Multimodality in the teaching of biology: comparing some semiotic resources

Abstract
In the teaching of scientific subjects, several semiotic resources such as images, texts, physical models, audio recordings and film have been used for a long time. In recent years, digital learning resources have also been added, such as simulations and virtual and augmented realities. In this paper, an investigation of how pupils understand the science of hearing and the anatomy of the ear with the support of various semiotic resources is performed by a teacher/researcher. How do pupils reflect on their understanding of hearing when they use different semiotic resources in teaching? In this investigation five different semiotic resources are compared. The analysis of questionnaires, interviews and lesson observations shows how the pupils move between the different modalities. The findings indicate that pupils can benefit from using carefully chosen different semiotic resources. It could also matter in which order the semiotic resources are used. The study shows that embodied cognition plays a prominent role, such as touching a physical model of an ear. Furthermore, understanding the anatomy of the ear is described as better using a physical model, while understanding the process of hearing is described as better using a simulation. These findings can be useful for teachers, student teachers, teacher educators and teaching aid developers.

1. BACKGROUND
The purpose of this study is to describe how pupils talk about their learning of the anatomy of the ear and hearing, and how they use the offered semiotic resources in the classroom. Semiotic resources are part of human communication to create meaning and to reinforce messages, it can be both actions and materials of various kinds (Airey & Linder, 2009; Selander & Kress, 2017). Many different semiotic resources are used in biology teaching, multimodality has a long tradition in the form of photographs, microscopic images, physical artifacts, narratives, posters, and videos.

The semiotic resources offered to pupils are therefore central to this study. These are affordances, i.e., the action possibilities’ latent in an environment, where the potential uses of a given object arise from its perceivable properties and always in relation to the actor’s capabilities and interests (MODE,
The research questions focus on how pupils in lower secondary school handle the offered semiotic resources in biology education.

1. How do pupils reason about the semiotic resources offered in the teaching of ear anatomy and hearing?
2. How is the sequencing of the various semiotic resources described when pupils talk about how they learn about hearing?

The study is limited to an area of hearing and ear anatomy in biology education, but the principles that are discussed are also recurring in the teaching practice in other science subjects, as physics or chemistry. The Swedish curriculum in biology describes learning about anatomy in the central content for grades 7-9 (Curriculum for compulsory school, preschool class and after-school center [Lgr11], 2019). The teaching of hearing should also include health aspects, such as knowledge of volume and noise. The basic anatomical knowledge is thus described as a prerequisite for being able to make informed decisions about one’s health. Furthermore, the requirements for a scientific basis and proven experience implies that the methods and teaching materials used have strong scientific support according to the Swedish Education Act (SFS 2010: 800). These aspects are carefully enrolled in the purpose and design of the lessons in the study.

2. EARLIER RESEARCH

In biology education, a lot of semiotic resources are traditionally used, often in abundance, something that Hipkiss (2014) claims creates a pronounced need for research that examines how teachers reflect on the consequences different choices can have for the meaning offer the student receives. In biology, the process of reading pictures has a prominent role. When we say “a picture is worth a thousand words” it renders the perception of the power of the image in communication. However, the perception of the pictures is not unproblematic. The student must develop the competencies to read images in the same way they also read text (Roth & Pozzer-Ardenghi, 2013).

A special interest for health issues also reveals that young people may have difficulty understanding the meaning of the risk of loud noises if they lack knowledge of the structure and function of the ear (West, 2011). In biology teaching, the human body has a central role, not only as teaching content, but also as a means of developing knowledge. A sign of this is the interest for cognitive science and embodied cognition (Amin, Jeppson & Haglund, 2015). The interest is not least driven by the multimodal complexity of science teaching practice, with all the semiotic resources offered today. Lundborg (2011) also describes how the cognitive processes are deeply rooted in how our body interacts with the world. Our body has many different sensory abilities that allow us, for example, to hear, see, taste, smell and feel. There are especially many receptors on our fingertips and the corresponding part of the brain, the cortical body map, that process these signals from the hand. Through the millennia, the importance of the hand for learning has been observed and described, among other things, Kant has called the hand the ”outer brain of man” and Aristotle believed that we both learn and remember with the hand. The hand thus occupies a special position for describing human perception and learning (Lundborg, 2011). For learning processes, memory capacity is important, and this also benefits from having physical experiences, something that can be described as an embodied memory (Sutton & Williamson, 2014). It is also important to understand the movement, the transduction, between the various semiotic resources. This movement is an expression of how the meanings of phenomena are moved between the modalities image, text, sound, physical objects and digital representations. Transduction is seen as a marker of understanding the connections between the various semiotic resources (Volkwyn, Airey, Gregorčič, & Heijkenskjöld, 2019). When the student can move freely
between text, model, spoken word, film and digital simulation, it is according to Volkwyn et al. (2019) a sign of understanding the phenomenon. The teacher can then take part in a visible aspect of what is difficult to measure in the teaching, namely the learning process. This visibility makes it possible for the teacher to plan the continued teaching with knowledge of what the student has learned. The design for learning is thus central. Selander (2017) describes how sequencing and tempo emphasize the importance of seeing learning as a series of activities where it is of great importance how often the activity is planned into a schedule and what time it has available. This is important not least in a crowded curriculum where much must be accomplished in a short time.

3. THEORETICAL AND METHODOLOGICAL FRAMEWORK

This study is performed by a teacher/researcher, who is investigating the teaching practice. That means reflecting about design and outcome, using theoretical frameworks as lenses for the analysis (Roth, 2007). The theoretical framework used in this study is about how we learn with the whole body, often referred to as embodied cognition (Lakoff & Johnson, 1999; Wilson, 2002; Wilson & Foglia, 2017). Our cognitive capacity includes how we take in information about the world around us, and Lakoff and Johnson (1999) describe, among other things, spatial references (in front / behind / over / under) and color, shape, and structure as crucial for how we should understand the world.

The interplay between the pupils and the semiotic resources used in the teaching of science are central in the present study. Design for learning from a multimodal perspective is selected in this study (Selander & Kress, 2017). It is characterized by considering the modalities that are available, analogue as well as digital. Central aspects are therefore: what is to be learned, who is to learn this content, how it is to be done and why this choice of content, and with what learning resources. Selander (2017) points to the possibilities of making a multimodal analysis that includes the combination and sequencing of semiotic modalities. In lower secondary school pupils meet many different semiotic resources. The five semiotic resources that are used by the pupils in this study are the textbook text, traditional sketch, physical model, simulation (Sensavis, 2020) and a film from a real ear (Figure 1).

![Figure 1. The five semiotic resources in the study](image)

The empirical data in this study are collected from the biology classroom and consist of observations, student surveys and interviews (Appendix 1). The pupils in the study are from two classes, 15 and 16 years old respectively. Swedish pupils in that age group participate in compulsory school. They learn
biology as an individual subject, although they have not yet chosen advanced studies. The data collection is from altogether 42 pupils, 20 girls and 22 boys. Of these, five pupils are newly arrived, and altogether 14 pupils have a mother tongue other than Swedish. Data collection takes place during 4 lessons of 50 minutes each, one lesson per week. The participating pupils have given informed consent to collect this data (The Swedish Research Council, 2017).

All data collection is done by the author, a teacher who also is trained as a researcher, with a perspective of a reflective practitioner (Roth, 2007). The perspective as a teacher/researcher offers both strengths and weaknesses. The teacher knows the situation in the classroom well, maybe even too well, so it is important to avoid assumptions about what is going on in the classroom. If this is considered, the investigations made by a teacher/researcher on how pupils learn are of great value for both academia and practitioners.

3.1 Design for learning from a multimodal perspective
The first step in the design is to select suitable semiotic resources for the chosen content and with this group of pupils. The design needs to consider the writings in the Swedish national curriculum (Lgr, 2019) and applicable parts of the central content with associated knowledge requirements are:

The body's cells, organs and organ systems and their structure, function and interaction. The student //... // shows connections that concern the structure and function of the human body.

The theoretical selection of what semiotic resources to use is based on research on embodied cognition (Lakoff & Johnson, 1999; Wilson, 2002; Wilson & Foglia, 2017). The practical perspective is also met, considering what is relevant to use at an average community school. The spatial conditions need special consideration (Lakoff & Johnson, 1999), which is shown in how various semiotic resources offer information about front / behind / over / under and similar position descriptions. As memory capacity is important for learning purposes, and this also benefits from having physical experiences, the tactile aspect is an important part of the embodied memory (Sutton & Williamson, 2014). As a result, a collection of semiotic resources is tested, based on earlier experience and research literature. In the case with the anatomy of the ear and hearing no semiotic resource can meet all these mentioned requirements on their own. The teacher/researcher therefore combine several semiotic resources to offer several perspectives on anatomy and physiology of hearing. The selection of resources is thus judged to complement each other. The selected semiotic resources will be compared with each other with a special interest in how the pupils describe how these resources contribute to their understanding of the teaching content.

3.2 The design of the teaching sequence
After the initial inventory of suitable semiotic resources has been made, the actual teaching is planned in detail. Two variants of the sequence of semiotic resources offered to pupils are planned. This sequencing provides an opportunity to investigate whether the order between some of the semiotic resources affects pupils' understanding of the subject content.

The first lesson is carried out in the same way for all pupils. The second lesson, each class is divided into two groups to use physical models of the ear and digital simulation of hearing in different order. The third lesson is the same for all pupils.

The first lesson is a teacher-led presentation in the whole class, among other things with the support of a projected image from the textbook. Experiments are done observing the direction to the sound source. There is also a student activity in the form of measurements of the frequency range of human hearing and decibel measurements of volume in the classroom. Relevant concepts are written on the board where the pupils take notes, most by hand, but some also use their computer for this.

During the second lesson, the pupils are divided into two groups. The pupils in one half of the class explain how hearing works for one or two classmates with the support of a model of the ear together
with the textbook. The pupils in the second half of the class explain the same content to one or two classmates with the support of a software with a simulation (Sensavis, 2020). The two classes are thus divided into two test groups each, two from each class. Group one uses the model combined with the textbook first, and group two uses the simulation first (Figure 2).

Figure 2. Pupils use two of the resources in different order.

The third lesson is again in full class, initiated by showing a 3-minute film from inside a real ear projected on a large screen. The pupils then answer a questionnaire about how they experienced their learning about the anatomy of the ear and hearing these three lessons. The remaining part of the lesson, the pupils work with exercises about the ear and hearing to consolidate the completed steps.

4. ANALYSIS

The collected data material is first transcribed. All student questionnaires, observations and interviews are then categorized so that a content analysis can be done (Abell & Lederman, 2014). The categories are chosen from the underlying frameworks and the described previous research as follows: the multimodal aspects of sequencing and interaction between different semiotic resources are compared according to design for learning described by Selander (2017). Characteristic for the analysis process is to examine how the pupils talk about and describe the strengths and shortcomings of the various semiotic resources. The analysis thus considers the embodiments of the scientific concepts that are taken from previous research. This analysis of the data material is done abductively by continuously switching between empirical and theoretical reasoning. The focus is mainly on distinguishing how pupils act and talk about embodied cognition (Lakoff & Johnson, 1999; Wilson, 2002; Wilson & Foglia, 2017) and embodied memory (Sutton & Williamson, 2014). Another focus is on how pupils show signs of movement between the semiotic resources, i.e., multimodal transduction (Volkwyn et al, 2019). This analysis is mainly conducted by reading the notes from the observations.

5. RESULTS

The empirical data that has been collected from observations, questionnaires and interviews is compiled based on following aspects of the various semiotic resources.

5.1 The selection of semiotic resources and their affordances

Five semiotic resources are investigated in the present study. The observation notes reveal how the chosen semiotic resources are used. The result is presented in Table 1 with a simple “yes”, “no” and “partially” in response to the question of how the semiotic resource is used by the pupils. As can be seen from Table 1, there are semiotic resources that only partially fulfill all requirements for the understanding hearing. For example, some pupils talk about how it makes it harder to understand when the textbook do not use terms such as ”in front”, ”behind” and other spatial references. Worth noting is that the three-dimensional model in scale 3:1 offers only partial explanatory capacity. The physical model does not show the true size of the auditory bones, as being the smallest bones in the human body. This is something that the pupils pay attention to when they compare the textbook with the model.
Table 1 How the semiotic resources are used by the pupils

<table>
<thead>
<tr>
<th>Explain the hearing</th>
<th>Visible time relations (before/after...)</th>
<th>Spatial relations (in front of, behind...)</th>
<th>Pronunciation of all words that describe hearing</th>
<th>Tactile aspects (touching)</th>
<th>Conceptual explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written text</td>
<td>yes</td>
<td>partially</td>
<td>No</td>
<td>no</td>
<td>Yes</td>
</tr>
<tr>
<td>Picture in textbook</td>
<td>no</td>
<td>partially</td>
<td>No</td>
<td>no</td>
<td>Partially</td>
</tr>
<tr>
<td>Film with sound</td>
<td>yes</td>
<td>partially</td>
<td>Yes</td>
<td>no</td>
<td>No</td>
</tr>
<tr>
<td>Simulation without sound (Sensavis)</td>
<td>yes</td>
<td>yes</td>
<td>No</td>
<td>no</td>
<td>No</td>
</tr>
<tr>
<td>Model of the ear, scale 3:1</td>
<td>no</td>
<td>partially</td>
<td>No</td>
<td>yes</td>
<td>No</td>
</tr>
</tbody>
</table>

As can be seen from the table no semiotic resource meets all aspects for the pupils to understand hearing. The design of the teaching thus needs a careful combination of semiotic resources.

5.2 Physical model before simulation
The pupils express their opinions about what benefit they experience from the semiotic resources in the interview and questionnaire. A common answer is to say that it is both rewarding and difficult to explain a scientific process to a classmate. By explaining to someone else, they themselves are forced to understand. Most pupils mention the importance of being able to touch an object, twist and turn it, touch it. The most prominent result is that the pupils say they prefer the physical model when explaining the anatomy of the ear. The pupils in group one, who use the physical model first, express that they have a good understanding of the anatomy of the ear:

_"I think it's easier to have a thing you can touch or put together than to have a simulation or a video._

However, there are several pupils who used the model first, who describe the effort to visualize themselves:

_A disadvantage of the text and the model is that you must visualize in your own head how it works with the whole process. One advantage is that you get to practice more on visualizing something you have never done before._

These pupils say they find it strenuous to turn the model into a sequence of events, the understanding of hearing, as a process, is difficult to understand using the model.

5.3 Simulation before physical model
Many of the pupils say they appreciate the digital simulation as it shows in what order everything happens. However, the pupils who did the simulation first say they find it more difficult to describe the anatomy of the ear with the support of the simulation:
I learn best if I can touch things when I explain, and I would like a slightly longer explanatory text with information or an audio file with longer info. Being able to write down notes or the like also helps to remember what I have seen or read.

The simulation is often described in terms of comprehensibility with respect to the hearing process:

* I thought this was easier because you got to see the ear work and then I got a better idea of how everything works.

* The simulation provides a more figurative explanation as you get to see what really happens when the sound waves reach the ear.

The pupils that did the simulation first also have comments about memory and imagination:

* I like the simulations more because they are easier to remember.

* Simulations also makes me understand all the steps and every movement as I can see it in front of me instead of just thinking that it looks a certain way after images you have created when you read the text.

In conclusion, many of the pupils say that their understanding of the anatomy benefits from a model to touch, point to and reason about. They also say they appreciate the simulation when they need to understand a sequence of events. These pupils express that the simulation has its strength when it comes to processes to be described.

### 5.4 The authentic film

The film from inside the ear was presented on the third lesson. The pupils’ descriptions of how they understand a film from inside a real ear (Figure 3) are characterized by many comments about authenticity, that the real ear creates more emotions than the digital and physical models.

![Figure 3 shows a real ear, captured from a film sequence, with magnification.](image)

Some of the pupils emphasize that the film from inside a real ear requires prior knowledge to be able to distinguish the different parts of the ear. The film is judged to be difficult to understand and distinguish the various details in unless you already know a lot about the anatomy of the ear. It is also when talking about the authentic film that the pupils highlight feelings as “disgusting” about the visualizations of the ear that are not drawn or simulated.

* I easily lose focus as I tend to look away when the pictures get a little “too much”.

Several of the pupils say that the film adds important information, although it is difficult to see as clear as in the model. Worth noting is that the film clip offers a magnification that none of the other
semiotic resources have. Pupils talk about the magnification and how they are fascinated by the microscope perspective. In the film sequence, the pupils also get to see what the eye cannot perceive, how the ear hair moves and what the cochlea looks like inside.

5.5 Observations of transduction
The pupils’ ability to switch between different semiotic resources, i.e., multimodal transduction, is observed in the classroom notes as well as in the student responses. However, the notes from observations reveal that not all pupils show signs of this multimodal transduction. When a student does not show the ability to switch between the semiotic resources, it becomes a signal for the teacher to step in. The pupils who show that they can switch between the different semiotic resources perform a good understanding of how hearing works. For example, the pupils who can retell all the different modalities also show that they have learned the subject content in a successful way.

In the interviews after completing the learning sequence the pupils describe what was initially easy and/or difficult to understand. Several pupils highlight how they switch between the different semiotic resources. They talk about how the physical model offers an opportunity to touch and thus concretize the anatomy of the ear, and the simulation as well as the text offers opportunities to repeat the information. The pupils pay attention to how the cartoon image of the ear makes it easier to understand the authentic movie.

6 DISCUSSION
Touching a physical model with your hand is a tactile and emotional experience which stays in the memory (Merleau-Ponty, 2000; Sutton & Williamson, 2014). It is something different compared to seeing the ear depicted in a film, reading about it, or experiencing it in a digital simulation. The physical model also occupies a special position in being able to offer clear spatial references about what is behind / in front of / above / below each other, something that is described in detail by Lakoff and Johnson (1999). It is therefore not so surprising that several pupils say they appreciate using the physical model to understand the anatomy of the ear, even though the enlarged model (3:1) does not reflect the size correctly. The hand is important for providing information to the brain about our world. This is consistent with previous research on embodied cognition (Lundborg, 2011; Wilson, 2002). The body’s experience therefore has a bearing on how the teaching planning is carried out and how the offered semiotic resources are made available to the student.

6.1 The significance of sequencing
The pupils in the participating classes were offered two of the semiotic resources, the physical model, and the simulation, in different order. The collected data indicates that the order in which the semiotic resources are presented affects how the pupils say they understand the topic. To understand the anatomy of the ear, pupils said it was more successful to use the physical model before the simulation. This shows the significance of the order between the semiotic resources. This can be explained by the fact that the pupils are still novices in a scientific content, it is then of greater importance in which order semiotic resources are presented (Selander, 2017).

This sequencing also seems to affect when the authentic film is presented. In the design the authentic film was placed last in the sequencing, and there are some pupils who comment on this. They say that it would be difficult to distinguish the different parts of the film if there had not been instructions with sketches before: “You do not see everything so clearly because everything is pink”. As previously reported, the pupils have also made a lot of comments about the authentic film being unpleasant. At the same time, they emphasize that it should not be avoided: “When I saw how the camera went into the ear, I saw something you recognize and then it becomes more real.”

The physical model of the ear seems to be very important. It is only when the pupils have seen the model, twisted, and turned it, that several pupils say they can make full use of the digital simulation.
Most of the pupils in this study, regardless of test group, describe their understanding of the anatomy of the ear and hearing with references to the physical model of the ear. That is interpreted as if the tactile moment seems to be difficult to totally replace with digital simulations.

6.2 Variation and repetition
An additional aspect of teachers working with several semiotic resources in teaching is that the variation also offers repetition of a subject content. Selander (2017) emphasizes that each repetition is a new design and a test of their understanding. The repetition can be expressed in several ways, in this study it is observed how the pupils tell, point, lift, twist, explain to each other and ask questions. This multimodal transduction between the different modalities is an important signal for the teacher that the pupils have understood the subject content, something which therefore confirms what was shown by Volkwyn et al. (2019). Several pupils similarly express that they remember with the help of the body, something that is consistent with what Sutton and Williamson (2014) talk about as embodied memory.

6.3 A transductive capacity
The observations reveal that the pupils can work on a transductive capacity when they practice switching between textbook text, physical model, simulation, image and film. Such a transductive capacity is demanding to build up as it includes a large amount of knowledge and understanding of how the whole is put together. Each switch between the semiotic resources provides an additional perspective for understanding a subject content. The pupils use their hands and all their body when they explain the process of hearing to each other. The embodied cognition is thus prominent in the observations, for example when pupils express themselves about concepts, where they point, how they describe the course of events. These observations can be recognized in what Wilson (2002) writes about the episodic memory’s dependence on space and time. Using the whole body in the learning activity enhances the memory.

6.4 Implications for teaching practice
The purpose of this study is to investigate how pupils act and talk about how they understand the science of ear anatomy and hearing with the support of different semiotic resources. Particularly interesting is the process of how pupils reflect on their understanding of hearing when they use the different semiotic resources in different order. In this study, five semiotic resources have been used in the science education and compared: text, sketch/image, simulation, physical model, and an authentic film sequence. The observations and the reflections made by the pupils and the teacher/researcher provide a basis for further planning of teaching, something that has also been noted by Volkwyn et al. (2019). The design of the lessons where the potential of the various semiotic resources is reviewed is helpful to reach as many pupils as possible.

As stated earlier, teachers have a long tradition of planning teaching with access to several modalities (Selander, 2017). As new learning resources are added, the teacher constantly needs to evaluate the new learning resources to be able to plan and prepare the teaching in the best way. The teacher evaluates which semiotic resources are useful in the specific context. That is dependent on the content of the teaching and the group of pupils. The findings from this study indicates that pupils can benefit from using carefully chosen different semiotic resources. This study also shows that the sequencing of how the semiotic resources are presented can be important. For example, some of the pupils in the present study emphasizes that the authentic film would be difficult to understand if sketches and animated images and simulations had not been shown before.

However, there is a worrying sign in the observations. The pupils’ ability to absorb extensive textual content appears to vary greatly. Some of the pupils state that they prefer to avoid the long text. This is especially important if several pupils, as in the present study, do not have Swedish as their mother tongue. In that sense this investigation raises a concern about the ability to read a text as well as the ability to read an image (Roth & Pozzer-Ardenghi, 2013).
It is also worth noting how the digital solutions were used by the pupils. During the pandemic, it has become even clearer what can happen when the opportunity to be in classrooms, carry out laboratory work and use physical models drastically decrease. The schools have been referred to using digital solutions, in the form of simulations, films, images and animations. On the one hand, the digital solutions have been a prerequisite for being able to carry out distance education at all. On the other hand, according to the empirical evidence in this study, it points out that digital solutions cannot fully replace the variations of semiotic resources that can be offered in the physical school environment. There are many reasons to, like Amin, Jeppson and Haglund (2015) highlight, the need for increased knowledge about embodied cognition. As memory capacity is important for learning purposes, and this also benefits from having physical experiences, the tactile aspect is an important part of the embodied memory (Sutton & Williamson, 2014).

The results presented here would benefit from follow-up studies. Among other things, it would be important to make a comparative study of how pupils learn and retell content knowledge in relation to which semiotic resources they have been offered. Longitudinal studies would also be valuable, how are pupils, for example, affected in the long run by physical examinations being replaced by digital simulations? Another topic to investigate is how pupils’ understanding of science is affected if extensive texts are replaced by simulations and videos. These types of questions are important to answer in an education system that must rest on a scientific basis and proven experience (SFS 2010: 800). There is a constant need for research into the details of how high-quality education is designed.

REFERENCES
APPENDIX 1

Observation protocol
During the lesson, activities and statements are observed, in groups of 2-3 pupils. In the observed activity they collaborate and explain to each other. There are mainly two types of observations here: signs of transduction and embodied cognition.

<table>
<thead>
<tr>
<th>Student group</th>
<th>Text</th>
<th>Sketch of ear</th>
<th>Physical model</th>
<th>Simulation (Sensavis)</th>
<th>Authentic film</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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</table>

Pupils answer digital questionnaires in Google forms after completing the teaching sequence, depending on which of the following two test groups they belonged to:

Test group 1
You have explained to a classmate how the ear’s hearing works with the help of a model of an ear. How did you think it could be explained? Did you understand yourself and did your classmate understand?

Test group 2
You have explained how the ear’s hearing works using a digital simulation. How did you think it could be explained? Did you understand yourself and did your classmate understand?

All pupils
Finally, we watched a film from inside a real ear. What advantages and disadvantages do you see with the “real” film clip?

Interview guide
In-depth interviews are conducted with one student in each test group.
1. Describe all the ways you used to help you understand the hearing, and what the ear looks like.
2. Do you think some of the methods we used work better or worse to understand this specific topic?