

Susanne's answers to some questions about her research, her book, and her work with cats (updated October 2018)

#### WHY DO RESEARCH ON CAT COMMUNICATION?

1. How did you have the idea of producing this research?

What made you decide to expand your phonetics studies into cat communication?

Why did you decide to do this study?

What inspired this study?

- a. As a researcher of phonetics I study human speech. I am interested in how we produce different consonant and vowel sounds, how we perceive these sounds and what their acoustic characteristics are. I am also interested in how we vary our voices, especially the intonation (pitch/tonal patterns, melody) to signal different linguistic as well as paralinguistic (e.g. gender, age, emotion) meanings and how we often change or adapt our voices to the person (or animal) we are talking to. One of my occupational hazards is that I tend to listen less to *what* people are saying than *how* they are saying it. As I share my home with five cats and we communicate using both visual and vocal signals. I couldn't help listening to how my cats varied their voices. I noticed that cats use a large repertoire of different sounds (e.g. purring, meowing, trilling, howling/yowling, growling, hissing etc.) and that they vary them extensively, (e.g. the intonation) depending on the context or situation and their mental state. I wanted to learn more about what causes this variation. I found that there was surprisingly little earlier research on cat communication, and so I began recording my own cats in different situations and analysed their vocalizations with the same phonetic methods I use to study human speech. This confirmed my hypotheses about cats being able to use a wide range of vocalisation types and variation in their voices, especially the intonation. I discussed this matter with my Swedish colleagues Joost van de Weijer (Lund University) and Robert Eklund (Linköping University) and we decided to submit a project application for studying the melody in human–cat communication, and were able to get a small grant to do just that. On the project website ([meowsic.se](http://meowsic.se)) you can find more information about our project, studies and publications as well as our project blog.

#### DESCRIPTION OF THE MEOWSIC PROJECT

2. Can you describe the project, what information are you gathering and what is it you want to decode about cat communication?

What are you going to study in the project?

- a. Our research team consists of linguists with long experience of research on human speech. However, we are also cat lovers, and we have found that cats seem to vary the melody in their sounds in ways that sound similar to how humans vary the intonation when we speak. We became interested in what this variation in cat vocalizations means. Does it signal size or emotion, or can cats vary the melody in their sounds intentionally to signal different specific messages. Do they adapt their melody to the same tonal patterns as the humans around them use in their speech? We are using mainly phonetic methods to investigate this, but also collaborate with veterinarians, ethologists (specialists in animal behavior) and zoologists. We will first investigate the melody in cat vocalizations to see if it can be related to certain contexts, to specific mental states or emotions and/or if cats vary the melody in their sounds intentionally

to convey certain messages. Do most cats use similar patterns in the same situations or are there differences between different breeds, between cats living in different geographical regions and so on? We have now recorded vocalizations of between about 70 cats in different contexts (for instance during feeding time, when they want access to locations behind closed doors) and are currently using phonetic methods to analyze the melody. In our second study we want to look at how cats perceive the melody in human speech. Many humans use a similar speaking style when they talk to cats and to small children; high average pitch, extended pitch range, clear melodic patterns). How do cats perceive these melodic characteristics? Do they prefer that we talk to them as children or as adults? Can they recognize a familiar human voice based on the intonation or speaking style? Do they prefer some voices over others (children's voices, adult voices etc.). We will record human speech of different melodic and speaking styles and use them in listening experiments with cats to learn more about how they respond to different kinds of human speech.

The purpose of this project is to study the communication between humans and domestic cats. Specifically, we will investigate how the prosody, including the voice, melody (intonation) and speaking style – in human speech as well as in cat vocalisations – influence the vocal communication.

We will conduct two different studies:

- i. We are first investigating the melody in cat vocalisations to see if it can be related to certain situations, to specific emotions and/or if cats vary the melody in their sounds consciously to convey certain messages. Do most cats use similar patterns in the same situations or are there differences between different breeds, between cats living in different geographical regions and so on? We will record vocalisations of between 30 and 50 cats in different situations (for instance during feeding time, when they access to locations behind closed doors) and use phonetic methods to analyse the melody.
- ii. In our second study we want to look at how cats perceive the melody in human speech. Many humans use a similar speaking style when they talk to cats and to small children; higher average pitch, extended pitch range, clear melodic patterns). How do cats perceive these melodic characteristics? Do they prefer that we talk to them as children or as adults? Can they recognise a familiar human voice based on the intonation or speaking style? Do they prefer some voices over others (children's voices, adult voices etc.). We will record human speech of different melodic and speaking styles and use them in listening experiments with cats to learn more about how they respond to different kinds of human speech

The project primarily concerns basic research and represents pioneering work within human– cat communication. Our results may lead to an improved quality of life for cats and potentially for other pets as well. Understanding the vocal strategies used by humans and cats in human–cat communication will have profound implications for our understanding of how we communicate with our pets in general, and has the potential to improve the relation between animals and humans within several fields, including animal therapy, veterinary medicine, and animal sheltering.

## RESEARCH RESULTS/FINDINGS?

1. What do you hope to find out with this study/your research?
  - a. We hope to find patterns in the melody that correlate with different types of messages uttered in specific situations or contexts (e.g. I am hungry, I want to come inside, I am content, excited, anxious, stressed, in pain, etc.), and we also hope to help cat owners as well as professionals working with cats (in animal hospitals and animal shelters etc.) to increase our understanding of cats by becoming better at interpreting their vocal signals. Our results will be presented on our project website for anyone to consult.
2. What are the new search results? Do you have some news that you could advance us?
  - a. We have recorded meows of cats in different situations and made acoustic analyses of these sounds. We found that cats who had been recorded in their home kitchen during feeding time often had melodies with a tonal rise at the end, while cats who had been recorded in the waiting room of a vet clinic had meows with a rising-falling melody (a fall towards the end of the sound). We asked human listeners to judge the meows as either belonging to a kitchen-feeding situation or to a vet-situation, and many were able to make correct judgements. I have also analyzed a large number of different cat vocalizations and found that there is a very large variation in the melody and pitch between cats as well as for the same cat in different situations.
3. What are you trying to find with this investigation?
  - a. We hope to find distinct melodic patterns that can be related to specific contexts, and that different cats use similar patterns in the same situations, but we also hope to find that cats in different geographic locations adapt their melodies (at least to some extent) to the human languages and dialects spoken around them. We have begun our analyses but have no general results yet. If we can relate different types of melodies to certain contexts we hope to contribute to improving human–cat communication and also the quality of life for cats. This is important not only in animal hospitals, animal shelters, and in every home with a cat, but also in institutions like retirement homes, as cats are being increasingly used in therapy and as companions in various care facilities.
4. What has been your most interesting or surprising finding?
  - a. That cats are using such a wide repertoire of different sounds and that the tone and melody of a cat vocalization varies extremely and seems to carry an important part of the message. For instance, the more variation in the melody, the more excited or urgent the message seems to be. But there is also much individual variation in the melody of especially meowing, and this we are still trying to learn more about. Also, every cat has its own personal voice quality, just like we humans do.

## CHALLENGES/DIFFICULTIES WHEN STUDYING CAT COMMUNICATION

1. What do you think are the most challenging aspects of studying cat communication?
  - a. The fact that you can't ask them if you got it right. My research mainly concerns the vocal communication, and although I have recorded and analyzed thousands of different cat sounds from over 30 individuals I can never be one hundred percent sure that I have interpreted their vocal signals correctly. Furthermore, just like us humans, every cat has a unique voice, and there is a huge variation in the sounds produced by different individual cats, as well as between different breeds and perhaps even between cats exposed to different

human languages, dialects or accents.

#### CAT COMMUNICATION GENERAL

1. Do you have some evidence about a “cat language”? Or could you recognize when a cat is hungry or happy?
  - a. Not yet. That is one of the research questions that we will investigate in our project. However, our pilot studies suggest that there may be differences in the melody depending on the context or situation that the cat vocalises in. Many humans feel that they can communicate with their cats, and it is possible that cats and their human companions develop a kind of “pidgin language”. Our project will look at what these signals may have in common in terms of the melodic or tonal patterns. There is some anecdotal evidence as well as results from our pilot studies that suggest that cats use melodic variation to alter or emphasize a certain vocal message.
2. Are there cats more communicative than others?
  - a. We will compare different breeds of cats and also compare cats from different geographic locations in order to investigate this. There is some evidence that some breeds are more talkative than others, but we have no scientific evidence of this yet as far as I know.
3. Do cats use other ways of communicating besides vocal signals?
  - a. Cats also communicate with olfactory (scent), visual (body posture, tail and head movements, even eye and ear movements) and tactile (touch) signals. Scent (olfactory) communication/signals: Cats are very territorial and mark their home environment with scent by rubbing the head or body, by scratching and by spraying. The cat’s sense of smell is not as good as the dog’s, but it is so much better than ours. It’s been harder for us to study because we don’t pick up the scents ourselves. We know that females in heat leave their scent, and cats of both genders use scent to mark their territory. Scents indicate gender and age, and because they fade with time, how long ago the other cat was there. A scent can even communicate a cat’s state of health.
4. What about homes with multiple cats. Do cats within a given space pick up the same language?
  - a. Cats living together in a group may develop a group dialect. They listen to what other cats are saying to get what they want, and they adopt those successful sounds. Cats also literally pick up a tone of voice from their humans. That’s not all –humans pick up melodies from cats–I know I pick up melodies and rhythms from mine.

#### CAT VS HUMAN COMMUNICATION

1. Can cat communication be understood as an actual “language” by the standards that humans use?
  - a. Not by the human definition of language. Cat communication was developed to express the needs, intentions and desires of cats, which are quite different from ours. They don’t talk about yesterday or the last decade, countries far away, the political situation or their career plans. Vocal cat communication has much fewer “words” which are tightly related to the context and the cat’s mental state. However, these words have neither structured rules about how to pronounce (phonology) them or combine them (morphology, syntax) to change the meaning) nor a written language in cat communication. On the other hand, cats are much better than humans at communicating with scent marks, and they also use visual (e.g. body/tail/head postures and movements) and tactile signals

extensively. It also seems that many cats develop a kind of unique “Pidgin language” with their owners by finding which communication signals work the best.

2. Are there any human languages that have the features of complete context dependence, and phonemes constructing different words with different meanings flexibly rather than statically?
  - a. Not that I know of.

## CAT VOCALISATION TYPES

### MEOW

1. Currently, how many types of meows have been identified? Is there any estimated how many can be identified?
  - a. As this project mainly deals with melody in human-cat communication, we will not be able to investigate all different types of meows. However, as a sub-project I am trying to collect all types of cat vocalization on our project website ([meowsic.info](http://meowsic.info)) under ‘cat sounds’. There I have identified at least four subtypes as well as several combined, mixed or merged variants like the combined and the merged/mixed trill-meows and purr-meows.
2. Does every meow mean the same thing?
  - a. After we got our grant, we started to record more cats and, mainly, the conversation between humans and cats. We recorded the cats in several contexts: Feeding time, when the cats wanted to play or to be let out.... Bringing the cats to vets in carriers. We found variation depending on the context.
3. Can you describe the variation?
  - a. All the categories are interesting. Trilling is a congenial sound between cats who are friends. Hissing, howling, spitting, growling, snarling –these are aggressive or defensive sounds. Meowing is an attention-seeking sound which can mean different things depending on the situation: I’m hungry, I want to play, I’m bored, I’m in distress. The meow has many more meanings and so we are studying it first by looking at dialect and melody.
  - b. There are so many meow variants, and I have been able to use my knowledge of phonetic methods to divide meows into subtypes based on types of vowels and consonants; loudness and softness; and whether the melody is falling, or rising, or rising and then falling –things like that.
4. What are the subtypes of the meow?
  - a. I have found four subtypes. One is the “mew,” which is a high-pitched meow that often contains the “e” and “i” vowels –“mieww!!” Kittens use this when distressed or need attention from other cats. Adult cats keep this sound to get attention or help from humans. There is the squeak, with an “a” vowel as in “bad”. Squeaks are made with a more open mouth – and often signals a friendly request. Then there is what I call the “moan” with “o” and “u” vowel; this is a sad sound. “I am trapped in my carrier, trapped indoors, feeling stress.” In the “moan” the melody often first rises and then falls toward the end. Finally, we have the typical “meow,” which includes several vowels.
5. How exactly does *that* sound?
  - a. It may sound like it is spelled, but a meow can vary a lot depending on the situation. The mouth first opens, then closes. The meowing cat is seeking attention, but can have a range of meanings. She can sound hungry, or be

asking to cuddle or play. This sound contains a lot of variation and that makes it especially interesting to me.

6. I take it the general meow is not really a one-size-fits all universal language but rather varies in cats across a range of dialects and melodies.
  - a. Exactly, it varies in vowels, in melody –and each cat has a personal voice quality, some in a low pitch and others high pitch and, depending on the cat, these can mean the same thing. It is up to human caretaker to decode and learn the differences in sound, to interpret. Cats try different sounds when they communicate with their humans, and those sounds which get the results –for instance, is a sound is effective in getting the owner to feed the cat –are the sounds the cat keeps on using for that goal.
7. What about the sounds beyond the meow that cats use to communicate with other cats?
  - a. Notice two cats howling and growling at each other. The cat with the loudest, darkest, lowest frequency howl tends to win. That sound says, I am the biggest and most aggressive. When one cat wins the howling contest the other cat usually leaves the territory in slow motion.

#### CAT ACCENTS/DIALECTS

1. Why there is strong evidence that cats also have meows with an accent, such as humans? The influence would be human or through contact with other cats? is there some result?
  - a. I don't know if cats meow with different accents. That is one of the questions that we want to find answers to in this project. However, it seems that cats and their human companions together develop some kind of unique "Pidgin language" in their vocal communication, and it is not impossible that some of the accent or dialect features of the human speech is included in the vocal signals of the cat as well. I have been approached by a number of people after having given talks about cat vocalisations who say that their cats do not sound anything like the cats in the sound examples I have played, and could this be because they speak another language (like e.g. Japanese) or a different accent/dialect with their cats?
5. What's your hypothesis with regards to dialects? Do you think cats from different regions have different 'accents'?
  - a. I don't know. That is one of the questions that we want to find answers to in this project. However, it seems that cats and their human companions together develop some kind of unique "Pidgin language" in their vocal communication, and it is not impossible that some of the accent or dialect features of the human speech is included in the vocal signals of the cat as well. I have been approached by a number of people after having given talks about cat vocalisations who say that their cats do not sound anything like the cats in the sound examples I have played, and could this be because they speak another language (like e.g. Japanese) or a different accent/dialect with their cats?
6. Can you explain what the terms 'dialect' and 'melody' mean for the study of human speech?
  - a. In the human languages I study, a dialect is a variety spoken in a specific geographic region. Melody, or intonation, refers to the rises and falls of the pitch. This may vary between dialects, but sometimes melody can be universal across dialects. For instance, I raise my voice at the end of a sentence if I'm uncertain, as in this question: "Is this okay?" On the other hand, if I want to

say something I am certain of, my voice will fall: “This is what melody is all about.”

7. But melody can vary from dialect to dialect as well. How does that work in humans?
  - a. Let’s look at an example in a language you probably don’t know, Swedish, where we have several dialects and use melody to distinguish between them. In south Swedish, which is my dialect, for instance, the word for “spirit” is “anden” –we pronounce it “AN-den,” with a tonal peak at the first syllable. But in Stockholm there are two tonal peaks, and they say “AN-DEN.” There are languages like Mandarin Chinese with four tones on the same syllable to mean four things, while some Chinese dialects have six different tones.

## CAT–HUMAN COMMUNICATION

1. How do people talk to their cats and can you put a few words on cats and humans communication in general?
  - a. The cat is one of the most popular pets of the world. Since its domestication about 10,000 years ago, humans and cats have learned to communicate using visual as well as vocal signals. Still, we know surprisingly little about this interspecies communication. We do know, for instance, that cats vary the melody of their sounds extensively, perhaps using intonation patterns similar to those used in human speech, but we do not know how to interpret these variations. For instance, kittens meow to get their mother’s attention, but adult cats usually don’t meow at each other. However, cats have learned that a good way to get the attention of their human companions is to meow, and have – together with their human companions – developed some kind of unique “pidgin language” using sounds like meows, purrs, chirrs as well as visual signals. Does every human-cat pair have a unique way to communicate or does the vocal communication between cats and humans share some characteristics (and if so, which are they?), and are their systematic differences, perhaps depending on the human language, dialect or accent, on the breed of the cat. One goal of the project is to find out more about that. Another goal is to study whether cats react differently to various aspects of human speech, such as different voices, speaking styles, and intonation patterns.
2. What is the difference between how cats communicate with other cats and humans?
  - a. Kittens meow when they want their mother’s attention, but wild and feral cats usually have no need to continue meowing after having reached adulthood. Instead visual and olfactory signals are used, and vocal signals are limited to mother-kitten sexual, and agonistic (aggressive) situations. However, many domestic cats continue meowing, most likely to get the attention of humans. They probably have learned that people are very sensitive (and respond quickly) to meowing, and this may be because meowing sounds similar to a human child crying.
3. Do cats communicate differently with humans than with other cats?
  - a. Many cat sounds are used with humans as well as cats, but meowing is mainly addressed to humans. Kittens meow but adult cats rarely meow to each other.
4. Cat–human communication: what leads to believe that the cat prefer a specific form of communication, for example, be treated more sweet way, with a voice tone acute or not, with a different voice tone?
  - a. We don’t know yet. This is one of our research questions. We will do listening test with cats using new methods to examine how cats perceive different prosodic (melodic) cues in human speech. Do they distinguish between

different voices (familiar-unfamiliar, adults-children) and speaking styles (pet-directed, adult-directed), and do they prefer certain intonation (melodic) patterns?

5. Can cats identify different intonations in your voice? (Not only the volume, like a scream, but the intonation in the sense of sadness, anger, happiness etc.)
  - a. We don't know yet. This is one of our research questions. But it is likely that cats can pick up the emotional state of humans from our voices. We will investigate this further in our project.
6. In your book you write about how you used what you have discovered about cat communication to improve your relationships with and between your cats. Can you offer any other day-to-day examples of how you have found cat communication knowledge to be useful?
  - a. I have learned more about my cats' personalities and mental states by observing their communication patterns. Confident, curious and bold cats sound different than shy, nervous and anxious cats. The difference is mainly in the pitch and intonation, the voice quality and in the intensity. This has helped me to understand when my cats are content and when they are discontent, stressed or anxious.

#### GOALS OF MY RESEARCH: BETTER UNDERSTANDING, HOW HELP CATS

1. After this study, how are you better able to understand your own cats?
  - a. I have learned to listen more carefully to the many phonetic features of my cats' vocalizations. Is the mouth closed or open and does it move (e.g. from opening to closing)? Is the pitch high or low? Is the tone rising or falling? Is the sound long or short? What vowel or consonant-like sounds can you hear in the vocalization? But also other aspects, like what visual signals usually accompany a particular sound or tone of voice, and in which contexts and mental states is a sound produced? By paying more attention to the phonetic characteristics as well as the accompanying context I think that I am now able to understand my own cats much better.
2. How can your research help cats?
  - a. We will be able to better understand our cats, not just in our homes, but also in shelters and sanctuaries. If we listen closely to the variation in cat sounds we'll be able to hear the difference between cats who are content, friendly, aggressive, scared, stressed, or even in pain.
3. What take-home message would you like my audience to receive about how they talk with and understand their cats?
  - a. I would recommend all cat owners to listen more carefully to their cats if they want to understand them better. By learning which sounds and nuances in the voice (e.g. the vowel and consonant sounds or the intonation) your cat uses to express their different needs or desires in different contexts, and which visual or tactile signals accompany them, you will become much better at interpreting their vocal messages.
4. Is there anything else you'd like to add?
  - a. Please remember that cats are individuals with unique personalities and this includes their communicative behavior. Some cats are more talkative than others. But generally, the more you talk to your cat, the more your cat will talk to you.

#### CATS VS. DOGS AND OTHER PETS

5. Is there something about cat owners that make them more eager to understand their pets than, say, dog owners?
  - a. I wouldn't know. I love dogs too, and perhaps we usually think that dogs are easier to understand than cats (which are sometimes considered to be more mysterious), but I honestly don't know and I haven't read any research reports on this difference either. Perhaps we think that cats are sometimes more difficult to understand as they are less eager to please us than dogs and therefore want to learn more about how cats communicate their needs, intentions and desires.
6. Do you ever foresee a day where we can understand the language of cats or other pets as simply as we understand other humans?
  - a. I would like to think that by listening more carefully to the vocal signals of our cats and by learning more about in which situations cats use different sounds that we will be able to better understand our feline (or canine or other) friends. I myself have noticed a huge difference after being more sensitive to the many nuances in the vocal communication of my own cats. But we have to remember that cats use their communication skills for other purposes than we do. Cats don't discuss the weather or politics, for instance. Their communication system is adapted and has been perfected for their species, just as human language and speech has been for our species. However, I think that humans can learn to understand the vocal signals of their cats better just by paying a little bit more attention to them.

#### OTHER/EARLIER STUDIES ON CAT COMMUNICATION

1. You say in the book, the research on cat communication is limited. Why do you think that is?
  - a. Cats are not pack or flock animals, and have less need to communicate socially than for instance dogs. As wild and feral cats often are solitary animals, they tend to communicate only in three basic contexts: mother-offspring, sexual, and territorial. However, many domestic cats form social bonds with other cats and also with humans. These cats have developed ways to communicate with their group members, and for instance learned that vocal signals seem to work best with us humans. Moreover, it is not that easy to study the vocal signals of cats. First you have to be there with a microphone when the cats are actually saying something. Cats usually don't say anything on command. You can't just hold a microphone to their mouths and ask them to produce a few meows and trills, and finish off with some growling, howling (or yowling) and purring, and to explain afterwards what these sounds actually mean. Once you have some recordings of cat sounds you need to be able to categorize them (divide them into distinct sound types like purring, hissing, meowing, trilling, etc., which sometimes can be quite challenging) and then use appropriate methods to analyze the sounds in each category. One way is to use acoustic-phonetic methods, but many researchers also use bio-acoustic methods.
2. Tell me about your first (early) studies of cat communication.
  - a. Cats seem to use different tonal patterns in different situations to signal different messages or to alter or emphasise a message ("I'm a bit hungry", "I'm VERY hungry", "I'm unhappy", "I am content", "Could I please have your attention?", "I need your attention NOW!", etc.). My cats seemed to do just that (I had human listeners judge vocalisations of my cats and many of them were able to distinguish happy from unhappy meows). Or could it be that

cats simply imitate human intonation, perhaps to improve cat–human communication? The literature I read about earlier studies of cat vocalisations and how cats perceive human speech, but realised that there was surprisingly little research about this, and only very few had used phonetic methods to look at some of these aspects, and my questions were not answered. I began recording meows and other cat sounds in different contexts and made acoustic analyses of these sounds, sometimes with my colleagues Joost van de Weijer and Robert Eklund. We found that cats who had been recorded in their home kitchen during feeding time often had melodies with a tonal rise at the end, while cats who had been recorded in the waiting room of a vet clinic had meows with a rising-falling melody (a fall towards the end of the sound). We asked human listeners to judge the meows as either belonging to a feeding context or to a vet context, and many were able to make correct judgements. I have also analyzed a large number of different cat vocalizations and found that there is a very large variation in the melody and pitch between cats as well as for the same cat in different contexts.

3.

#### OTHER STUDIES ON OTHER ANIMALS

1. Are you aware of any other studies that have looked at the accents of different animals?
  - a. Well, as animals do not have languages in the same sense that humans do, although some develop large and varied vocal repertoires to communicate with their own species or with humans, it may not be quite adequate to talk about dialect or accent, but it seems that some animals have some regional variation in their vocalisations that resemble accents or dialects. For instance, birds are known to have different accents or dialects, and wolves, seals, dolphins and whales seem to have dialects as well.
2. Human language is passed down through the generations. Is the same true for cats?
  - a. Different breeds may have different vocal behavior. Siamese cats are known for being very vocal. Bengals tend to vocalize in longer and darker tones. Moreover, it seems that the melodies they pick up from their humans and other cats influence the dialect as well. Cats lack grammar or a large number of words, but they don't need that to be able to communicate.