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Barking and its meaning in inter and intra-specific language

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Abstract: In intra and interspecific communication, barking is the most used and known sound and is the most studied. There are different types of bark: for excitement, alarm, fear, guard, defense, frustration and others that can be identified according to the phonographic structure and the context.

The bark has different shades, low, medium, high and also varies in intensity, duration and frequency. The tone reveals the basic emotion, the duration has to do with communicative urgency and frequency with the level of excitement. Generalizing, the high tones call attention and the low tones convey threat.

It is possible to identify the various parameters using a vocal spectrograph. Research shows that regardless of their direct experience, most people correctly identify the vocalizations of aggression and alert.

Moreover, the acoustic parameters of the tonality, the intensity and frequency influence people in correctly describing the emotions to the base of the vocalizations (aggression, fear, play ...). In intraspecific language, research shows that dogs recognize the barks emitted in different situations, react more to the barks of familiar dogs, can distinguish between barks issued in different contexts and discriminate between different individuals who bark in the same context.

Key Words: dog, behavior, bark, communication of dog.

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Introduction

An alternative channel to visual communication, widely used in dogs (Mariti et al., 2017), is the acoustic one. The bark is surely the most common sound emitted by dogs, with many other functions besides attracting attention (e.g. a signal of presence, identification of an individual, territorial signal) that differs according to the context and whose meaning must also be interpreted in dependence on the body's attitudes (posture and motor sequences) of the dog.

Among the wolves the bark is used by stranger individuals approaching to the pack; stray dogs, instead, rarely bark (Overall, 2001). In the ritual of invitation to play, barks and growls can be emitted with joking value (Colangeli, 2004).

Quantifying the frequency and duration of barking episodes is important to distinguish between normal and abnormal episodes. On average, when the owners are at home, the dogs bark 3.1 times (from 0 to 8) for a total of 198 seconds (from 0 to 430) in 24 hours.

While the dogs are sleeping, they remain more alert to barks than to other stimuli, even if the other stimuli may be more significant for the owner. Dogs living in a group have a greater probability to bark than those living alone (Beaver, 2009).

Many animals bark, growl and whine: for example, squirrels, elephants and monkeys bark and even the peeps of some birds follow the basic patterns of the bark, probably because the common evolutionary origin of the barking signal is simply an alarm call (Coren, 2004).

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In dogs there is a type of bark that communicates excitement, one for the alarm, one for fear, one for guard or defense, another that expresses states of frustration and others that will described later.

The barking propensity may also be different according to the breeds: in general, the dogs that bark less are those selected for race competitions, such as the Greyhounds and the Whippets and other breeds such as the Husky and the Greenland dog (Rugaas, 2011).

The sound structure of the bark

According to a study by Molnar et al. (2008) the barks have phonic characteristics related to the specific context and individual acoustic traits. In the various types of bark, we find different tones (low - medium – high); also, the intensity, duration and frequency or the rhythm can vary.

Tones have to do with the basic emotion: the high tones indicate excitement or insecurity, while the low tones are detectors of assertiveness and security.

Sound duration instead indicate how much the dog considers urgent what he wants to communicate.

The frequency will be proportional to the excitement or better to the agitation of the moment (Dalla Valle, 2014).

In general, the bark is classified as a complex, broadband, segmented sound, between 200 and 6000 Hz, with an average of 650 Hz (Beaver, 2009). Therefore tone, duration and frequency of the bark and of other sounds of the vocal communication, are modulated by the dog to express different meanings. In addition, the messages that the dog is sending with body language, the context in which the dog is located and the relationship with the individual to whom that sound is sent must also be considered. (Dalla Valle, 2014).

According to Dehasse (2011) the barks are often a symptom of excitement, referring both to a positive and negative emotional state. These vocal emissions begin to be emitted at 2-4 weeks of age, especially in the contexts of invitation to play; since the age of 8 weeks they can be also produced in aggressive contexts. The barks signaling pleasant emotions have more acute and modulated tones than those produced in contexts of distress (Dehasse, 2011).

According to Beaver (1999), the meaning of the bark is different depending on the context in which it is issued: for example, the high tone alternating with whining is an attention seeking, low tones have, instead, a threatening value (Shepherd, 2004).

Yin & McCowan (2004), testing 10 domestic dogs in three specific contexts (play, isolation, noise), demonstrated that the vocalizations emitted were similar.

Another study on canine vocalizations compared the bark of dogs affected by separation anxiety with that of normal dogs. Barking of normal dogs was an alert signal, with a single high frequency note like that emitted during the play; dogs affected by separation anxiety emitted barking complexes, repetitive and atonal (Overall, 2013).

The bark in the communication with man

Dogs do not bark continuously in response to any stimulus and do not use the same type of bark in all circumstances. The various aspects of vocalizations can be measured using a phonogram / spectrogram, a vocal spectrograph.

Molnar et al. (2006, 2008, 2009) have shown that, regardless of their experience with dogs, most of human beings correctly identify the vocalizations emitted during a fight and when a stranger approach. There was instead a lower correspondence for the vocalizations issued during the walks, the play or when dogs are alone. This means that people can recognize an aggression

or an alert vocalization, but they do not correctly identify the information contained in barks in other situations (Overall, 2013).

Pongrácz et al. (2005) have examined the ability of people to identify the barks of dogs recorded in various situations and to associate them with the related emotional circumstances. The answers had a high percentage of correspondence, without depending on the direct experience of the person with canine vocalizations. Emotions were well correlated with peak, frequency and vocal emission intervals, instead there was no correlation with tonality (harmonic / noisy relationship).

A 2006 research conducted by Molnár et al. examined people's ability to recognize their dogs from their barks. The aspects under investigation were represented by: (1) how accurately humans discriminate between dogs by hearing only their barks, (2) the impact of the eliciting context of calls on these discrimination performances, and (3) how much such discrimination depends on acoustic parameters (tonality and frequency of barks, and the intervals between the individual barks). The results confirmed that discrimination between individuals was more successful when listeners were listening to low harmonic-to-noise ratio (HNR) barks. The contexts in which barks were recorded affected significantly the listeners'performances: if the dog barked at a stranger, listeners were able to discriminate the vocalizations better than if they were listening to sounds recorded when the dog was separated from its owner. It is rendered probable that the bark might be a more efficient communication system between humans and dogs for communicating the motivational state of an animal than for discrimination among strange individuals.

A research by Pongrácz and colleagues (2010) revealed that in the vocalization repertoire of dog, the bark is unique in producing wide ranges of acoustic parameters, such as frequency, tone and rhythm.

It has been demonstrated that the type of bark is related to the context, shows precise acoustic characteristics according to the specific context and conveys to people information about the dog's inner condition; in fact people of different ages and with different levels of knowledge of canine communication, are able to recognize from a recording the context in which the dog is barking and the basic emotional condition that caused it.

A study by Molnár et al. (2009a), proposed listening to recordings of barks of domestic dogs to three groups: one of congenitally blind people, one of blind people with previous visual experience and one of sighted people; none of these people had ever owned a dog.

The research showed that congenitally blind people can accurately classify the various types of bark registered in different contexts and describe their emotional contents, with results very close to those of sighted people.

These findings suggest that humans can recognize in barks some of the most important motivational states (fear, aggression ...) although they have no previous visual experience.

From a study (Pongrácz et al., 2010) it emerged that humans can correctly identify dog barks, recorded in various circumstances. Acoustic parameters, such as tone, intensity and time intervals between one bark and another, seem to have a clear effect on how people describe the emotionality underlying these vocalizations (aggression, fear, despair, playful moment, happiness).

The selection of the barks was made based on the values of the tone and of the frequency peak, such as low, medium and high. To classify the sequences of the intervals between the various artificial barks, the short, medium and long values were used.

People with different levels of dog experience have described the emotional contents of the bark sequences in a similar way. The score of the emotional contents of the bark sequences was in accordance with the "Structural-Acoustic Rules of Morton" (1977). (The low intensity barks were described as aggressive; the tonal and high intensity barks were reported as scary and / or despair).

The intervals between the various barks have a strong impact for human listeners: the bark sequences with short intervals are identified as aggressive, instead the bark sequences with longer intervals between them are read with low values of aggression.

High intensity barks with long intervals between them are considered happy and playful, regardless of their tone. It follows that in accordance with Morton's rules, the communication between humans and dogs is probably based on the characteristics of the basic mammary homology and that the acoustic signals of barking of the dog are correctly recognized by humans.

A study by Pogràcz et al. (2011) compared the ability of children (between the ages of 6-8 and 10 years) and that of adults in the distinction of the barks registered in three different contexts.

Most children have succeeded in classifying dog barks in the actual corresponding situations. Lakestani et al. (2005) had reported that children tend to neglect the body language of dogs by giving much more importance to their facial expression.

These results have also shown that the sounds of dog barking are less ambiguous for children, who easily distinguish the acoustic characteristics of aggressive or friendly vocalizations (Pongrácz et al., 2011).

The bark in intraspecific communication

Maros et al. (2008) investigated the possibility that dogs can distinguish the bark of another individual registered in two remarkably different situations: the first, when a stranger enters the property where the dog lives; the second, when the dog is tied to a tree and left alone.

The experiment was carried out using an adaptation-mismatch paradigm detected by measuring variations in the dog's heart rhythm to which was made to listen to the recording. The experiment showed that dogs can perceive the difference between the barks emitted in different situations, so it is possible to establish that the bark is a means of communication addressed to both humans and conspecifics.

A research by Szabò et al. (2008) has exposed family dogs listening to barks recorded in two contexts: when the dog was left alone and when the dog barked in response to the arrival of a stranger. Were chosen owners who had at least two dogs.

Each dog has undergone 4 tests in which he has been exposed to both, barks of a known and not known dog. Dogs have more frequently issued an alternation of the gaze between the sound source and the owner when they were exposed to listening to familiar dog barks.

It has been concluded that dogs react to the barks of other dogs and that their responses depend in some way on both the familiarity and the context of the barks.

In the study conducted by Molnár et al. (2009b) it has been evaluated whether dogs are able to distinguish between barks issued in different contexts both by different subjects and by the same subjects in the two classic contexts: a) the presence of a stranger near the enclosure; b) the circumstance in which the dog is left alone.

It was discovered that the dogs, listening to the recordings, were able to distinguish between the barks emitted in the two contexts and were also able to discriminate between different individuals who barked in the same context. These results indicate that, through barking, the dog can transmit and receive information on the context of the issue and specific individual information of the issuer.

In an experiment conducted by Pongracz et al. (2014) pet dogs were exposed to pre-registered barks of both a familiar dog and an unfamiliar dog, played outside their home gate. The barks used for the reproductions were recorded in two different contexts: when the dog was left alone and when he was barking at a stranger present near the fence.

The subjects, exposed to listening to the recordings, remained at the gate (closer to the origin of the sound), longer when they heard the bark of an unfamiliar dog turned to a stranger, instead they were closer to the house during the barking of an unfamiliar dog left alone.

In addition, the dogs were longer directed towards the house (where the familiar dog was during the experiment) when they heard the bark of an unknown dog left alone. The subjects ex-

amined barked more often when they heard the barks addressed to a stranger, regardless of the familiarity they had with the dog they were listening to.

It has been deduced that dogs distinguish barks both based on familiarity with the issuing subject and the context of the bark, that is that dogs are able to extract detailed information from the barks.

A study by Larrañaga et al. (2014) compared four types of computerized acoustic analysis by evaluating which was most reliable to identify, through the analysis of the bark, the sex, age, identity and context of the subject that issues the bark. The classifications were correct for 85.13% in the determination of sex, for 80.25% in age attribution (schematized in: young, adult, old), for 55.50% in the classification of contexts (seven types) and for 67.63 % in identity recognition (8 dogs), so the results were encouraging.

The method with the best performance was that of the k-nearest neighbors ("wrapper feature selection"). In this study for the first time, the sex and age of domestic dogs were identified with the help of sound analysis.

This study shows that dog barks transmit important information about the characteristics of the issuer and provide the indirect proof that the barks can serve as a great resource of indications also at the intraspecific level (Larrañaga et al., 2014).

The main types of bark

By integrating some literary sources, (Rugaas 2007, 2011; Dehasse 2011; Coren 2004; Dalla Valle 2014), we can outline the structures of the main types of bark:

- Bark as welcome greeting of known people arriving home: a single bark or followed by another, with high or medium intonation, also used as a request bark when the dog wants to attract attention or look for the contact.
- Excitement bark: it has a very high tone, high frequency, with constant sound or in series with small pauses; it can be interspersed with whimpers, in a context of excitement, joy, stress, waiting. It is emitted by the dog while he is moving and if he is forced to remain still, he can bite the leash or someone close to him.
- Warning bark: with a medium intonation the dog shows interest or curiosity; if it becomes medium-high indicates surprise or startle and is a single bark, clear and short; if the dog repeats it two or three times with intervals, the meaning turns into alert. When the bark becomes less short and slower it takes the value of an imperative call, as when the dog claims food. The warning bark has a medium-high tone, fast barks, a short, high-pitched sound that is sometimes repeated.
  This type of bark gives the alarm to the rest of the pack to signal a possible danger and warns the intruder that the dog is controlling his territory.
  With a string of barks of high pitch, the dog gives the alarm to indicate that the intruder is entering into the territory. When the sequence is slower and the pitch decreases, the danger is imminent. When the distance is wide, the dog uses the warning bark; instead over the safety distance emits the defense bark.
- Bark of defense / guard: it is a short and deep bark with a medium-low tonality and guttural sounds like a growl; often it begins with the growl and it continues with the bark interspersed with growl, it is repeated quickly. However, if the dog in the defense lives also emotions of fear, the defense bark will be more acute, the tone becomes medium-high and the bark is interspersed with sounds like yelps. In the sequence if the dog feels confident, he can make jerky movements towards the stimulus, he leaps forward to make it move away, showing teeth, growling, pinching, barking and even biting. If the dog feels insecure, he performs escape movements without losing sight of what scares him.

If the bark has the meaning of threat or warning it has a severe sound and it is associated with high and rigid postures. The bark, during an aggression aimed at keeping the receiver at a distance, is produced in semi-acute tones while the dog is fast approaching the intruder.

- Instead to reprimand the puppies the mother uses a single net bark and short with medium-low intonation (Guardini, 2015; 2017). An adult dog emits it if he feels discomfort, then if it has a slightly lower intonation it can have the value of threat to signal the receiver to interrupt his action.
- Play and excitement bark: it is made with high-pitched sounds. A high or medium-high pitch is associated with whining, repeated quickly, exhibiting low postures and uncoordinated movements. If the dog plays fight it can contain nervous whimpers and guttural sounds. When it is short and with a slightly lower pitch and more relaxed rhythm it signals a state of joy. Usually the dog during the play bow emits a stuttering bark with medium pitch. During the play there is a growing bark, a series of barks each with a medium pitch that quickly grow in tone going on high pitched sounds. The sound is similar to that of the yelp, but with a less high and less strident tone.

  From a context of excitement, it is possible to move to a state of stress where the bark has very high tones and it is repeated many times with a regular and rapid rhythm; it can be emitted when an expectation is betrayed.
- Bark of despair: It is produced in separation or isolation contexts, characterized by acute, repeated sounds, sometimes associated with panic attacks. The bark of despair can turn into a bark of fear, in a state of fear that can lead to panic; it represents a request for help, it has high tone and it consists of a long series of barks that can end with a howl. The dog is probably in constant movement and can chew on objects or bite itself.
- Bark of frustration and stress: A state of serious frustration and prolonged stress corresponds to a rhythmic bark. It has a medium-high tone with static and monotonous sound, short and continuous that sometimes ends with a howl and it can turn into a stereotypical behavior (Mariti et al., 2012). It is a succession of long barks, with moderate-long intervals. With a high level of stress, we have a higher pitch, resembling a combination of yelp and bark. It is typical of kennels and dogs that are isolated in the box or who are alone for a long time

Discussion

The dog's bark contains in its various forms of tonality and rhythms precise information that are clearly and unambiguously received by other dogs and that can be correctly recognized by people even if they are not used to the relationship with the dog. This observation opens the possibility of deepening the dog's vocal communication as a tool for better understanding of canine behavior.

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L'abbaio ed i suoi significati nel linguaggio inter ed intra specifico

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Sintesi

Nella comunicazione intra ed interspecifica l'abbaio il suono maggiormente utilizzato e conosciuto ed peraltro il più studiato. Ci sono diverse tipologie di abbaio, per eccitazione, allarme, paura, guardia, difesa, frustrazione ed altri ancora che possibile identificare in base alla struttura fonografica ed al contesto.

L'abbaio ha diverse tonalità, bassa, media, alta e varia anche di intensità, durata e frequenza. La tonalità rivela l'emozione di base, la durata ha a che fare con l'urgenza comunicativa e la frequenza con il livello di eccitazione. Generalizzando, i toni alti richiamano attenzione e quelli bassi veicolano minaccia. È possibile identificarne i vari parametri utilizzando uno spettrografo vocale. Dalle ricerche emerge che indipendentemente dalla loro esperienza diretta, la maggior parte delle persone identifica correttamente le vocalizzazioni di aggressione e di allerta. Inoltre, i parametri acustici di tonalità, l'intensità e frequenza influenzano le persone nel descrivere correttamente l'emotività alla base delle vocalizzazioni (aggressività, paura, gioco…) Nel linguaggio intraspecifico le ricerche dimostrano che i cani riconoscono gli abbai emessi in situazioni diverse, reagiscono maggiormente agli abbai di cani familiari, sono capaci di distinguere tra abbai emessi in contesti diversi e di discriminare tra individui differenti che abbaiano nello stesso contesto.