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Hundens perception av mänsklig akustisk kommunikation

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SAMMANFATTNING

För de flesta hundägare är det idag självklart att använda akustiska signaler för att kommunicera med sin hund. Ord används både för att be hunden utföra uppgifter och för att hålla ”konversationer” med hunden. I denna litteraturöversikt undersöks hur hundar uppfattar human akustisk kommunikation och hur denna kan påverka hundens beteende. Denna information kan vara viktig vid till exempel inlärning.

Akustiska signaler kan användas för att spegla avsändarens känsloliv. De används också för att bedöma andra individers beteende genom att värdera deras kommunikativa signaler. Detta sker både genom direkta interaktioner med andra individer, men också genom att bedöma signaler vid kommunikation mellan två andra individer. Vid denna typ av bedömningar har de akustiska signalerna visat sig vara särskilt viktiga för att förstå den sociala kontext i vilken kommunikationen förekommer. Akustiska signaler kan även påverka mottagarens beteende och olika ljud har visat sig vara olika bra på att framkalla olika svar hos mottagaren. Korta ljud har visat sig vara signifikant bättre på att framkalla ökad motorisk aktivitet, medan långa ljud visat sig ha en tendens att ge upphov till minskad rörelseaktivitet.

Vid träning av hundar är akustiska signaler oftast centrala. Hundar har visat en stor kapacitet att använda sig av verbala signaler för att lära sig namnet på olika saker, och en del individer har rapporteras kunna namnet på upptill 200 olika objekt. Samtidigt uppvisas en förmåga att snabbt associera nya objekt med ett ord. Vanligtvis genomförs denna inlärning oftast med hjälp av en träningsmetod kallad ”shaping”, där hunden belönas för att den närmar sig och manipulerar det önskade objektet, med ökande krav för belöning. Studier har dock visat att man genom att bara hantera, titta på och tala om objektet framför hunden kan uppnå jämförbara resultat med oförändrad inlärningstid. Det finns dock även studier som tyder på att akustiska signaler såsom tal och ljud skulle kunna inverka negativt på hundens inlärning, genom att demonstrera kortare inlärningstider vid träning helt utan akustiska signaler.

Betydelsen av akustiska signaler för hundar vid inlärning tycks vara osäker. Akustiska signaler är viktiga för hunden vid bedömning av sociala situationer. För att få klarhet i hur man på bästa sätt använder akustiska signaler vid kommunikation med hundar krävs ytterligare studier av hur de påverkar deras beteende och inlärning.

SUMMARY

For most dog owners today it is natural to use acoustic stimuli such as talking to communicate with their pets. Words are used both to ask the dogs to perform tricks, as well as to hold "conversations" with the dog. This literature review looks at how dogs perceive human acoustical communication and how this can influence the behaviour of the dog. This information could be used e.g. during dog training.

Acoustic signals are said to be a reflection of the inner state of the signaller, but they can also be used to assess the behaviour of other individuals by looking at their communicative signals. This can be done both through direct interactions with another individual, but also by assessing signals that are used in communication between two other individuals. Acoustical signals have also been showed to be especially important for understanding the social context in which these types of communication are used. Acoustic signals can also be used to influence the behaviour of the receiver. It has been shown that different kinds of sounds diverge in their ability to generate different responses from the receiver. Studies has shown that multiple short tones are significantly better at inducing increased motor activity, while long sounds have a tendency to give rise to decreased movement.

Acoustic signals are often central in dog training. Dogs have showed a great capacity for using acoustic signals to learn the name of novel objects and some individuals are reported to be able to retrieve up to 200 different upon hearing an acoustic cue. Dogs also have the ability to quickly associate new objects with words. This kind of learning is usually accomplished by using "shaping", a training method in which the dog is rewarded for approaching and interacting with the novel object, but with increasing demands for attaining the reward. Studies has showed that by handling, looking at and talking about an object in front of the dog, you can achieve results that are comparable in quality and with the same learning time as in training using shaping. But there are also studies whose results suggest that acoustic signals such as talk and sounds might interfere with the dogs learning, by demonstrating decreased learning times when dogs were trained entirely without using acoustic signals.

While being important for dogs to assess social situations, the importance of acoustic signals for learning in dogs is unclear. To better understand how to use acoustic signals when communicating with dogs further studies are needed about how these signals affect the behaviour and learning of dogs.

INTRODUCTION

Humans frequently use acoustic signals such as words and other sounds to communicate with each other. The evolved verbal language of man is considered unique and is in combination with different forms of body language central in our communication with other individuals of our species. Human reliance upon acoustic signals in human-to-human communication as well as the lack of knowledge about the body language of other species often leads to a tendency for humans to rely primarily on vocal signals in interspecies communication. This might prove to be a problem in our interspecies communication, since vocal signals do not always have a central role the communication of other species.

Most dog owners today frequently use acoustic stimuli as a means of communicating with their dog. Both spoken word and various sounds are used to command the dog to perform tasks and tricks, as well as to make them refrain from performing unwanted behaviours. Acoustic stimuli can therefore be said to be at the heart of human-dog communication and is often considered central in dog training. But how does our vocal signalling really influence learning and understanding in dogs?

The aim of this paper is to investigate how dogs perceive human acoustic communication. It will look at what dogs hear, how they make use acoustic signals used in social interactions as well as how humans talk to dogs and what dogs make out of our words and sounds. Further, it will look at the importance of acoustic signals during training of dogs and at how dogs define objects, which can help us understand the cognition of a dog. This information could be relevant to dog owners in their everyday life and communication with their dog, as well as for patient communication and design of clinics for practicing veterinarians.

MATERIALS AND METHODS

The material for this paper have been found by performing searches in the database Web of Knowledge for keywords such as Dog, Dogs, Canine, “Canis familiaris”, Human, Communication, Interaction, “Acoustic signal*”, Speech and Speaking. Information has also been found in the books “The Behaviour Biology of Dogs” (Jensen, 2007) and “Dog Behaviour, Evolution and Cognition” (Miklósi, 2007), as well as in studies referred to in these books. Some articles used have also been found by following references in other read articles, by looking for studies with titles that seemed relevant to the aims of this paper.

LITERATURE REVIEW

Hearing in dogs

Dogs can perceive sounds between about 67 – 45 000 Hz, whereas humans can hear sounds in the range of 64 – 23 000 Hz, meaning that dogs can hear sounds in what is usually referred to as the ultrasonic spectrum (Miklósi, 2007). Hearing in the ultrasonic spectrum can be used to locate prey, such as rodents, whom to a large extent communicate in ultrasonic frequencies (Jensen, 2007). According to Jensen, it is also plausible that ultrasonic frequencies are used by puppies in distressful situation to communicate with their mother, since sounds of higher frequencies travel shorter distances compared to sounds with lower frequencies. The same author writes that this quality of higher frequency sounds means that the usage of them in these types of situations lowers the risk sounds are picked up by predators.

Dogs are able to move the pinnae of their ears independently, meaning they can direct them towards the origin of perceived sounds (Miklósi, 2007). According to Miklósi, this is useful in the wild by using sounds to locate prey. The author also points out that the often large pinnae of dogs pick up and direct the sound into the ear, which amplifies the sounds heard. According to Miklósi, there are no data as to how drooping ears affect a dog's hearing abilities.

Acoustic Signals in Social Situations

In ethology, communication is when a sender uses a signal to change the behaviour of the receiver of the signal, aimed at giving either the sender, or both parties, an advantage over some period (Miklósi, 2009). Signals used in communication are according to Miklósi related to the inner state of the sender. When engaging in a social interaction, many different signals will have to be taken in and processed to be able to create an understanding of the social context (Pongrácz et al., 2001). Pongrácz et al. suggests that acoustic signals are part of a more complex, contextual situation were both social and environmental signals are integrated through cognitive processes. The author writes that signals sent out by an individual can be behavioural, visual, acoustic or other types of signals, which are used in combination with contextual, environmental signals as releasers for subsequent behaviour. According to Pongrácz et al., the behavioural response stems from an understanding of the social situation and is based on earlier experiences from similar situations.

Elgier et al. (2009) showed in their study that dogs prefer social cues (e.g. pointing) to physical ones (non-social; e.g. smell). The authors mean that this results from dogs spending much of their time near humans, therefore being provided with many opportunities to learn human social cues. The same authors also showed that dogs preferred physical cues to unusual social cues like elbow-pointing, which would suggest that learning influences the preference of cues. This would according to the same authors mean that training could change the preference of social signals over physical ones. Elgier et al. also suggested that experiences during ontogeny might be important for the preference. In a study by Mills (2005), dogs were shown to prefer following visual signals to acoustic ones when given contradictory signals, indicating that non-verbal signals might also be important during training. According to Mills, this preference probably varies with the task.

For communication between different species to work, similar communicative signals, stemming either from a close evolutionary relatedness between the communicating species, a similar evolutionary pressure or a shared environment, are required for successful communication, (Miklósi, 2009). Miklósi also writes that in the case of dog and man, past selection for behavioural predispositions improving interspecies signalling in the dog, as well as learning during ontogeny, facilitates the communication between dogs and humans.

It is important to understand that the human-dog communication consists of numerous simultaneous cues, where acoustic signals only constitute one component in a complex communicative situation (Mills, 2005; Miklósi & Csányi, 2001). It is also important to recognise that the dependence upon different kinds of signals vary in dogs. When following verbal commands relating to the position of objects for example, Warden & Warner (1928) showed that dogs seem to be dependent upon visual cues such as gaze or body orientation for localisation of the object of interest (e.g. "Go over to the door"). When the owner of the dog tested in Warden & Warner's study was blindfolded or looked away from the object of interest, the dog failed to successfully perform the task. But the same authors concluded that in most situations, acoustic signals were quite sufficient for the dog to be able to successfully perform the issued commands.

Being able to use earlier experiences to assess other individuals, e.g. for food-sharing tendencies, can be useful for survival, and using acoustic signals to assess another individual's behaviour can therefore be evolutionary favourable in a social species (Marshall-Pescini et al., 2011). In Marshall-Pescini et al.'s study, it was shown that dogs can "eavesdrop" on signals used in social interactions between other individuals to assess the behaviour of the communicating individuals. The dogs in the study dogs preferred to approach a donor whom acted generously by providing food as well as positive acoustic stimuli towards a third party, rather than a selfish donor, whom provided negative acoustic and visual stimuli and refused to provide food. Marshall-Pescini et al. points out that it is also possible, although less likely, that dogs where avoiding the selfish donor rather than preferring the generous donor. The results from Marshall-Pescini et al.'s study showed that the third party, the beggar, is important as a provider of information for the dog in this situation.

Further, Marshall-Pescini et al. (2011) demonstrated that when the donors used only acoustic signals, the dogs displayed a preference for the generous donor, while displaying no preference when donors only used gestures. In a mixed group, where both acoustic and visual stimuli where given, the authors could show that dogs spent significantly more time close to the generous donor compared to the dogs in the voice-only group, suggesting that the dogs had better discriminatory abilities when provided with more communicative cues to help them assess the situation. According to Marshall-Pescini et al., this might include a learned component, since this would probably require the dogs to have a prior understanding of human behaviour in different situations to be able to abstract social knowledge from the interactions. Results from Marshall-Pescini et al.'s experiments indicated that vocal cues were important for understanding the social situation and that gestures alone did not provide

enough information about the situation for the dogs be able to separate the intents of the selfish and the generous donor.

Studies have also shown that not all acoustic stimuli are equally good at eliciting specific responses. In her study from 1990, McConnell showed that four short tones with a rising frequency were significantly more effective than other sounds at increasing motor activity (e.g. to elicit a summoning response), while one continuous, descending tone was showed to have a tendency (non-significant) to be more effective at decreasing motor activity (e.g. to elicit a sit/stay response). According to McConnell, this means that using specific acoustic features can increase the probability of a particular response. Further, data collected by McConnell from professional dog handlers also suggested that there are in fact two types of inhibiting signals: (i) long continuous notes without change in frequency that were slowing or soothing, and (ii) short, rapidly descending notes that immediately stopped the animal. According to the author, the uneven potency of different acoustic signals to get specific responses can be explained by the fact that the signal tells the receiver about the internal state of the signaller. McConnell writes that increases in the arousal of the signaller for example have been showed to lead to an increase in the rate of note repetition. Further, McConnell states that signals emitted by the sender will also affect the receiver's response directly, meaning that the sender can vary the type signal used according to the response desired from the receiver.

How we talk to dogs – Words and sounds

As shown by both Mitchell (2001) and Mitchell & Edmonson (1999), many people talk to dogs in a special way, similar to the way they talk to babies. According these studies, the function of this "dogtalk" is to (I) control the behaviour and attention of the receiver, (II) communicate with and gain the attention of a receiver with limited attention and understanding of the meaning of the language used and to (III) indicate friendliness and affection. Mitchell (2001) showed that people talking to unfamiliar dogs used "dogtalk" to a higher degree. Further, Mitchell showed that there is an individual variability in the features of "dogtalk" between owners. The author showed that the most common features of "dogtalk" included changes of sound properties – such as talking in a higher pitch – whispering and extending the duration of words, usage of other types of words, a lowered complexity of utterances – such as shorter length of utterances and many one word utterances – and repetition of words and utterances. Mitchell also showed that imperatives accounted for most repetitions, indicating that failure to control using imperatives lead to the word being repeated. Mitchell & Edmonson (1999) showed that 8 words accounted for more than 50 % of the words used by owners interacting with their dog, with "Come" being the most frequent one, followed by the dog's name.

To study how dogs reacted to acoustic stimuli and how many words the dogs responded to, a survey was made amongst dog owners (Pongrácz et al., 2001). Most owners that participated in Pongrácz et al.'s survey believed that their dogs understood human utterances quite well. Authors showed that it was more common for dogs to react every time to frequent signals and requests, such as disallowance ("No!"), posture ("Sit!") and invitation ("Come!"). Other

signals and requests were mostly executed when the dogs were in the proper situation, which authors meant could indicate a form of social understanding in dogs. Older dogs as well as dogs of older owners were shown by Pongrácz et al. to have a tendency to react to more utterances. Older dogs were also shown by the authors to respond more seldom to disallowance and invitation commands, while responding more frequently to unique action commands. Single-word commands were likely to be responded to every time in Pongrácz et al.'s study, while longer sentences were responded to occasionally and mostly in contextually appropriate situations, showing that dogs were more likely to react to single-word commands than to commands that consisted of multiple words. The authors believed that this might indicate that dogs do not assign every distinct verbal unit a special meaning, meaning that longer sentences would be treated as a single acoustic signal. This would according to the authors explain why dogs seemed to react more infrequently to multiple word commands. Pongrácz et al.'s study also showed that dogs with larger estimated vocabularies were believed by their owners to react more seldom to commands every time, but much more frequently in the correct context.

As shown by both Mills (2005) and Fukuzawa et al. (2004) the exact physical properties of an acoustic signal, such as pitch, tone and oral harmonics vary to a great degree between persons and contexts. According to Fukuzawa et al., it is plausible that dogs recognize these differences and that they use them to discriminate between commands issued by humans. Using a tape recorder to issue recorded commands to dogs, the authors showed a significant decline in performance as well as a longer period needed to acquire a reliable response rate from them. According to Fukuzawa et al., recorded sounds deviate from verbally issued ones in terms of frequency composition and harmonics as well as lacking resonance, meaning that dogs might find it difficult to generalise between the two. Mills (2005), commenting on Fukuzawa et al.'s study, meant that these differences could be comparable to the variations in vocally issued commands between occasions and individuals. This could, according to the author, mean that it is possible that dogs seeming to have problems understanding a familiar word is actually understanding the acoustic signal all too precisely. Further, Mills writes that lack of previous experiences with recorded commands could also affect these results and that generalisation might be improved if recorded commands were used regularly during training.

Words in training

Young showed in a study from 1991 that dogs can be successfully trained to retrieve objects upon usage of a vocal cue. Dogs that were trained to retrieve one of three different objects upon hearing a learned vocal cue in Young's study obtained a success rate of 86 % or higher. Similar results of success rates were showed in another part of Young's study when the same objects were put on varying heights above the ground. The author's study also showed that dogs that were asked to retrieve a familiar object that had been replaced with a novel object dogs did in a majority of cases return without an object. When an error was made, the retrieved object was never the novel object. Young's study shows that dogs are clearly able to make an association between a verbal command and an object.

The Border collie Rico was shown to be capable of learning the "name" of new objects in a single trial in Kaminski et al.'s study from 2004. In the study, Rico was asked by his owner to retrieve objects from an adjacent room. Rico successfully retrieved 37 out of 40 objects that had been requested, which according to the authors showed that he in fact did know the labels for these objects. It was also shown is Kaminski et al.'s study that Rico could quickly learn the names of new objects through exclusion learning, as well as showing retention of this knowledge a month later. The study showed that Rico can associate previously random acoustic patterns, such as human words, with objects around him.

Although Rico was shown to know the label of more than 200 objects, it is according to Kaminski et al. (2004) still unclear whether he understands the reference to the object mentioned in the command as well as the different grammatical parts of the command, or whether he simply associates the command with a specific behaviour. The authors argue that it is more plausible that one can break Rico's performance down into a set of simpler cognitive mechanisms, including (i) understanding that objects have labels; (ii) a mechanism of learning (in Rico's case exclusion learning); and (iii) an ability memorize the acquired knowledge.

In a study from 2012, Ramos & Ades showed that dogs were able to use previously learned object names and action tasks to understand and execute new combinations of the two, as well as being able to execute the command even when the words of the command were switched around ("Ball Fetch" instead of "Fetch Ball"). The results from Ramos & Ades study suggest that dogs have an ability to extract and process information from verbal stimuli independent of contextual parameters. According to the authors, this indicates that dogs are able to combine an object and an action task (such as "Ball" and "Fetch"), by identifying and processing verbal information in more complex utterances and change their behaviour according to this information. These conclusions from Ramos & Ades study contradict the conclusions of Kaminski, et al. (2004), as these suggest a more complex mechanism of cognition in dogs.

According to the Pongrácz et al. (2004), acoustic signals are important for getting the attention of a dog prior to and during training and work as an occasion-setting cue that can enhance learning. Pongrácz et al. also showed that verbal signals can be an additive component during training, which increases the effectiveness of demonstrations. According to the authors it is unclear whether non-verbal acoustic stimuli would be equally effective at getting the same results, but results from a study performed by Fukuzawa et al. in 2004 suggest gestural signals could also be used to gain and maintain a dog's attention during training. Pongrácz et al. (2004) suggest that the effects on training by acoustic stimuli in their study are probably dependent of the earlier experiences of the dog. Since many dogs are only spoken to when asked to perform a task, Pongrácz et al. suggest that many individuals have associated acoustic stimuli with training.

In a study from 2002, McKinley & Young investigated the efficiency of an alternative type of learning, called the model-rival method, as compared to operant conditioning (shaping). In McKinley & Young's study the dogs were taught the names of novel, previously unlabelled

objects, by being allowed to observe two people sitting in front of it, engaged in a simple conversation about the novel object, while at the same time looking at and handling it (for an example of the conversation, see Box 1). This was repeated for several novel objects, followed by a retrieval-selection task, where the dog is asked to retrieve the object. McKinley & Young's study found no significant difference between the model-rival method and operant conditioning in terms of training time and success, but the authors argued that while operant conditioning only taught dogs that retrieving an object meant obtaining a food reward, the model-rival method actually taught dogs the name of an object and the connection between an object and its name.

Box 1: Example of conversation had during training according to the model-rival method from McKinley and Young's study from 2002

Trainer: "Can you see the SOCKS" – hand the object to the model-rival.
Model-rival: "Yes I can, thank you for the SOCKS" – hand to the trainer.
Trainer: "Can you pass me the SOCKS" – hand to model-rival.
Model-rival: "Thank you for the wonderful SOCKS" – hand to trainer."

Cracknell et al. (2008) repeated McKinley & Young's study, while also performing and analysing different variations of the study. Their results showed no significant difference between operant conditioning and the model-rival method. They also found that a variety of the model-rival method, referred to as the direct stimulus enhancement method, was equally successful at teaching the dogs the name of novel objects. In this training method the experimenter held the object and gazed at it, while an assistant looked at the dog, while no additional gestures or vocal signals were made or given. The direct stimulus enhancement method was shown to give significantly shorter training times for individual dogs and Cracknell et al. therefore suggested that the acoustic signals given in the original model-rival setup might actually interfere with the dog's learning. They argued that the dogs might simply be drawn to the object observed by the experimenters and that learning in the model-rival method therefore could more likely be explained using more simple forms of learning.

Generalisation or How dogs define an object

Young (1991) showed that when objects were deprived of their smell and dogs were asked to fetch an object using vocal cues, dogs generalised to objects of similar size and shape, but not to similar objects of different material. In a similar experiment by van der Zee et al. (2012), dogs were only showed to generalise to objects of the same size, irrespective of their shape or texture. Van der Zee et al. demonstrated that dogs that were presented with replicas of familiar objects in different sizes showed a bias to objects of the same size as the ones used during the learning process. Authors also demonstrated that after becoming familiar with an object, dogs seemed to start relying on object texture rather than size to identify similar objects. Fukuzawa et al. presented similar results in their study from 2004. Fukuzawa et al. suggested that the poor vision of dogs makes it very hard for them to discern the shape of an object and thereby making visual stimuli unavailable for generalisation between objects. Assessment of size and texture is available to the dog through manipulating the object with the mouth, which according to Fukuzawa et al. therefore makes identification using these

parameters preferable. Preference of size and texture could also be explained by these cues being relevant during training (Fukuzawa et al., 2004; van der Zee et al., 2012).

In a study performed by Kaminski et al. (2009), dogs were shown to be able to successfully retrieve a familiar object after being shown a replica of the object and asked to retrieve it. The authors found that the size of the replica shown was not important. Further, the same authors demonstrated that dogs to some extent are able to use photographs as communicative signs in a fetching task, correctly fetching the object in a photograph showed to them. When dogs in Kaminski et al.'s study were shown a photograph and being given the option to fetching photographs as well as objects, most dogs chose to fetch a photograph, while one dog preferred to fetch objects. According to the authors this indicates that dogs are able to recognise objects depicted in photographs and successfully make use of this information to fetch the correct object. Also, Kaminski et al. suggests that these results show that dog have a flexible interpretation of the photograph as a signal, referring to either the object depicted on the photograph or the photograph itself. Kaminski et al. mean that this shows that the fetching is not a narrow routine but rather a flexible one, where new stimuli, in this case visual ones, can replace a previously used stimulus such as an acoustic one. Dogs were better at using replicas rather than photographs to successfully fetch the correct object in Kaminski et al.'s study, which is most likely explained by their lack of experiences with the usage of photographs during training.

DISCUSSION

It is not possible to give a definite answer as to how dogs perceive human acoustic communication. One has to take into account what dogs can hear, how they process the incoming stimuli as well as within which frames they interpret that information. It is also important to remember that acoustic stimuli are always a part of a more complex communicative situation, where both other social signals (such as visual and behavioural stimuli), and physical stimuli relating to environment (such as smell and taste, although smell could also be a social signal) affect the behaviour of the dog (Mills, 2005; Miklósi & Csányi, 2001).

We do know that dogs hear sounds in a much wider spectrum than humans do (Miklósi, 2007). This means that dogs can hear and thereby have a possibility to react to a wide arrange of sounds that are inaccessible to humans. While maybe not always relevant in everyday life, it is possible that dogs might be affected by sounds of which the owner is unaware. These sounds could potentially distract dogs during training, as well as being a stressor when dogs are brought to a previously unknown environment, e.g. when moving to a new home or when visiting a veterinarian. In a clinical setting, high-frequency sounds emitted from other patients as well as from electronic and medical equipment could possibly be stressful to the canine patient.

Differences in the sound characteristics may also affect how the dog reacts to an issued command (Mills, 2005; Fukuzawa et al., 2004). Sounds were shown by these authors to differ a great deal regarding pitch, tone and oral harmonics between people as well as from one time

to another, which could affect what auditory information is provided. According to Mills (2005), this also means that dogs could find it difficult to understand issued commands, if they differ too much regarding sound characteristics from the sounds to which the dog has been taught to respond to. This is also shown in Fukuzawa, et al.'s study from 2004, where the results of dogs responding to issued commands significantly declined when the commands were given through a tape-recorder. Recorded messages are thought by the authors to lack certain acoustic qualities, such as frequency composition, harmonics and resonance that are produced when a human produces the same sounds, as well as containing more background noise. This makes it possible for the information in the recorded messages to deviate from the original one, meaning that dogs could find supposedly familiar sounds to be unrecognisable, even though we have no problem recognise these sounds. It is plausible that differences in sound characteristics between different people and occasions have a similar effect, meaning that dogs could learn to react to a very characteristic sound. This could mean that attenuation to distressful sounds using recorded sounds, such as recordings of fireworks or gunshots might not have the desired effect, since they might lack some of the acoustic characteristics of real life sounds.

It still unclear in what way dogs process the information provided commands consisting of more than one word. While some authors mean that dogs react to the whole sentence as a single stimulus, that is as one long word (Pongrácz, et al. 2001), there are also studies indicating that dogs do in fact understand different types of words. Ramos & Ades' study from 2012 showed that dogs seem to able to identify object names and action task independently in a given command, being able to execute the task even when the order of the words within the command were switched or even entirely new combinations were introduced. According to Ramos & Ades, this indicates that dogs might be able to identify and separate different word classes, indicating a basic understanding of syntax. Another possibility, although not found in the read literature, could be that dogs merely identify and react to keywords in longer sentences.

As shown by Marshall-Pescini et al. (2011), dogs are able to use acoustic signals in communication between third parties to assess the behaviour of these individuals, thereby extracting information from overheard "conversations". Dogs have also been shown to be able to use acoustic and visual stimuli from conversations between third parties to learn the names of novel objects (McKinley & Young, 2003; Cracknell et al., 2008). In Warden & Warner's study from 1928, the dog being studied showed the ability to successfully perform most tasks relying solely on acoustic commands given in the form of everyday conversation.

There seems to be no consensus as to whether acoustic signals during training help the dog's performance, or if they could in fact decrease training efficiency. Pongrácz et al. (2004) showed that acoustic stimuli worked as an occasion-setting cue for dogs, gaining their attention and increasing the effectiveness of training, while Cracknell et al. (2008) demonstrated a shortened learning time when excluding acoustic signals as opposed to when they were used. When commands were related to the location of an object, acoustic signals alone did not provide enough information for the dogs to be able to perform successfully (Warden & Warner, 1928), while acoustic signals were helpful for identifying social contexts

for interactions (Marshall-Pescini et al., 2011). And while Elgier et al. (2009) showed a preference for social signals over physical ones during interactions (for example acoustic stimuli over smell), Mills (2005) showed that dogs preferred following visual signals to acoustic ones when given contradictory these two gave information. In summary, acoustic signals should be used to initiate training by gaining the dogs attention and to maintain this throughout training sessions, as well as being used in situations when visual stimuli are unavailable or irrelevant. During social interactions, acoustic signals could also be used to help the dog grasp the social context.

CONCLUSIONS

Dogs hear sounds in a much wider spectrum than humans, meaning that sounds unavailable to humans might interfere with communication with dogs. In social situations, acoustic stimuli are important for understanding social context, while being but one part of a complex of communicative signals provided in any given social interaction. In learning situations, acoustic signals should be used to gain and maintain the attention of the dog and it is still unclear in what way dogs process information provided in commands consisting of more than one word. When deprived of olfactory stimuli, dogs use size and texture to define and generalise between objects. When talking to dogs, most people modify the way they talk, including changes of sound properties and types of words used, as well as a lowered complexity of utterances and high frequency of repetition of words and utterances.

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