive affective responses to sound stimuli in hearing-impaired individuals. The goal is to deepen the understanding of the impact of hearing impairment and hearing-loss compensation on the affective state of the listener. In particular, we are interested in the involvement of the two reward systems mentioned above in hearing-impaired individuals, namely, the pleasure of hearing and the motivational aspects of hearing, and their impact on the quality of life of hearing-aid users.

## Examples of research topics include, but are not limited to:

* + Do hearing aids restore both the pleasure and motivational aspects of hearing at the neurological and the experiential level?
  + Social bonding is increased through play, where laughter is one of the most common occurrences, engaging the ‘like’ system and triggering the release of endogenous opiates (Panksepp, 1998; Panksepp, 2010). Can the pleasure of social bonding be investigated in both aided and unaided hearing-impaired listeners, by measuring physiological, neuroanatomical and behavioural responses to positive affective stimuli such as laughter?
  + Research on the feelings of pleasure and reward evoked by music has introduced novel methods and deepened our understanding of music processing (Bold and Zatorre, 2001; Mas-Herrero et al. 2018, Ferreri et al., 2019; Gold et al., 2019). Can this knowledge about the positive affective impact of music be used to investigate the loss and restoration (reactivation) of the emotional aspects of unaided and aided hearing?
  + Another path to understanding the emotional impact and pleasure of sound is research on the emotional impact of acoustics (Lawless and Vigeant, 2015; Pätynen and Lokki, 2016). Can similar methods be used to examine listening pleasure in hearing-impaired listeners?
  + The concept of personality describes individual differences in cognitive, emotional and motivational aspects of mental states that result in stable behavioural action patterns (Montag and Panksepp, 2017). Does personality influence the pleasure of hearing in hearing-impaired listeners?
  + How is the pleasure of hearing influenced by hearing-aid signal processing?
  + Can the affective state of listeners be measured using sensors available in current wearable technology (e.g. for heart rate, blood pressure or skin conductance) and be used to give a hearing-aid wearer feedback about his/her affective state? How could such information provide benefit for a hearing-aid user?

Berridge, K. C., & Robinson, T. E. (1998). What is the role of dopamine in reward: hedonic impact, reward learning, or incentive salience? Brain research reviews, 28(3), 309-369.

Berridge, K. C., Robinson, T. E., & Aldridge, J. W. (2009). Dissecting components of reward: ‘liking’, ‘wanting’, and learning. Current opinion in pharmacology, 9(1), 65-73.

Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. Proceedings of the National Academy of Sciences, 98(20), 11818-11823.

Ferreri, L., Mas-Herrero, E., Zatorre, R. J., Ripollés, P., Gomez-Andres, A., Alicart, H., ... & Riba, J. (2019). Dopamine modulates the reward experiences elicited by music. Proceedings of the National Academy of Sciences of the United States of America.

Gold, B. P., Mas-Herrero, E., Zeighami, Y., Benovoy, M., Dagher, A., & Zatorre, R. J. (2019). Musical reward prediction errors engage the nucleus accumbens and motivate learning. Proceedings of the National Academy of Sciences, 201809855.

Husain, F. T., Carpenter-Thompson, J. R., & Schmidt, S. A. (2014). The effect of mild-to-moderate hearing loss on auditory and emotion processing networks. Frontiers in systems neuroscience, 8, 10.

Lawless, M. S., & Vigeant, M. C. (2015). Investigating the emotional response to room acoustics: a functional magnetic resonance imaging study. The Journal of the Acoustical Society of America, 138(4), EL417-EL423.

Mas-Herrero, E., Dagher, A., & Zatorre, R. J. (2018). Modulating musical reward sensitivity up and down with transcranial magnetic stimulation. Nature Human Behaviour, 2(1), 27.

Montag, C., & Panksepp, J. (2017). Primary emotional systems and personality: an evolutionary perspective. Frontiers in psychology, 8, 464.

Panksepp, J. (1998). Affective neuroscience: The foundations of human and animal emotions. Oxford University Press.

Panksepp, J. (2010). Emotional causes and consequences of social-affective vocalization. In Handbook of behavioral neuroscience (Vol. 19, pp. 201-208). Elsevier.

Pätynen, J., & Lokki, T. (2016). Concert halls with strong and lateral sound increase the emotional impact of orchestra music. The Journal of the Acoustical Society of America, 139(3), 1214-1224.

Pecina, S., Smith, K. S., & Berridge, K. C. (2006). Hedonic hot spots in the brain. The Neuroscientist, 12(6), 500-511.

Picou, E. M. (2016). How hearing loss and age affect emotional responses to nonspeech sounds. Journal of Speech, Language, and Hearing Research, 59(5), 1233-1246.

Picou, E. M., Singh, G., Goy, H., Russo, F., Hickson, L., Oxenham, A. J., ... & Launer, S. (2018). Hearing, emotion, amplification, research, and training workshop: Current understanding of hearing loss and emotion perception and priorities for future research. Trends in hearing, 22, 2331216518803215.

## Procedure

## Submission

To submit a proposal, complete the application form available on the IRC website [www.hearingirc.com](http://www.hearingirc.com), and submit the completed application form as a **single** PDF file on the proposal submission form at http://proposals.hearingirc.com. You will know that your application has been received when you receive a confirmation via e-mail.

## Review

Proposals will be reviewed by the IRC board and their nominated representatives. The review process may include further dialogue with the applicant for clarification and/or revision.

## Deadlines

Submission of proposals: 19th August 2019.

Announcement of grant winner by 31st December 2019.

## Contact

Further information and enquiries may be directed to ‘contact@hearingirc.com’.

The mission, activities and membership of IRC are described in detail on the IRC website [www.hearingirc.com](http://www.hearingirc.com).

## Guidelines

Projects must be defined pieces of research with clearly stated objectives, experimental plan, and expected outcomes. The level of ambition should correspond to the funding magnitude.

The funding pool for this RFP is 300,000 US Dollars, and the time period for execution of projects under this RFP is 2-3 years from 1st January 2019. Proposals for projects of two years duration are preferred. It is envisaged that one or two project proposals will be funded.

There is no restriction regarding how many proposals may be submitted by the same investigator or institution.

Proposals may include aspects of co-funding from other sources. However, it must be possible to separately identify what the IRC Grant is supporting, and co-funding must not hinder the fulfillment of the terms and conditions of the IRC Grant.

The proposal should indicate if the cost is scalable to 150,000 US Dollars.

The proposal should provide evidence that the proposed research team has experience in all of the relevant disciplines that impact the successful execution of the project.

## Terms and Conditions

The terms and conditions for IRC research grants are given below where IRC is referred to as “we”, “us” or “our”, the Institution administering the grant is referred to as “you”, “your” or “yours”, and the Principal Investigator managing the execution of the Research is referred to as “PI”.

**Research Practice**

* + The PI must conduct the Research as it is described in the Application and in accordance with any other reasonable requirements notified to you by us from time to time.
  + You must obtain institutional and personal licenses and consents from relevant ethical committees as necessary for proper conduct of the Research, and adhere to guidelines from relevant authorities in your Territory.

**Finance**

* + The IRC Grant is payable only to you and may only be passed in whole or in part to a third party outside your institution in accordance with explicit provisions of the submitted project plan.
  + The IRC Grant will be paid in two annual installments during the Term. The first payment will be made on or before the Start Date, or once a counter-signed copy of the offer letter is received, whichever is later. The second payment will be made within one month of your submission of the progress report at 12 months, if IRC’s evaluation of that report determines that satisfactory progress is being made on the Research.
  + IRC policy is to pay indirect costs (institutional overhead) amounting to max. 15% of the total grant amount.
  + Payments will be made in US Dollars and the sums paid over to you will be inclusive of any currency conversion fees that may be incurred.
  + The IRC Grant must be used exclusively for the purpose of the Research.
  + If we become aware that the IRC Grant or any part of it is not being used exclusively for the Research we may withhold any payments not yet made, and recover any part of the IRC Grant which has not been properly used.
  + One year after the Start Date you must send us a signed statement detailing the IRC Grant income and expenditure. Within two months of the End Date, you must send us a statement detailing the overall income and expenditure.
  + You must return any of the IRC Grant which remains unspent at the end of the Term.

**Dissemination and Publicity**

* + The findings from the Research must be published in an appropriate form, usually as one or more papers in a peer-reviewed journal, preferably as open access articles. Failure to do so will jeopardize any further sponsorship of the PI’s research by IRC.
  + IRC’s contribution to the Research must be acknowledged every time the Research is published or disseminated.
  + The PI must inform IRC of any press statements about the IRC Grant or the results of the Research, and should consider formulating such statements jointly with IRC.

**Reporting and Activities**

* + IRC will nominate one of its board members as a Project Owner for the granted project. The Project Owner will be the PI’s primary point of contact with the IRC regarding issues of substance during the course of the Research.
  + The PI will submit a written progress report to the Project Owner every six months after the Start Date, detailing progress of the Research and identifying successes, failures and, if appropriate, any circumstances which may prevent the Research from being completed within the Term.
  + Efforts should be made for the PI to meet the Project Owner in person for a verbal report at the end of the first and second year of the Research.
  + Given reasonable circumstances of location and events, the PI may be requested to make a report in person to the IRC board.
  + On reasonable notice, you will permit a person delegated by IRC to observe the Research.
  + Within three months of the End Date, the PI will also provide us with a comprehensive report of the Research.
  + You grant us the right to use any non-confidential information from the reports for publicity purposes.

**Intellectual Property**

* + The topic areas within which IRC issues Requests for Proposals are considered pre-competitive and unlikely to generate valuable Intellectual Property (IP). For this reason, and for simplicity of administration, it is a requirement that you do not take any steps to protect any IP which might arise during the project, but on the contrary that the PI publishes the results of the Research in a timely and complete manner, such that the results remain free of protective restrictions and available for all.

**Variation and Termination**

* + No amendments to the grant will be effective or enforceable unless agreed by us and evidenced in writing.
  + The PI must inform us as soon as practicable of any significant divergence from the original aims and directions of the Research. We may withhold any payments not yet made if we are no longer satisfied that the research is in keeping with our objectives.
  + If you or the PI do not comply with the terms of this offer we may give you 28 days written notice to remedy the non-compliance or provide acceptable evidence it will be remedied in a timely fashion. If you do not remedy the failure or provide suitable evidence, we may terminate the IRC Grant, and you will not be entitled to any further payments.
  + If we believe that satisfactory progress is not being made on the IRC Grant, we will notify you in writing. If there is a not a prompt and sufficient improvement, we will terminate the Grant with immediate effect and you will not be entitled to any further payments. Any decision as to whether satisfactory progress is being made will be entirely at our discretion.

**General**

* + You are responsible for ensuring that the PI adheres to all of the terms of the Grant.
  + Any staff recruited by you in connection with the Research are your employees and you shall be solely responsible for them and for any costs, taxes and liabilities arising under any present or future employment law or regulations.

**Governing Law**

* + Without prejudice to your obligations to comply with the laws and regulations of your Territory, the terms of this offer will be interpreted in accordance with the laws of Denmark, and courts of Denmark will have exclusive jurisdiction.

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