Hearing Progress
Update on our search for treatments and cures
Welcome

Hearing Progress 2017 is our latest update on the progress we’re making to accelerate the development of technology and treatments to help people confronting deafness, tinnitus and hearing loss.

Our work is vital. One in six people have hearing loss and one in 10 have tinnitus. Hearing loss can have a devastating impact on communication, making daily life a real challenge, whether at work, at school, or when socialising with friends and family. As a result, people feel isolated and cut off, which can lead to depression and other mental health problems. And research shows that the risk of developing dementia is significantly increased among people with hearing loss.

The impact that tinnitus can have on someone’s life is also often underestimated. For some people, tinnitus leads to depression, anxiety, stress and sleep problems.

So hearing loss and tinnitus matter, yet for the millions of people seeking treatments, and ultimately a cure, options are largely limited to hearing aids and cochlear implants for hearing loss, and counselling and sound therapy for tinnitus.

That’s why our research is so important. We want to find new ways to prevent hearing loss, silence tinnitus and restore hearing. And we’re also working hard to improve the technology available to help people.

Last year we invested £1.7m in supporting more than 100 research projects around the world. Recent achievements include finding a way to study human inner-ear cells outside the body, which will help speed up the discovery of new treatments to protect and regenerate cells vital to hearing. We’ve also made significant progress towards understanding how loud noise leads to permanent changes in brain activity that are linked to tinnitus, and, importantly, how we might be able to prevent these changes.

In this edition of Hearing Progress you can read more about these and other achievements. None of this work would be possible without the generosity of all our supporters, who are helping us bring forward the day when there will be treatments, and ultimately cures, for all types of hearing loss and tinnitus.

Ralph Holme, Director of Research
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The personal and social costs of hearing loss are huge. Left untreated or ignored, it cuts people off from friends and family, and has been linked to depression and other mental health problems.

As hearing loss worsens, so the risk of dementia increases, doubling in someone with mild hearing loss, and increasing even further in someone with moderate or severe hearing loss.

Hearing loss also has a significant impact on quality of life, on education and employment. People who are severely or profoundly deaf are four times more likely to be unemployed than the general population. It costs our economy up to £30bn each year, and that doesn’t include the cost to the NHS and private healthcare providers of treating it.

Tinnitus is also a common problem, affecting more than 6 million people in the UK to some degree. For a small proportion of those people, it’s so severe that it seriously affects their quality of life, leading to anxiety and depression.

Why our research matters

Hearing loss is associated with age and, with an ageing population in the UK, it’s a growing problem. The figures show, in fact, that we are facing a potential public health crisis.

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How we fund research

Capacity
We support the training of the next generation of hearing researchers in the UK, to increase the number of talented scientists working in the field.

Discoveries
We fund innovative projects around the world to generate discoveries that will lead to new treatments.

Treatments
We support the translation of promising discoveries into treatments ready to be tested in the clinic. We also work with industry and clinicians to ensure new treatments are clinically tested and quickly brought to market.

Awareness
We get people excited about the prospects of cures and treatments so they will support our cause, and to aid recruitment into clinical trials.

Currently, there are no cures for hearing loss, with treatment largely limited to hearing aids and cochlear implants. While these devices bring benefit to many people, they’re not perfect – particularly in noisy environments, where many people using them still struggle to hear well. There’s a great deal of work yet to do to improve how they work.

For tinnitus, there are no cures and no treatments, only ways to help people cope with it.

If we are to avoid the looming health crisis, we must now work towards a future in which effective medical devices, treatments and cures for hearing loss and tinnitus are available to everyone who needs them. To reach that goal, we need research.

We support research to:

• improve the diagnosis of hearing loss, so that people can receive the best treatment as soon as possible

• increase the benefit gained from medical devices (such as hearing aids and cochlear implant technology), so that they work well in noisy situations, and can reproduce the rich quality of sound

• increase understanding of the biological causes of hearing loss and support the development of treatments to prevent hearing loss

• advance cell, gene and drug-based therapies to restore hearing

• understand the biological causes of tinnitus and support the development of effective treatments to silence tinnitus.

In this report, we only have room to cover a fraction of the projects that we currently fund, and we have many more in the pipeline. If you’d like to find out more about our Biomedical Research programme, please visit our website - actiononhearingloss.org.uk/finding-cures – or get in touch with our Information Line (contact details on the back cover).
Restoring hearing

Prevention is better than cure, but isn’t always possible. With millions confronting daily the challenges of hearing loss, we urgently need to find ways to improve and restore hearing.

For most people, hearing loss is the result of damage to the cochlea, the delicate inner-ear structure that detects sound vibrations. Or to the auditory (hearing) nerve, which carries this information to the ‘hearing parts’ of the brain. Or both.

Hearing aids amplify sound to make it easier for people with damage to the cochlea to hear. For those with more severe loss of hearing, a cochlear implant bypasses this damage to stimulate the auditory nerve directly. But our ultimate goal is to develop treatments that actually fix the root causes of hearing loss to restore natural hearing.

Replace, regrow, restore

We have thousands of hair cells, responsible for detecting sound, in each ear. Damage to these hair cells (and other cell types), through ageing or exposure to loud noise, can cause hearing loss.

Our ears can’t replace damaged or lost hair cells, which is why most hearing loss is permanent. To restore hearing, we need, therefore, to find ways to replace them or ‘trick’ the ear into regrowing them.

By studying how hair cells form in the developing ear, scientists are discovering the genes that control the growth process. Remarkably, one of these genes, called Atoh1, can convert supporting cells, which normally surround hair cells, into new hair cells. A clinical trial in the US is underway to see whether a gene therapy that switches this gene on can restore hearing.

Meanwhile, in Europe, scientists are about to start a clinical trial of a drug that blocks the activity of a protein called ‘Notch’, which in the developing ear stops supporting cells from becoming hair cells. In animal studies, the drug has been shown to convert
supporting cells into hair cells. We will soon find out if the same is true in people.

The difficulty, however, is that we don’t know how successful these approaches will be. They rely on turning supporting cells into hair cells – but at the expense of reducing the number of supporting cells in the ear. Running out of supporting cells may limit how much hearing is restored.

Reversing to go forward

As the inner ear develops, hair cells and supporting cells both grow from the same ‘precursor’ cells. Crucially, precursor cells can also produce new cells to replace lost ones. This points to an interesting possibility.

If we can turn surviving supporting cells back into precursor cells, the newly created precursor cells would then produce both new hair cells and new supporting cells. This could prove to be a much more efficient way of restoring hearing.

To explore this possibility, we are funding Dr Nico Daudet and Dr Magdalena Zak at University College London’s Ear Institute to work on discovering which genes we need to activate to achieve this.

Can stem cells turn the tide?

We have been funding a team of scientists at the University of Sheffield for over 10 years to develop ways of transplanting healthy new cells safely into the cochlea to replace damaged or lost cells.

The Sheffield researchers are working with human stem cells, which can turn into any type of cell in the body, including the hair cells that detect sound and the nerve cells that carry this information to the brain.

With our support, the researchers have already discovered how to turn stem cells into both hair cells and auditory nerve cells in the laboratory. They have also used them to repair damaged auditory nerves in deaf animals, restoring their hearing.
Now, they’re focusing on developing ways to allow these cells to be used safely and efficiently in people. By encasing the cells in a special type of gel, they hope to be able to prevent the body’s immune system from rejecting the transplanted cells and keep them precisely where they are needed.

**3D vision for future treatments**

We have been supporting research at Indiana University in the US, where Professor Eri Hashino has developed a new way of using human stem cells to grow inner-ear tissue, including cells similar to sound-sensing hair cells.

This new method involves growing the cells in three-dimensional structures, rather than as a flat layer on the surface of a culture dish. This allows the cells to interact with each other more like they would inside the body. It also means that the cells grow in a way that more closely resembles how they develop in the inner ear.

It is incredibly difficult to carry out research on the cochlea to develop new treatments, because the cells that scientists need to study are difficult to get at, few in number and easily damaged. Being able to grow and study human cochlear cells outside the body will help speed up the discovery of new treatments to protect and regenerate hair cells.
Improving cochlear implants

Cochlear implants can greatly improve hearing, but produce degraded and artificial sound compared to what we hear naturally. That’s why we continue to invest in improving this life-changing technology.

The inner ear, or cochlea, contains thousands of hair cells, which convert sounds into electrical signals for the brain to interpret. Unfortunately, these hair cells can become damaged or lost, and cannot be repaired or replaced. As a result, the ear can no longer convert sound signals into electrical signals, the brain stops receiving information, and hearing loss occurs. This is known as ‘sensorineural’ hearing loss.

Hearing aids help to improve hearing by making sounds louder. However, for people with severe sensorineural hearing loss, no matter how much they amplify sounds, there just aren’t enough hair cells to turn them into the electrical signals that the brain needs.

In these cases, a cochlear implant can help by replacing the hair cells, transmitting the necessary electronic signals along the hearing nerve to the brain. However, many people with a cochlear implant...
implant can find the artificial sounds difficult to understand, especially speech. Essentially, they have to re-learn how to hear, which can take a lot of time and effort, and be mentally tiring.

**Implants: the next generation**

In the 1980s, our Technology team helped to develop the very first cochlear implant used in the UK. Now, more than 35 years on, we are supporting research into the development of the next generation of cochlear implants.

For cochlear implants to work, the platinum electrode arrays have to bypass the damaged hair cells and make direct contact with the hearing nerve, so that the electrical signals can reach the brain. However, scar tissue can form, preventing good contact between the electrodes and the hearing nerve. This reduces how well the implant works, and how much a person can hear.

**The living electrode**

Dr Rylie Green from Imperial College London is working to overcome this problem.

We funded an undergraduate student, Robert Toth, to work in Dr Green’s lab over the summer on a new ‘hydrogel’ coating for the electrode array, a soft, degradable material intended to reduce scar tissue.

The material can also be loaded with nerve cells, designed to grow and form long-term connections between the electrode array and the hearing nerve. This is called a ‘living electrode’. Development of living electrodes could lead to the next generation of cochlear implants, capable of improving people’s understanding of speech.
Faizah Mushtaq, one of our funded PhD students at the University of Nottingham, sets up an experiment to measure a volunteer’s brain activity using fNIRS (functional near-infrared spectroscopy) as part of her studies.
Shining new light on the brain

Currently, how well a person can hear with a cochlear implant is assessed using a speech test: a recorded sentence is played and the person repeats back what they hear. However, this test can’t be used with infants or children too young to tell us what they can hear.

Clearly, clinical professionals urgently need a different way to measure how well children’s implants are working. Measuring brain activity could tell us whether sound information from the implant is reaching the brain, and whether the implant needs adjusting to improve how much the child can hear.

Professor Doug Hartley, consultant and cochlear implant surgeon, and his research team at the NIHR Nottingham Biomedical Research Centre, are using a new way of measuring brain activity in adults and children with cochlear implants – functional near-infrared spectroscopy (fNIRS).

The technique, which uses light to measure brain activity, is safe to use with a cochlear implant, unlike other methods, such as functional magnetic resonance imaging (fMRI), which can damage an implant’s metal and magnetic components.

We are funding Faizah Mushtaq’s PhD studies in Professor Hartley’s lab. Faizah will measure brain activity in children who can hear very well with an implant, and in children who cannot. Looking at the differences in brain activity could help to identify those children who cannot hear very well with their implant, and who therefore may be at risk of developing poor language skills.

This could help professionals to intervene at the earliest possible stage so that children get the rehabilitation they need to benefit fully from their implants.

One step closer

“My interest in hearing research arose from my work as an audiologist, as I had the opportunity to experience first-hand the impact hearing loss has on children and their families.

“My research is bringing us one step closer to a technique that can be used in clinics to identify children, and even babies, who are struggling to hear with their cochlear implants. I hope that this will help to change how we support young cochlear implant users, especially as the ability to hear well is so important for child development and has lasting effects.

“Action on Hearing Loss funding has enabled me to pursue this exciting and vital area of research, which I hope will have a real impact on quality of life for many young children with cochlear implants.”

Faizah Mushtaq, Action on Hearing Loss-funded PhD student
Gained in translation

There are no approved treatments for hearing loss or tinnitus, and potential treatments face a lack of funding for the ‘translational research’ needed to get discoveries in the lab into clinical trials. That’s where TRIH comes in.

Through our Translational Research Initiative for Hearing (TRIH), we provide funding to researchers and small biotechnology and pharmaceutical companies to develop potential treatments to the point where they can attract further support from the pharmaceutical industry or other investors.

Combatting the effects of noise and age

Hearing loss affects 360 million people in the world – more than 5% of the global population. Though the condition has many causes, ageing is the most common.

Throughout our lives, we lose hair cells, the sound-sensing cells in our ears that allow us to hear. As we can’t replace them, the older we get, the fewer we have. That puts us all at risk of losing our hearing later in life.

Noise is another major cause of hearing loss – one that’s becoming more common in younger people. 1.1 billion young people (aged 12–35) are at risk of losing their hearing due to exposure to recreational noise, for example, at music concerts or in bars and clubs. Noise-induced hearing loss is also the second most common service-related disability among military veterans.

Hearing loss is a significant burden. Those affected frequently experience feelings of isolation and depression. Despite this, there are no medicines approved to treat age- and noise-related hearing loss.

That’s why we’re funding an international team of scientists, made up of the French biotech company PRAGMA Therapeutics and Professor Robert Frisina’s team at the Global Center for Hearing and Speech Research at the University of South Florida in Tampa, to develop drugs to treat these conditions.
Solving the glutamate problem

Glutamate is a chemical ‘neurotransmitter’ in the brain that carries signals across a synapse (a tiny gap) between neurons. It also carries signals across the synapse between the hair cells in the ear and the auditory (hearing) nerve, which then takes the sound information to the brain.

At the synapse, auditory nerve cells produce a protein called ‘mGlu7’ on their surface. This detects glutamate and when glutamate binds to mGlu7 it activates the auditory nerve to transmit a message to the brain. When hair cells are damaged by ageing or noise, they can release too much glutamate, damaging the auditory nerve and causing hearing loss.

Previous studies in people have shown that the gene that produces the mGlu7 receptor is linked to susceptibility to age-related hearing loss. This suggests that if we could alter how mGlu7 functions through medication, we could help prevent or treat hearing loss.

PRAGMA Therapeutics is developing drugs that can change how the mGlu7 protein works, and is testing whether these drugs can reduce age- and noise-related hearing loss in animals. The aim is to develop drugs that can be taken in tablet form and reach the ear from the bloodstream, avoiding the need for injections.

By supporting this international collaboration, we hope to help speed up the development of these new treatments.
Silencing tinnitus

We still don’t fully understand what causes tinnitus or how to stop it. That’s why we fund research to understand more and find treatments that can efficiently silence its persistent and disturbing phantom sounds.

Around 10–15% of adults have tinnitus – a ringing, hissing, roaring or any other sound in one or both ears or in the head, which has no external source. It has a number of possible causes, but is most frequently associated with exposure to loud sounds that damage the ear and ultimately cause changes to the brain.

Many of us may have experienced some sort of temporary tinnitus after a night out at a concert, but, for some people, tinnitus becomes permanent.

In the UK alone, 6 million people – around one in 10 of us – have tinnitus. For 600,000 of these people, tinnitus causes serious anxiety and stress, in some cases leading to depression and sleep disorders. Tinnitus is also one of the major disabilities reported by military veterans exposed to explosions and artillery fire.

“I can’t wait to see what comes out of all the exciting research that’s going on in the world of tinnitus and hearing loss. It’s really inspiring and innovative at the moment – gene therapy, stem cell advances, clinical trials for new tinnitus drugs and devices. Worldwide, tens of millions of people are living with tinnitus, with more than a billion young people at risk of tinnitus and hearing loss. A cure or treatment could avert a lot of suffering.

“I’ve lived with worsening tinnitus for over 20 years. Although it doesn’t usually cause me much distress, many don’t fare so well. In extreme cases, some have taken their own lives. Any cure or treatment that avoids this needless suffering has my full support, especially as young people, in particular, seem ignorant of the dangers of loud music.

“I hope within the next few years, and certainly within my lifetime, that there will be an effective cure or treatment. That excites me and I’m proud to be part of the movement striving to make a difference. I’m also humbled by the work of organisations like Action on Hearing Loss, which work ceaselessly to support people with tinnitus and hearing issues, and invest directly in the research that will one day end an affliction touching millions of people.”

Tre Lowe, DJ and Action on Hearing Loss volunteer
Changes in the brain

We funded Thomas Tagoe as a PhD student several years ago, at the University of Leicester, where he worked in Dr Martine Hamann’s lab. His research has now shed new light on what happens in the brain when tinnitus becomes established.

When we are exposed to loud noise that causes temporary hearing loss, cells in the dorsal cochlear nucleus, in the hearing part of the brain, respond by boosting the sound signals coming from the ear. When this boosting signal is stored as a ‘memory’ in our brain, and persists even after the temporary hearing loss is gone, it seems the result is tinnitus.

Thomas discovered that repeated exposure to loud noise can lead to changes in the dorsal cochlear nucleus that cause tinnitus. He also found that it might be possible to use magnesium to prevent these changes and the development of tinnitus after exposure to loud noise. This important finding points towards a potential treatment for tinnitus.

Stress, anxiety and tinnitus

We are currently funding a project led by Dr Amanda Lauer, at Johns Hopkins University in the US, to investigate how high levels of anxiety and stress affect both susceptibility to developing tinnitus and its severity.

Serotonin, a neurotransmitter in the brain, is involved in mood control, and is linked to anxiety and stress-related disorders. It is also involved in controlling auditory nerve cells, which carry sound information from the ear to the brain.

Amanda and her team will investigate a specific type of serotonin receptor, a protein on nerve cell surfaces that triggers activity in the cells when it detects serotonin. The aim is to uncover what role the serotonin receptor plays in tinnitus. She will also test new drugs that target these receptors to see whether they can block or silence tinnitus.

Exploring an interesting pathway

“Many people with tinnitus also report high levels of anxiety or distress, but we don’t know if this increased anxiety is caused by tinnitus or pre-existing stress. We also don’t know if the anxiety makes the tinnitus worse or if they affect each other. The grant from Action on Hearing Loss allows us to study this in more detail.

“We are particularly interested in changes in a neural (brain) pathway involved in stress, anxiety and, possibly, tinnitus. This pathway connects directly to the auditory (hearing) system, and its function is impaired by stress, anxiety and noise-induced hearing loss.

“We plan to see if changing the activity of a specific serotonin receptor in this pathway prevents or improves tinnitus. Our studies will help with future experiments investigating the underlying processes in the brain that lead to tinnitus, and in initial tests of a potential treatment.”

Amanda Lauer, Johns Hopkins University, Baltimore, US
Focus on our Flexi Grants

Our Flexi Grant scheme provides small grants to researchers around the world, to support a variety of activities that benefit the research field, as well as people with hearing loss or tinnitus.

Through our Flexi Grants, we support researchers to do things they might otherwise struggle to find funding for:

- carrying out a small study that increases their chances of securing larger grants from other funders
- developing a new collaboration with another researcher or lab
- opening up a new area of hearing research
- gaining valuable new skills
- opening up resources they wouldn’t otherwise be able to access, including access to people with hearing loss or tinnitus.

Kick-starting epigenetics in Tel Aviv

In 2013, we provided initial funding for Karen Avraham’s lab at the University of Tel Aviv to research the ‘epigenetics’ of inner-ear development. Epigenetics is the study of the biological processes that switch genes on and off in cells, but which don’t change the genes themselves – that is, they don’t affect their DNA sequence.

Using our funding, the group was able to set up and run a pilot study to assess how these epigenetic processes change as cells in the inner ear develop.

The researchers were then able to use their findings to apply for a much larger grant to continue the work, and have now set up a full programme of epigenetics research in their lab. Without our funding, they would have struggled to obtain the larger grants and get started on the work – a good example of how our funding can be used to kick-start larger research programmes.
A person with hyperacusis has a lower tolerance for ordinary environmental sounds than most people. The condition is thought to affect around 15% of people, which rises in adults with tinnitus to 40%. Hyperacusis can affect people’s emotional wellbeing, sleep and concentration. It can cause anxiety and is associated with tinnitus, hearing loss, migraine and many other conditions.

As with tinnitus, current treatments help people to cope with hyperacusis. There’s no cure and very little research into it is being conducted, or ever has been.

We’ve funded a research team in Nottingham to initiate a James Lind Alliance (JLA) Priority Setting Partnership (PSP) for hyperacusis. This will involve clinicians and people with hyperacusis identifying the top 10 priority research questions in hyperacusis of direct relevance to them. Ultimately, these priorities should lead to better outcomes and improved quality of life for people with hyperacusis.
Finding an accurate way to measure tinnitus

In the UK, tinnitus affects more than 6 million people to some degree. There are currently no cures, just ways to help people cope with it.

One reason that treatments are taking so long to develop is that we presently have no way of measuring someone’s tinnitus objectively (in a way that isn’t affected by a personal judgement, either by the person with tinnitus or the person measuring it).

Currently, clinical trials of potential treatments use questionnaires and subjective measures (influenced by personal judgement) to assess their effects. These measures can be strongly influenced by placebo effects, in which a patient’s belief produces the benefit not the actual treatment itself. This makes it difficult to interpret and use the questionnaires as reliable evidence that a treatment is working.

We’re funding researchers at the Bionics Institute in Australia to investigate whether functional near-infrared spectroscopy (fNIRS) can be used as an objective measure of tinnitus. The technique has many advantages that make it ideal for regular clinical use: it is non-invasive, cheap and can be used in people with implanted devices like a cochlear implant; and it can be used with children and infants.

Such a measure would speed up and greatly improve how tinnitus clinical trials are carried out and, hopefully, lead more quickly to new treatments.
Auditory processing disorder

To better our understanding of auditory processing disorder, and improve care for those with the condition, we’re funding researchers to investigate the difficulties people face and to develop diagnostic tests.

Someone with auditory processing disorder (APD) appears to have normal hearing when assessed using a standard hearing test. Despite this, they have difficulties processing and making sense of sounds, including complicated and fast-changing sounds like speech.

APD is often present from a young age. There is growing interest in APD in children, with suspicions that it leads to learning difficulties with language and literacy, and is associated with children doing badly in school. Auditory processing difficulties can also affect older people who have no detectable hearing loss, because, as the brain ages, its ability to process sounds deteriorates.

APD is not well understood and difficult to diagnose. Researchers and clinicians do not even agree about what it really is, and there is no routine test for it. As a result, many people with APD are not being identified or helped.

Mind the gaps

People with APD commonly complain that they find it difficult to understand speech, especially in noisy environments. To understand why, we need to appreciate that following a conversation in a noisy environment involves being able to identify short gaps between sounds. Because people with APD have difficulty detecting these gaps, speech becomes jumbled.

Unfortunately, standard hearing tests don’t identify this problem. They only tell us that a person can hear something, not whether they can understand what they’re hearing. That’s why we’re supporting Dr Jennifer Linden’s work at University College London’s Ear Institute.
Previous work by Dr Linden’s team suggests that people may not be able to detect gaps in sounds because their brains struggle to identify when individual sounds have ended. In her current research, Dr Linden is examining brain responses in mice to find out if this is indeed the case. Her work could lead to a better understanding of APD and how researchers and clinicians think about the condition. Ultimately, Dr Linden’s research could lead to a way to accurately diagnose APD and improve its treatment.

Tom, 19, plans to study chemistry at a top university. Yet, up to the age of 14, Tom’s life was one of struggle and ‘behavioural issues’.

As a baby, Tom had problems with his tonsils and adenoids, which were eventually removed. He also had glue ear. In year one, he kept falling asleep in class. At five, he struggled to learn numbers.

“Around the age of eight,” says Tom’s mother, Caroline, “he thought he wasn’t as good as other children because he struggled to learn.”

His parents pushed for an assessment. With dyslexia ruled out, an audiologist said Tom was unable to distinguish some words, although he had ‘A1’ hearing. In secondary school, teachers described ‘behavioural issues’, which was frustrating and upsetting for Tom. He was told to concentrate more, but would misinterpret what was being asked of him.

Finally, in August 2012, aged 14, Tom was diagnosed with APD by Great Ormond Street Hospital.

“The APD diagnosis has been really positive for Tom and a relief for us,” says Caroline. “Teaching staff at school, and then at college, started checking his understanding, because they knew he had a physical problem. He also got extra time in exams.”

Tom received a school sports award, as well as a prefect badge. Prior to his diagnosis, neither Tom nor his parents would have believed either to be possible.

“Tom doesn’t set limits on himself anymore,” adds Caroline. “Had he been diagnosed sooner, he would’ve received the support he needed sooner. This research, aiming to improve diagnosis of APD, will, hopefully, mean that other children won’t have to struggle the way our son did.”
Developing diagnostic tests for children

An alternative approach that we are supporting in order to diagnose APD, focuses on a person’s ability to tell sounds apart based on their location.

If you are listening to someone talking, and that person is close to a source of background noise, it makes it more difficult to understand what the person is saying. When the person talking and the source of background noise are further apart, the brain more easily recognises that they are different and focuses on one while ignoring the other, meaning that it is much easier to understand what the person is saying. This is known as ‘spatial release from masking’, and is related to the brain’s ability to hear sounds in three dimensions.

Children suspected of having APD seem to struggle with this kind of listening, finding it difficult to understand someone talking, even when they’re not close to a source of background noise. If we could accurately measure a child’s ability to listen in this situation, it could help us to identify children with APD and better understand the difficulties they are facing.

To this end, we’re supporting PhD student Shiran Koifman in Professor Stuart Rosen’s lab at University College London. In collaboration with clinicians at Great Ormond Street Hospital for Children, Shiran is working to develop easy and reliable tests, for future clinical use, to diagnose APD in children. We are grateful for the support of the Masonic Charitable Foundation in funding this project.
Technology for hearing loss

Technology is a lifeline for people with deafness, tinnitus and hearing loss. With rapid advances over the last decade, there are more choices than ever before. It’s time to maximise the benefits.

The first hearing aids date from the early 17th century. But it is only in the last couple of decades that the lives of people with hearing loss have been transformed through digital hearing aids and cochlear implants. Recent technological advances in artificial intelligence, automated speech and motion recognition, and the internet of things (devices interacting with each other via the internet) are opening the door to new possibilities.

In December 2016, in order to make the most of the opportunities afforded by this growth in technology, we launched our Technology Initiative for Hearing Loss. It seeks to catalyse further innovation in hearing technologies and increase people’s awareness and use of technologies that may help them.
Identifying user needs

At its heart, the Technology Initiative is about understanding the needs of people confronting deafness, tinnitus and hearing loss and finding practical ways to address them through new or improved technology.

Catalysing innovation

To catalyse innovation in areas of need, we will set technology challenges to inspire academics, developers, manufacturers and funders to collaborate and create innovative solutions to real-life problems.

Our Technology Challenges will focus on the following areas:

Alerting devices We want to make alerts for household devices and alerts outside the home more accessible and better integrated into mainstream products and devices.

Text-based communication Speech-to-text and other automated text devices can be a big help to people with hearing loss. Currently, automated text-based solutions are often inaccurate or slow, or simply unavailable. Innovation in this area would improve access to a wide range of services and entertainment for people with hearing loss.

Sign-based communication Currently, very little information is available in sign language. Automated sign language technology would greatly benefit people who use sign language, so they don’t have to rely on friends and family to communicate with the general public.

Clear audio People with hearing loss continually struggle to hear speech over background noise, in noisy restaurants, on film soundtracks or when using a phone in a noisy location. We need new technology to make speech more audible in such challenging listening environments.

Listening to music can also be difficult for people with hearing loss. Current technology tends to focus on improving speech recognition, but often fails to improve the experience of listening to music. We need better technology so that all music enthusiasts with a hearing loss can still enjoy listening to music.
**Game changer**

“Technology has certainly changed my life. It’s enabled me to work and maintain relationships. When I lost my hearing, I thought I wouldn’t be able to speak to friends and family on the phone – the early type talk services were too slow and complicated. Social media allows me to have conversations, and video chat (FaceTime) has been a game changer.”

Suzi Rees, Director of iDID Adventure

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**Tinnitus management** Technology to help people manage their tinnitus is limited. The most commonly used devices generate sound to mask or distract attention from the tinnitus. New technologies to better manage tinnitus would help millions of people.

**Supporting development**

To ensure that researchers, developers and manufacturers are developing technology that meets users’ needs, we are supporting them by providing guidance during product and service development. This includes recruiting people with hearing loss and tinnitus to try out prototypes and review products, and letting people with hearing loss know about technologies that may help them.

**Speech-to-text technology**

The potential applications of speech-to-text technology are huge. Geemarc have developed a real-time, automated speech-to-text technology. Their speech-to-text app TextHear is now available (texthear.com) and we are working with them to increase awareness and uptake of their phone adapter. The adapter allows a landline phone to be connected to a device running the TextHear app to provide captioned phone calls.

**BSL Augmented Reality (AR)**

We have helped Signly, who have developed an app that displays pre-recorded sign language videos on a user’s mobile, enabling better access to written content for BSL users. The relevant video is triggered by detecting a QR code or an image, using a phone’s camera, which then prompts an AR sign language translator to pop up. The technology has already been used by the Roald Dahl Museum and Network Rail.

**Increasing uptake**

It’s important that any technology that could benefit people with hearing loss and tinnitus is used. We are therefore keeping people up to date with developments in technology through our website, magazine, e-newsletter, factsheets, face-to-face community services and our online shop.
You can make a difference

With hearing research so underfunded, it’s tempting to ask: “Can I make any difference?” You can. For every £1 you give, our researchers attract, on average, £10.45 more to continue vital research work in all areas.

Life-changing breakthroughs

A seismic shift is happening in the world of research. We see it every day with new breakthroughs and treatments for other conditions such as cancer, heart disease and Alzheimer’s disease. We cannot ignore the 11 million people affected, many of them devastated, by hearing loss and tinnitus.

That’s why we’re asking for your help. Only by investing significantly more money in hearing research can we continue to make important scientific advances to improve hearing devices and develop treatments for hearing loss and tinnitus.

We are one of the world’s leading medical research charities tackling hearing loss and tinnitus. Our mission is to train more scientists, drive research to make important discoveries and support the translation of this research into real treatments (see pages 14–15). This is the only way to be sure that we will, one day, be able to cure hearing loss and tinnitus.

We receive no government money for research. Instead, we rely entirely on voluntary donations. Without your generous support, we couldn’t have achieved what we have to date. But we urgently need to find ways to restore hearing, silence tinnitus and prevent hearing loss. A lack of funding remains the main obstacle to achieving these goals.

With your continued support, there will be more scientists and laboratories working in hearing research, accelerating the discovery of treatments and cures.

With your support, there will be real hope of life-changing breakthroughs for 11 million people. Thank you.
Over **£17m in research funding** since 1999

- **Causes and prevention of hearing loss:** £5,985,387
- **Improving devices:** £3,546,635
- **Restoring hearing:** £2,859,607
- **Improving diagnosis:** £1,129,461
- **Tinnitus:** £2,073,745
- **Other:** £424,359

(excludes DRUK funding)

We need **your support to find cures** for hearing loss and tinnitus

- **£10**
  - would pay for a volunteer to take part in a research project to improve how well cochlear implants work in noisy backgrounds.

- **£30**
  - would pay for the measurement of auditory brainstem responses (ABR) in two people. An ABR measures the brain’s response to sound.

- **£200**
  - would support a student during a summer project, encouraging more scientists to pursue a career in hearing research.

- **£1,000**
  - would support a small project or collaboration between scientists to develop groundbreaking ideas.

- **£25,000**
  - would fund an Action on Hearing Loss PhD student for a year.

- **£50,000**
  - would fund one of our major, international research projects for a year.
Vote of confidence

“Funding from Action on Hearing Loss helped us jump-start the company. Together with support from the State of Maryland, we were able to do a lot of the initial laboratory work showing magnetic drug delivery to the inner ear works. We are starting a formal collaboration with one major pharmaceutical company and are in discussions with others. Pharma companies and sophisticated investors look at an investment by Action on Hearing Loss and see it as a vote of confidence by an organisation that’s expert in hearing.”

Ben Shapiro, President of the biotech company Otomagnetics and Professor at the University of Maryland

Halfway to independence

“Your Pauline Ashley Fellowship will allow me to combine all of my research to date into one cochlear implant research project. Often, postdocs like me are employed on someone else’s grant, gradually building up enough experience to apply for their own grants and choose the direction of their research. This Fellowship allows postdocs to choose the direction of their research at an earlier stage, under the sponsorship and guidance of a senior scientist. So it’s a great halfway point to full research independence.”

Alan Archer-Boyd, Action on Hearing Loss Pauline Ashley Fellow at the University of Cambridge
Of quantity and quality

“Often, charities fund small projects (up to £5,000), which is good for gathering initial data. But the much larger funding we’ve received from Action on Hearing Loss means we’re able to take the work forward without constantly searching for more money.

“Almost everyone has seen, first-hand, how hearing loss affects a person’s life and the lives of those around them. Hearing loss is isolating; a wall of separation. We need to break down that wall by finding ways to prevent, or reverse, hearing loss. Scientific research is the only way to do that. But research costs money.

“Cancer and heart disease command the lion’s share of medical research spending. But they’re killers, so research in those areas is critical. Hearing loss doesn’t kill. But it does increase the risk of depression and social isolation, and makes it difficult for people to find or keep jobs. Fighting cancer and heart disease is about quantity of life. Preventing or curing hearing loss is about quality of life. It’s all important. The truth is, we need more research funding overall to improve both quantity and quality of life.”

Allison Coffin, hearing researcher at Washington State University

Want to make a donation?

If you’d like to donate to our research programme, please contact us:

Telephone: 020 7296 8264
Textphone: 020 7296 8246
Website: actiononhearingloss.org.uk/donate
**Action on Hearing Loss** (formerly RNID) is the largest UK charity helping people who are confronting deafness, tinnitus and hearing loss.

We give support and care, develop technology and treatments, and campaign for equality. We rely on donations to continue our vital work.

To find out more, visit [actiononhearingloss.org.uk](http://actiononhearingloss.org.uk)

**Contact our free, confidential Information Line:**

- **Telephone** 0808 808 0123
- **Textphone** 0808 808 9000
- **SMS** 0780 000 0360 (standard text message rates apply)
- **Email** informationline@hearingloss.org.uk

**Join us**

- 🌐 Action on Hearing Loss
- 🐦 @ActionOnHearing

**Front cover image:** Faizah Mushtaq, one of our funded PhD students, administers a test to a child volunteer, as part of her studies.