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## Origins, Past, Present and Future

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# Melody in Human–Cat Communication (Meowsic): Origins, Past, Present and Future

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## Abstract

The recently funded, five-year, project Melody in Human–Cat Communication (Meowsic) has received vast media attention, both nationally and around the world. In this paper we summarize how our activities got started, our published results so far, the present situation and how we envision our planned, future research, including some of the core hypotheses to be addressed by the project.

## Introduction

The recently funded, five-year, project Melody in Human–Cat Communication (Meowsic) has received vast media attention, both nationally and around the world. In this paper we summarize how our activities got started, our published results so far, the present situation and how we envision our planned, future research, including some of the core hypotheses to be addressed by the project members.

Since the Swedish national Fonetik conferences have been at the core when it comes to dissemination of our results within this field, we deemed it appropriate to summarize and present our findings at the 2016 meeting.

## The Origins (2010)

Following activities as a volunteer at the Dell Cheetah Centre in Parys, South Africa (see Web Resources), where

Eklund had the opportunity to record the impressive cheetah Caine (see Web Resources), [Eklund, Peters and Duthie \(2010\)](#) presented a study on purring in a big cheetah and a small domestic cat at Fonetik 2010, Lund University. They showed that purring F0 was roughly the same in both species (~30 Hz), despite the 25-fold difference in size between the animals. They also examined the differences between egressive and ingressive phases in both species, and later studies have shown that these are subject to large individual variation in both frequency, amplitude and duration.

Inspired by the paper and the talk, Schötz went home and recorded the purring of her own cat Vincent. Moreover, when she a few months later became caretaker of the three young cats Donna, Rocky and Turbo she recorded them as well, contacted Eklund and that way initiated collaboration.

## The Past (2011–2015)

The aforementioned collaboration, and the addition of Joost van de Weijer to the mix, has resulted in a plethora of studies, both of purring and of other felid vocalisations. These are briefly described in the following.

## More purring (2011)

At Fonetik 2011, KTH, in Stockholm, [Schötz and Eklund \(2011\)](#) presented a paper on purring in four domestic cats.

The results added to the previously reported characteristics of egressive and ingressive phases. (Incidentally, Eklund and colleagues presented two papers on lion roars at the same conference: [Eklund et al. 2011](#); [Ananthakrishnan et al., 2011.](#))

### **Beyond purring (2012–2015)**

In 2012 – while/although Eklund once again presented a paper on purring, this times in cheetahs ([Eklund et al. 2012a](#)) – both Eklund and Schötz, independently, moved beyond purring, and presented papers on vocalisations from a wider perspective in domestic cats ([Schötz, 2012](#)) and agonistic vocalisations in cheetahs ([Eklund et al. 2012b](#); also see Web Resources).

During the period 2012–2015, Schötz and her colleague van de Weijer established themselves as the authorities par excellence on domestic cat vocalisations, from different perspectives, described below.

#### *Affiliative cat vocalisations*

In 2012, Schötz collected 538 affiliative vocalisations from three domestic cats. Based on auditive analysis, the vocalisations were categorized into five types and analysed for duration and F0. Within each type, duration was similar across the three cats, but F0 measurements (mean, minimum and maximum) were not, due to the large type number of intonation patterns used in each type.

#### *Prey-directed cat vocalisations*

[Schötz \(2013\)](#) collected 257 prey-directed vocalisations from three cats. The sounds were subdivided into the types chatter, chirp, tweet and tweedle, and analysed for duration and F0. Variation was found within and between these types as well as within and between the three cats in both duration and F0.

#### *Human perception of cat vocalisations*

[Schötz and van de Weijer \(2014a/b\)](#) examined human listeners' ability to classify domestic cat vocalisations (meows) recorded during feeding time (food related meows) and while waiting to visit a veterinarian (vet related meows). A pitch analysis showed a tendency for food related meows to have rising F0 contours, while vet related meows tended to have falling F0 contours. Thirty listeners judged twelve meows (six of each context). Classification accuracy was significantly above chance, and listeners who reported previous experience with cats performed significantly better than inexperienced listeners. Moreover, the two food related meows with the highest classification accuracy showed clear rising F0 contours, while clear falling F0 contours characterized the two vet related meows that received the highest classification accuracy.

Additionally, [Schötz \(2014\)](#) conducted a pilot study where 36 human listeners classified 28 cat vocalisations into seven emotion categories. Classification accuracy and between-listener agreement varied considerably between vocalisations. The vocalisations were subdivided into categories based on the emotions perceived by most listeners and compared in an acoustic analysis. Preliminary results suggest that cats vary their intonation to signal different emotions, and that humans perceive them based on cues used to signal emotion in human speech. Surprisingly, the chirr (trill) vocalisation used for affiliative greetings was often misjudged as anger.

#### *Agonistic cat vocalisations*

[Schötz \(2015\)](#) recorded 468 agonistic cat vocalisations as one cat was introduced to her home with three resident cats. Six vocalisation types were identified: growl, howl, howl-growl, hiss, spit and snarl. Numerous

other merged vocalisations and combinations were also observed. An acoustic analysis showed differences within and between all types in duration, F0 and spectral centre of gravity.

During the same period, [Eklund and Peters \(2013\)](#) presented a study of purring in cheetahs of different ages, as well as a tongue-in-cheek paper on “Cat Language” as described in a thesis from 1895 ([Eklund, 2015](#)).

### **The Present (2015–2016)**

In January 2015 the authors wrote an application for a project grant with the aim to combine the findings of our earlier studies further, with focus on prosody in human–cat vocal interaction. The project received funding from the Marcus and Amalia Wallenberg foundation (MAW) in December 2015, and will start officially in September 2016. The project objectives are described below.

### **The Future (2016–)**

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

#### **Study 1. *Prosody in cat vocalisations***

This study will build on existing theories of cat vocalisations. Previous studies (e.g. [Moelk, 1944](#); [Ohala, 1984](#); [Schötz & van de Weijer, 2014a/b](#), [Schötz, 2014](#)) suggest that cats vary the intonation and other prosodic features (voice quality, rhythm and duration) in different contexts and when signalling different emotions and/or messages. However, to our knowledge no larger systematic acoustic study of the nature of this variation has been carried out. We will explore a number of features in

order to learn more about how cats use prosodic variation when interacting with humans. Specifically, we will try to answer three main research questions:

1. What are the most common types of cat vocalisations and how do they differ prosodically?
2. Which types are used in different contexts or situations?
3. How do human listeners perceive this prosodic variation?

Our hypotheses are:

1. Cats “semi-consciously” use distinct prosodic patterns (intonation, intensity, length and voice quality) in different contexts to adjust, emphasize or alter the meaning of a vocalisation
2. Similar types of prosodic variation are used by different/most cats.
3. Experienced human listeners are able to interpret this variation.

A searchable and annotated corpus with high quality sound and video recordings of at least 30 domestic cats from two regions of Sweden (East central, South) will be collected. We will record the cats together with their human caretakers in their homes in everyday interactive situations, e.g. at feeding time, when greeting a companion, during play, etc.

Based on auditory and acoustic analyses of the cat vocalisations, we will develop a typology of the prosodic variation of cat vocalisations.

#### **Study 2. *Cat perception of (human) speech prosody***

As was shown by [Burnham, Kitamura and Vollmer-Conna \(2002\)](#), pet-directed speech shares many of the characteristics of infant-directed speech. However, we do not know whether pets, like infants, are also more drawn to this kind of speech than to speech that lacks these characteristics.

In order to investigate this question we will carry out a discrimination experiment in which we expose cats to audio samples of pet-directed and adult-directed speech – natural as well as resynthesized stimuli – and record their reactions to these samples. This experiment will serve two purposes: First, we want to explore which behavioral responses in cats may be used in an experimental setting. As preliminary candidates for such responses, we consider head (and eye) turns, ear and body movements, and exploring behaviour; Second, we want to investigate whether any of these responses is suggestive of a preference for either: a) pet-directed, or adult-directed, speech; b) children's or adult voices; c) familiar or unfamiliar voices.

To minimise the stress level of the cat participants, the experimental sessions will be carried out in the cats' home environment. We will use a specially built mobile box (which is carefully cleaned after each session to remove any remaining scents) to provide a similar environment for all cats, and the video recordings will be scored by two independent judges in order to guarantee objectivity and reliability of the results.

### **Inspiration: dialects in cats?**

Further inspiration concerning language learning comes from both ancient and recent sources. Already Aristotle observed that birds exhibited both vocal learning and dialectal variation (Zirin, 1980). Moreover, recently it was discovered that the Norwegian fin whales have at least six different dialects (Vester et al. 2016) – which does not come as a surprise since the literature is replete with reports of “dialects” in animal vocalisations. Thus, we hypothesize to find dialectal variation in domestic cats.

Another issue is to what extent – if at all – vocal learning can be observed. This, as already Aristotle mentioned,

is a prerequisite for dialectal variation: without learning, no dialects.

### **External collaboration**

The research team collaborates with clinical veterinarians, including Ann-Charlotte Sandberg (Landskrona Smådjursklinik), and also with ethologists, including Jennie Westander (PhD in Ethology, head of Education and Research at Kolmården Wildlife Park) and Elin Hirsch (PhD student in Applied Ethology, Swedish University of Agricultural Sciences).

Moreover, we will collaborate with some of the world's leading experts on animal communication and felid vocalisations, including Dr. Gustav Peters, Professor Gisela Håkansson, and Professor Emeritus John Ohala. This means that we will be in very good position to elucidate acoustic-phonetic aspects of cat vocalisations, relevant for communication between humans and cats.

### **Parallel projects**

Outside Meowsic, the research team is also active in three related projects that most likely will prove of value.

First, in 2013 Eklund recorded various cheetah vocalisations at the N/a'an ku se Foundation in Namibia, as part of project officially sanctioned by the Namibian Government. Analyses are under way and will be conducted in collaboration with Dr. Florian Weise, Stuart Munro and Gustav Peters.

Second, Eklund is collaborating with Dr Andrew Kitchener and Georg Hantke at National Museums Scotland in Edinburgh, where post mortems of all felid species are planned in order to map larynx structures with reported vocalisations in those species.

Third, Schötz and van de Weijer collaborate with Elin Hirsch and Maria Andersson, Swedish University of Agricultural Science and the Centre for Feline Behaviour and Welfare in a multi-disciplinary study of prosody,

behaviour and welfare in the domestic cat. The plan is to develop a web based toolbox with descriptions and examples to be used by humans wanting to assess cat welfare and well-being.

## Media attention

University press releases are normally made only when results are beginning to show up, but Lund University made an exception for our project, which proved a correct decision: media attention has been enormous, and the authors find it hard to even keep track of where Meowsic is reported. We have now (June 2016) done over thirty interviews which have resulted in over 100 articles in magazines, newspapers and websites.

Just to mention a few, we have been covered by National Geographic, The Washington Post, The Guardian, BBC 5 Live, The Telegraph, Daily Mail, as well as Swedish radio, TV and press, Norwegian radio and online all over the world, including Chile, China and Vietnam.

However, we take special pride in being covered in a special issue “Cats (and Dogs)” of *Annals of Improbable Research* (i.e. the people behind the Ig Nobel Prizes) where three of our papers are mentioned, and Eklund’s purring website is also referred to (see References and Web resources).

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## Web resources

- Meowsic Project website:  
<http://meowsic.info>
- Dell Cheetah Centre homepage:  
<http://www.dccafrika.co.za/>
- Eklund records the cheetah Caine:  
<http://www.youtube.com/watch?v=ZFvULxbN3NM>
- Agonistic vocalisations in cheetahs:  
<https://www.youtube.com/watch?v=bBI5g2Fp1U&feature=youtu.be>
- Eklund's purring website:  
<http://purring.org>