

ReSound Tinnitus Management: *Big Data and ReSound Relief*

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WHAT IS BIG DATA?

Have you liked something on Social Media today, or used a search engine to find more information about a topic? Perhaps you purchased something on your favorite online retail shop last night, or earlier today? If you responded 'yes' to any, or even perhaps all of these actions, that means you are allowing information about yourself to be collected. What information exactly, are you giving access to and where does it go?

Social Media and online purchasing have changed our lives in numerous ways, such as how we connect as communities and cultures, our accessibility to goods and services and how we interact and communicate with one another on a day to day basis. Every day, there are over 5 billion likes on Facebook and over 6 billion searches on Google worldwide, contributing to the over 2.5 quintillion bytes of data created daily¹. In fact, in 2013 experts claimed that 90% of all data was generated over the two years prior, and Business Insider Magazine expects the current total to double in the next two years². This increase in data creation and usage is largely attributed to the increase in mobile smart phone/tablet adoption. A 2016 Nielsen report estimated that the average American is spending almost 11 hours a day connected to a computer or mobile device. As of 2014, mobile smart phone/tablets have been used a majority of that time, a trend that continues to increase with the popularity of apps³.

Social media, online retail and search engines are some of the biggest collectors of data in the world today, and we now have access to them at the push of a button on our mobile devices. This data allows companies to understand their users better, and fine tune what they advertise and promote to their users, according to users' preferences and behavior. This is why when you go to your favorite online retail store, they often times already have suggested items before even purchasing anything. In order to do this, massive amounts of data, called Big Data, is collected.

Big data is an extremely large data set that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions. Furthermore, big data is commonly categorized into

a variety of segments. For this paper, we will focus on two of those segments, *Personal Data* and *Sensitive Personal Data*.

Personal Data: is data that relates to a person who can be identified from the data (e.g. name, address, D.O.B).

Sensitive Personal Data: is data that includes information about an individual's ethnic origin, political opinions, religious beliefs, sexual life, physical/mental health conditions, criminal convictions and/or alleged criminal offenses and related proceedings. There are strict requirements for how this data is processed, because this is sensitive data that has a very strong influence on our identity.

Personal data is often available in the Public Domain, and can typically be found doing a search for that person online. Sensitive Personal Data however, has much more strict rules about how that data can be accessed. The European Union (EU) in 2018 passed the General Data Protection Regulation (GDPR), which expands what falls into the Personal Data segment, and the individual's rights over that data. A big part of the legislation is that individuals must give permission to use the data. Companies cannot collect and use data without the permission of the individual, and furthermore, the more personal the data, the more clearly written the Terms and Conditions need to be. This is very important with the growing biometric data industry, which collects health measures from individuals that can be used to identify that individual, along with sensitive health information.

WHAT KIND OF DATA DOES RESOUND RELIEF COLLECT?

The ReSound Relief app does not collect any Personal Data and/or Sensitive Personal Data. All the data collected in the Relief app is general usage data, meaning how any particular user is interacting with the features of the app. Examples of this are how often a user plays a sound, or what particular sound they choose, as well as how many times the app may crash, or malfunction. It can also collect data showing how many times a user accesses the Deep Breathing exercise, and for how long they use it, as well as how a user utilizes the Learn section, where they can edu-

cate themselves about potential causes, common therapies and tips to help them cope better with their tinnitus. All data collected in Relief is aggregated, and it is not possible to link it to any individual's identity. The user's data only appears as a generic user of the Relief app. Any Personal Data and/or Sensitive Personal Data shared by the user is owned and operated under their corresponding app store, such as the App Store for Apple and Google Play for Google. For apps, this is often times in the form of credit card payments, which are tied to the individual's corresponding app store profile.

WHY IS DATA COLLECTION IMPORTANT FOR TINNITUS?

Collective general usage data, over time, starts to show patterns, trends and tendencies of all users of the app, and how particular features are being used. These behaviors allow us to assess how the app is performing, what experiences users are having (both positive and negative) and learn about areas we can make improvements, to help provide users a better experience. This is very important when it comes to the tinnitus population.

It appears a large portion of the tinnitus population goes untreated⁴. There is a long list of potential reasons why this is - lack of educational standards for tinnitus; no universal established protocols and subgroup data; lack of 3rd party funding, to name a few⁵. Whatever the reasons may be, a large percentage of this population is seeking help they just cannot find.

Often times, tinnitus patients are grouped into a general 'tinnitus bucket', although individuals may have very different causes and perceptions of their tinnitus, as well as unique needs on how to manage it. Just as hearing loss patients can be unique in their diagnosis, fitting and progress, tinnitus patients should also be considered individually. Unfortunately, a lack of definitive tinnitus subgroup data makes it difficult to understand what the best course of action may be for a specific type of tinnitus. A good example of this is someone who struggles with hearing loss due to aging, compared to someone with hearing loss due to a middle ear pathology, which is going to be surgically treated. Although there are some similarities and overlap in how you would go about examining and amplifying these two individuals, there are many other considerations to take into account according to the specific situation, such as style of earmolds, frequency of post-op appointments and what clinical tests a Hearing Care Professional (HCP) may perform. There is very clear subgroup data on these different populations (e.g. age-related hearing loss versus otosclerosis), and therefore clear instructions on what the best course of action for each case would be. This simply is not established in the tinnitus community as of now, even though there are many types of tinnitus, and people react to their tinnitus perception in many different ways. Subgroup tinnitus data has proven to be very challenging to collect using more conventional methods of research, largely due to the time it takes to collect this information on a large scale. However, with big data collection, we can start to see trends and behavioral patterns in users in just a few months, even weeks. These behaviors help us to col-

lect insights and analytics that will potentially yield subgroup data to help us work with the tinnitus population more thoroughly and effectively.

Another concern for many HCP's is the perception that tinnitus patients take up a lot of clinic time, and without 3rd party reimbursement in many countries, makes it difficult for clinic profitability. Tinnitus is often a difficult topic to address in the clinic, and tinnitus consultations can take upwards of an hour or more. ReSound Relief is designed to help HCPs overcome those difficulties, by offering the most complete and flexible app toolset to help people manage their tinnitus. In addition to providing more than 50 High Definition sounds to choose from, the app also allows the user to create their own dynamic soundscapes, with the ability to layer up to 5 sounds (Figure 1). What makes Relief truly unique is that it also educates the user about their tinnitus, while providing personalization and guidance on how to better manage their own tinnitus (Figure 2). Because the app is interactive, and tracks usage, Relief can be used to recommend follow-up visits where HCPs can review progress, fine tune the program and discuss further steps with their patients (Figure 3).

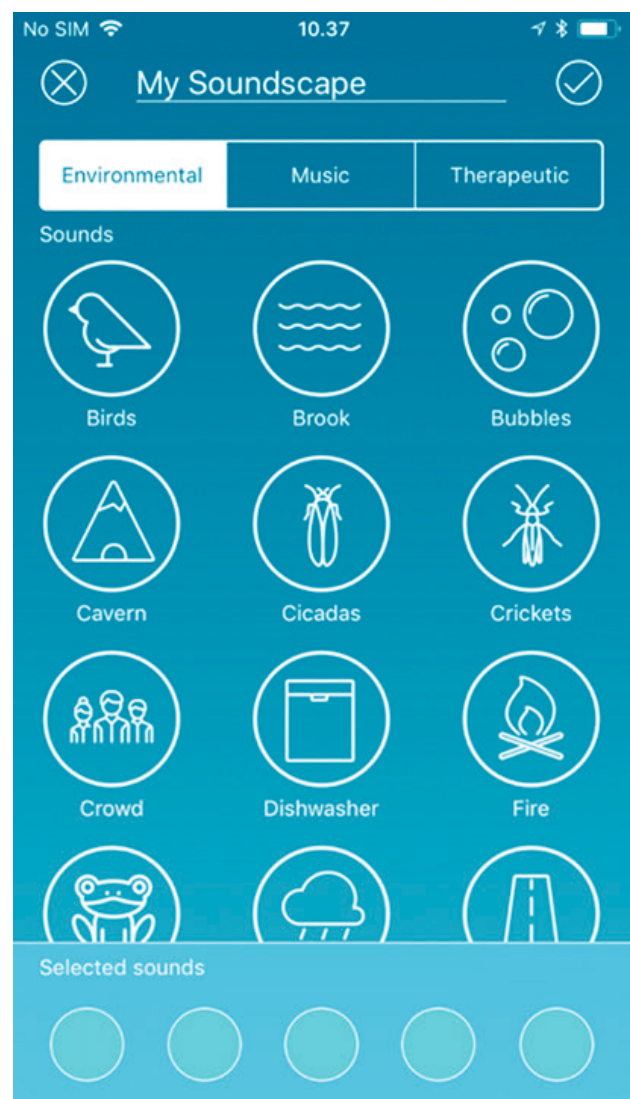


Figure 1: Combine up to 5 sounds from our High Definition selection and create multi-layered dynamic soundscapes.

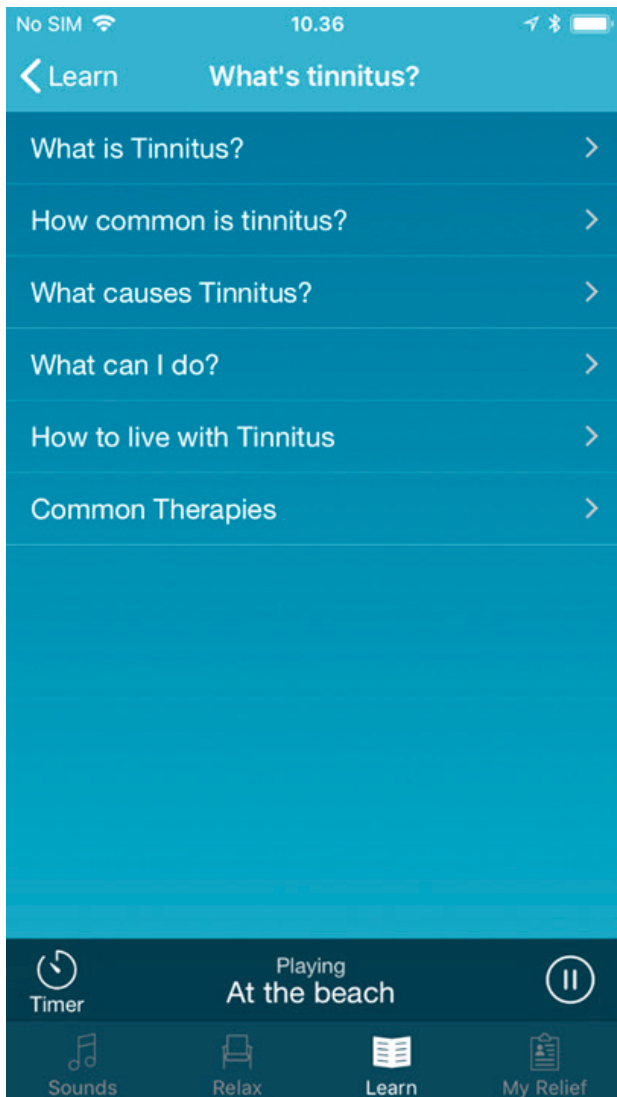


Figure 2: Learn about tinnitus, its causes and common therapies. Also find tips on better sleep and how to change negative thoughts related to tinnitus.

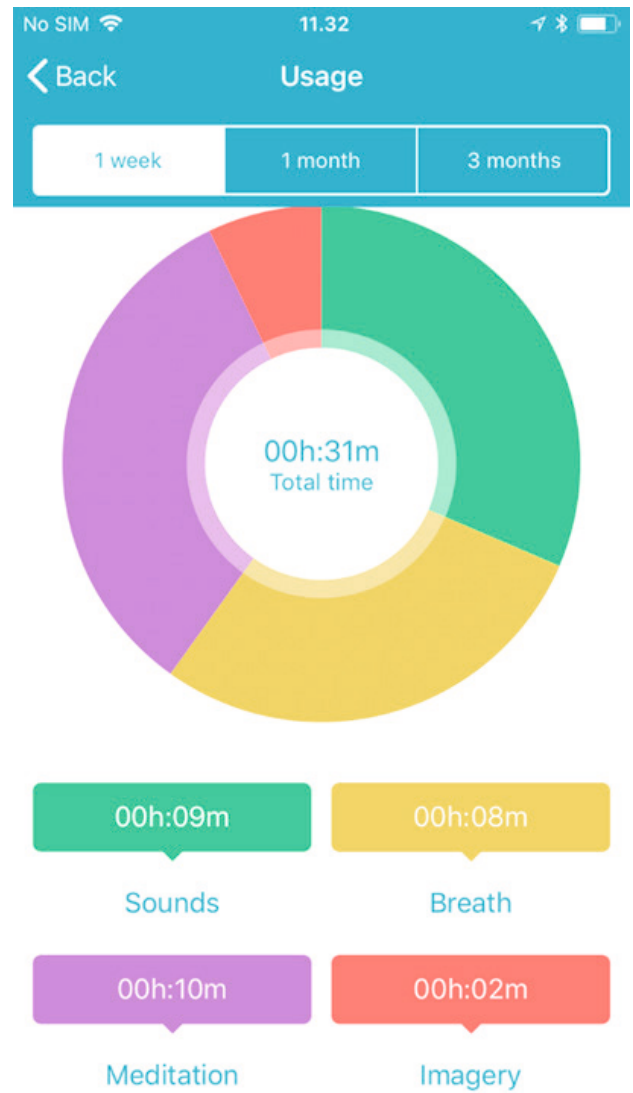


Figure 3: Keep track of Relief usage over the last week, month and 3 months.

RESOUND RELIEF - MY PLAN

The more data we collect from our users, the better we can understand how users interact with and utilize Relief. Over time this can provide us with information that can help design more personalized programs and features for users. A good example of this in Relief, is the **My Plan** feature. To help us offer more to our users and better understand their needs, we have introduced My Plan, which is a premium subscription-based feature in Relief. At a minimal cost, users can unlock My Plan, giving them access to new features that will provide additional support with personalized guidance on how to better manage their tinnitus.

My Plan offers the following additional features:

- Identify tinnitus type and the main day to day challenges
- Receive new weekly training plans to help manage tinnitus
- Track performance towards defined weekly goals
- Access to premium high definition environmental and musical sounds

My Plan begins by asking the user a series of intake questions regarding their tinnitus to help identify some concerns (Figure 4). Next, the user is asked to select the sound that most closely resembles their tinnitus (Figure 5). By answering these questions, we are able to develop a better picture of someone's tinnitus and what struggles they are facing. Once the intake questions are complete, a recommended plan will automatically be developed (Figure 6).

The screenshot shows a mobile app interface for 'About your tinnitus'. At the top, there's a status bar with 'No SIM', signal strength, time '11.36', and battery level. Below the status bar, there's a close button (X) and a progress indicator '1/8'. The main heading is 'About your tinnitus'. Below it, a sub-heading says 'In order to create a perfect plan to manage your tinnitus, please answer the following questions:'. The first question is 'Does your tinnitus make it difficult to relax?'. Below it are three radio button options: 'Never', 'Sometimes' (selected), and 'Always'. The second question is 'Does your tinnitus make it difficult to concentrate and/or focus?'. Below it are three radio button options: 'Never', 'Sometimes' (selected), and 'Always'. At the bottom, there's a large blue button labeled 'Next'.

Figure 4: Identify what are the most common problems your tinnitus causes in your daily life

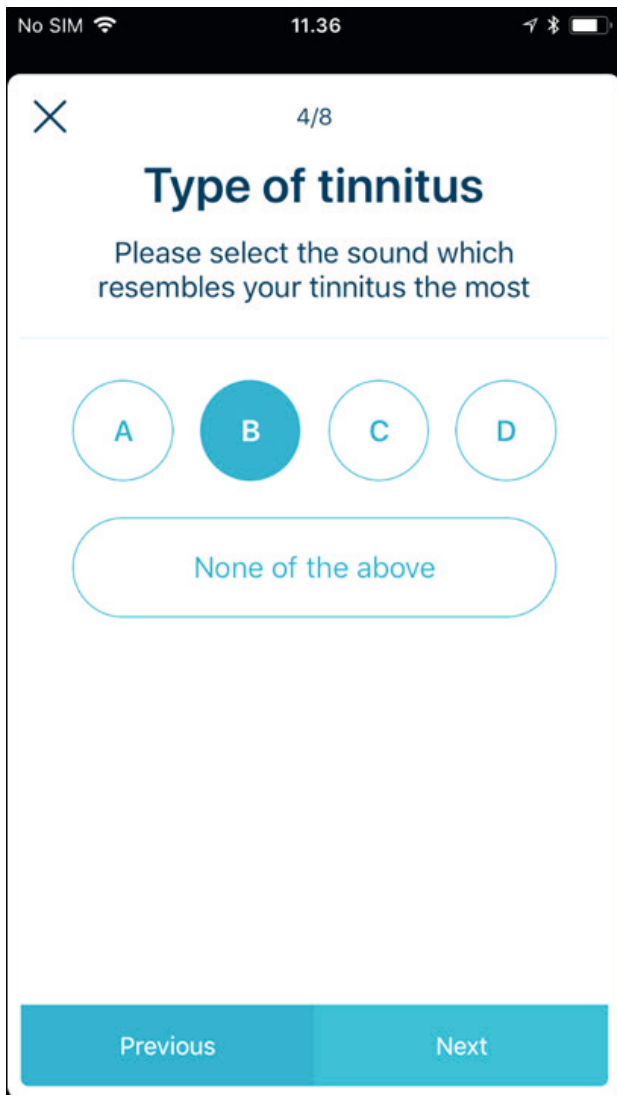


Figure 5: Listen to different sounds and identify which one most resembles the tinnitus

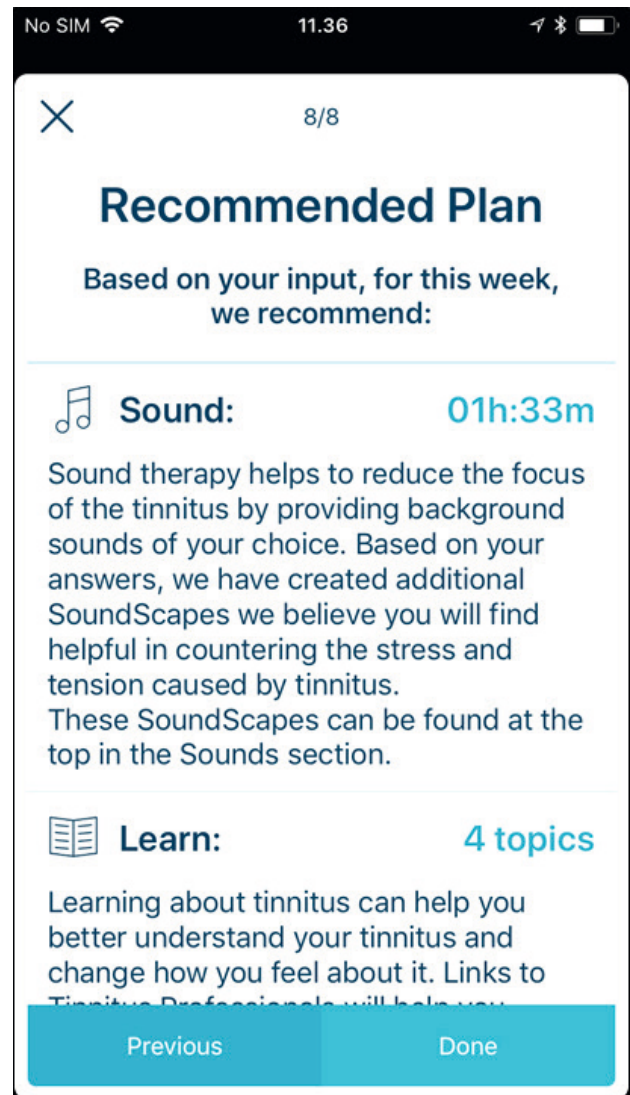


Figure 6: Design a personalized tinnitus management plan using My Plan. The plan changes every week to learn helpful tinnitus management skills.

The questions selected were carefully chosen to reflect different aspects of tinnitus management. The main categories represented are Relaxation, Focus, Sleep, Day to Day Effects and Communication. By asking these questions, we can better understand how these aspects of the user's life are being affected by tinnitus, and to what severity. We also examine correlations between how certain questions are answered, to provide more insight into potential subgroup information. For example, the question 'Does your tinnitus make it difficult to relax?' has three possible responses - Yes, No and Sometimes. If we identify a correlation between the response 'Yes' and a particular combination of sound files selected (e.g. Brook + Cavern), we can then start to recommend the 'Brook + Cavern' sound file to people who answer 'Yes' for the question pertaining to Relaxation. As we grow the number of Relief users, the more information we can collect to better understand the needs of users, which allows us to build features that meet the demands of this patient population.

My Plan not only offers user access to additional sounds, but it also offers users counseling information and guidance to help them manage their tinnitus. It designs a new plan every week for the user to follow, and allows them to track performance towards their defined weekly goals. Users also have the capability of recreating a new plan if an existing plan is not meeting their needs. Clinically, My Plan is a great tool for HCPs to use in their initial consultations when they don't have enough time to cover all the information necessary. Additionally, it can be used during follow-up visits, to monitor the progress of the patient, and to discuss future steps. MY Plan offers valuable patient insights for any HCP to help support their patients cope with their tinnitus.

Note: Relief is a free app, providing many of its features at no cost. My Plan is an optional Premium Subscription for users who want to create a personalized tinnitus management plan.

THE FUTURE IS NOW

App-based solutions are now common tools we use in our day to day lives, and are becoming more commonplace in the hearing care profession. From apps that control hearing instruments, amplify sound, help with tinnitus and even accurately perform hearing screenings, it appears apps are going to play an increasing role in our industry over the coming years.

With a large portion of the tinnitus population going untreated, and those struggling with tinnitus being similar in number to those with hearing loss, better tools and platforms are needed to help meet the demands of this underserved population. Apps and other mobile technology now gives us the ability to build tools that are defined and shaped by users. Getting insights and data from the very people who are using the app, allows for increased real-time data collection, which helps build focused and targeted app updates and ultimately, more effective end-user solutions.

By providing greater insight into end user usage, Big Data will potentially paint a picture of the tinnitus population never seen before. Although Big Data comes with its share of challenges and concerns about individual privacy, the Relief app only collects general usage data, ensuring your patient's anonymity when using the app. As our industry adapts to new technology and data collection platforms, it is important that we clearly understand the benefits and opportunities Big Data offers. Change is always difficult and takes time, but perhaps a key to our success moving forward is simply in the palm of our hand!

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