

Hearing trouble

Science versus business?

Eimear O'Carroll describes how a Young Scientist project led her and two fellow students to set up their own business before they left school.

Key words

hearing
sound waves
tinnitus
cochlea

When I first decided to do a Young Scientist project, I could not possibly have envisaged what was in store for me. Although I was always good at science and enjoyed its ability to answer so many phenomena questions, I didn't really think it was for me on a permanent basis. That was all about to change ...

I joined forces with two other students, Rhona Togher and Niamh Chapman, and we set about thinking of a new and imaginative science project. From the very outset, our physics teacher, Mr. Carolan, was highly enthusiastic about our project and gave us guidance at every stage. He saw my profound interest in our work as well as my sometimes pathological dedication to perfection in planning and executing every stage of our project. I was extremely lucky to work with likeminded people at this time and it started me thinking about the possibilities of working in science in the future. What I originally thought would be a predictable job in a lab suddenly metamorphosed into endless possibilities and an ever changing career. *I could see the profound benefits of working at something you love and knowing that each day brings new challenges.*

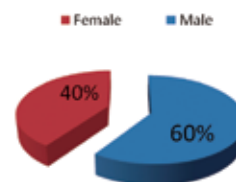
Where's that sound?

We originally studied the localisation abilities of humans in relation to pure tones. We used an older study as our foundation and extended it to include a wider breadth of candidates and a more precise level of technology. We designed and implemented a test that involved blindfolded candidates trying to locate the source of pure tone frequencies in the range 2000 - 4000 Hz. By measuring the angles within the circular testing system that the candidate indicated as the source relative to the actual source location we could analyse the localisation ability of the candidates.

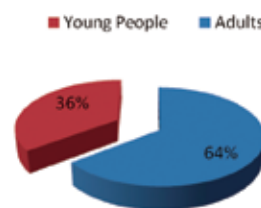
Our study concluded that girls were better able to localise pure resonant frequencies than their male counterparts. The project earned us 1st place in the senior group category of the 2008 Young Scientist and Technology Exhibition. We were all in 5th year and still had time to get back into a normal routine to prepare for our Leaving Certificate in June 2009.

But never presume plans will run smoothly. Mr. Carolan was always the first to tell us what we could achieve if we kept going with this research. And our display and presentation were considered so impressive that the judges encouraged us to

Ratio of average % error of Male against Female



Ratio of average Adults % error against Young Peoples' % error



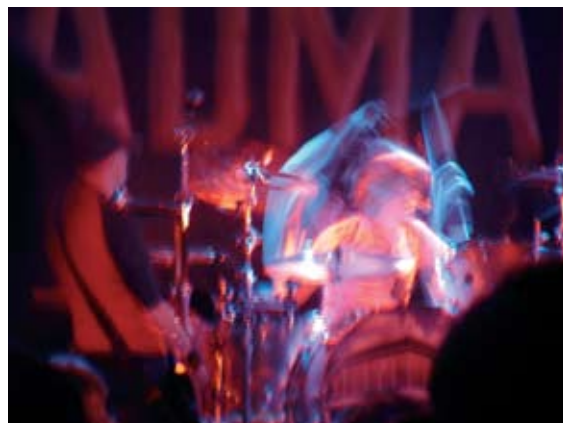
Our results summarised. Girls are better than boys at judging where sounds are coming from, and young people are better than older people.

enter another sound-related project the next year. And so the madness started all over again.

This time we decided that if we were going to do another project we would submit the best we possibly could. This would be our last chance to enter a project, and we now knew what was expected and we felt we could improve on our previous level of work. We had devised a new idea that we felt could have a profound effect on science.

A new project – temporary tinnitus

In deciding on our new project, we considered the old idea of looking around you and seeing common problems and then trying to come up with solutions. Given our background, we focussed in on sound theory. The problem that came up ahead of all others was the annoying sound evident after a disco, club, gig or mp3 player use.



The big sound of a rock band can be exhilarating – but it can also damage your hearing.

It was only on isolating the problem of temporary **tinnitus** that we realised how prevalent it really was. We surveyed 1000 people of all ages and discovered a 92% incidence rate. The sheer number of people who have experienced tinnitus (ringing in the ears) was staggering. When you take on board that temporary tinnitus can be an indicator of permanent damage to the **cochlea**, it should be alarming to realise how much damage is being done and how close we could be to a deaf generation in a couple of decades.

One part of our project was to identify a problem but the harder part was to devise a solution. Again, we worked closely with Mr. Carolan and we hypothesised as best we could, based on our knowledge of sound and how the ear works. Eventually, we hit on the core of the problem and the essence of the solution. The temporary tinnitus in many cases was being caused by bent or broken cochlear hairs and the hairs hitting off each other were creating phantom sounds being sent to the brain. If we could straighten those bent hairs, we could reduce interference and hence lessen the tinnitus. This is what we achieved.

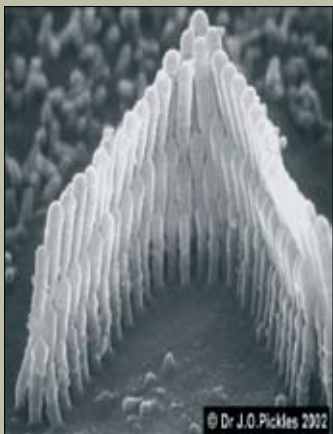
further when we were given overall runner up in the competition. Our work had paid off and we were ecstatic at have achieved so much. It could have been the end of the research but fate had other things in store.

We hadn't been back in school for more than a week when we felt that familiar tug of wanting to do more research. All the time we had been working on this project we had still wanted to know if our therapy would work for permanent tinnitus. Obviously we had to concentrate on our Leaving Certificate which was approaching fast but we wondered could we do more.

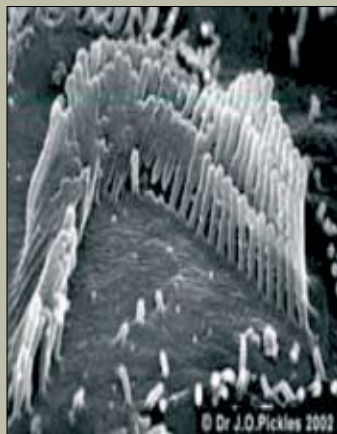
Finding funding

It was at this point that things changed drastically. One of our team, Niamh, decided to exit as she felt that she needed a summer off after exams. Mr. Carolan approached a number of companies and organisations to see if we could gain funding to do further research after our exams. There was very little interest until he talked to the county enterprise board. They suggested that the best way to protect our research data and, at the same

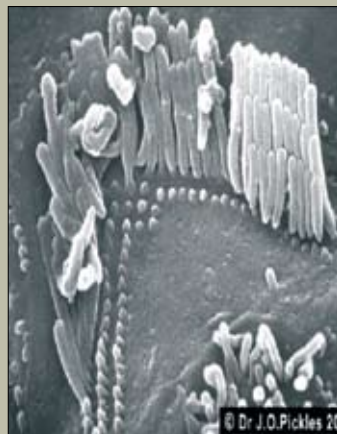
These electron microscope images show the damage done to cochlear hairs by loud noise.



Normal cochlear hairs



Moderate sound damage to cochlear hairs



Serious sound damage to cochlear hairs

Therapy

We succeeded in developing a therapy that manages to re-straighten some of those hairs in one minute. Our therapy combats sound damage by using sound to stimulate the inner ear and allowing it to vibrate maximally. By doing this we soothe the ear and allow the cochlear hairs to re-straighten. As the interference between bent cochlear hairs is no longer present the tinnitus is similarly gone. People have described our therapy as like listening to a low hum.

Our project went into overdrive and we produced a work of scientific research that I am still immensely proud of. We knew we had done well but when they called out our names for the special award of Health Innovation Award from the Health Research Board, we were in shock. This surprise was compounded



Ana Blazic/bigstockphoto.com

Restored Hearing's therapeutic sounds are delivered over the internet to the sufferer's computer; they then listen using headphones.

time, gain funding was to incorporate our group into a limited company. And so, on the 1st May 2009, Restored Hearing Ltd. was born with Rhona Togher, Anthony Carolan and me as directors. Anthony took over the initial running of it so as to allow Rhona and myself to study and sit our exams but as soon as the exams were over (that evening in fact), we got fully involved and we began a summer long study travelling around the country meeting and testing permanent tinnitus candidates and compiling our data.



Restored Hearing's homepage

What has happened since then has been like a rollercoaster. We officially launched in August with the co-founder of the Young Scientist, Dr Tony Scott, as guest of honour. We secured a business loan and were welcomed into the Nova UCD innovation centre to operate from.

We have gained worldwide insurance cover and to date have secured business from every continent. Over the last number of months we have achieved media exposure in a number of countries from print to TV.

Just lately, we won the regional finals of the Ulster Bank Business Awards, putting us through to the 2010 national finals.

Where are they now?

Rhona Togher is studying for a degree in Physics in UCD Dublin; she lives a few yards from the Restored Hearing office in Nova UCD.

Anthony still teaches in Ursuline College, Sligo, and is keeping the Young Scientist flag flying.

Eimear O'Carroll has started a physics degree in University of Edinburgh and is loving it.



The team, together with Dr Tony Scott (right).

How we work now

Things have not quietened. Our company is thriving. We conference call every day. We meet in our own respective locations and we work just as hard on our private company as we do in our day jobs. We scarcely believe the changes that have occurred in less than a few years – we are now directors, entrepreneurs, an scientists, but most of all, close friends. The hours we have worked, the challenges we have faced and the successes we have shared have only helped to strengthen the bonds and make our company stronger. We have great hopes for the future and many goals to fulfil but we are optimistic and enthused.

I once thought science was restricted to a lab and a test tube. But I would like to think that I have found what science really is. It is profound interest and discovery in an area which is in constant flux. How can you get bored with something which is never the same? I am delighted to be studying physics and I am thrilled to be a director of a fun cutting edge company. I could not have done any of this if I had not followed my heart and my instincts. Today, I now realise how simple almost imperceptible decisions in school can cause a ripple effect that will intensely change your future. I guess the chaos effect may have a point after all!!

My one piece of advice to any students at a crossroads in their career decision is choose what interests you. There are days I get a few hours sleep because a presentation for the company has to be finished, a lab report has to be submitted and a flight has to be caught for our next meeting but I don't regret one bit of it because I love every minute of it. If you can find something this interesting to work at, be thankful.