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Do children understand man's best friend? Classification of dog barks by pre-adolescents and adults

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ABSTRACT

Play back experiments compared the ability of children (aged 6, 8, and 10 years) and adults to discriminate dog barks recorded in three different contexts. Participants had to categorize barks according to recording context, and to characterize the inner states of dogs by relating barks to facial expression of humans. It was found that older children classified more barks correctly. Children in all groups classified barks at a 'Stranger' significantly above chance level, however, only the ten-year-old children and adults could classify 'Play' barks over the chance level. There were no significant differences between the groups' performances in the inner state characterization task. 'Stranger' barks were considered as more 'angry', while 'Alone' barks were indicated as being more 'fearful'. In the case of 'Play' barks, participants had more difficulties in characterization. Overall we found only slight differences between the performances of preschoolers and adults. This shows that the ability of understanding basic inner states of dogs on the basis of acoustic signals is present in humans from a very young age. These results are in sharp contrast with other reports in the literature which showed that young children tend to misinterpret canine visual signals.

1. Introduction

Recently in a series of playback experiments, we found that adult humans are successful in the recognition of contextual and motivational content of dog barks. Human listeners could categorize dog bark samples to the correct situations (like 'left alone', 'stranger at the gate', 'play' etc.) well over chance level, independently from the extent and quality of their previous experiences with dogs (Pongrácz et al., 2005). We found also that adult humans rely on basic acoustic parameters of dog barks for judging the possible inner states of dogs, as it would be predicted by Morton's (1977) theory (Pongrácz et al., 2006). Most importantly, deep pitched barks with fast repetition were considered aggressive and fearless, while high pitched, slowly repeating, rough (atonal) barks were considered as happy or playful, and finally, high pitched, slowly repeating, clear (tonal) barks were evaluated as being fearful and desperate.

These experiments were conducted on adult human participants, and it would be important to know whether the ability to discriminate between different inner states (therefore motivational states) of the most common domestic companion animal is present from a much earlier age in children. Besides the theoretical interest, the high incidence of dog bite injuries among children (see for example Beck and Jones, 1985; Shuler et al., 2008) also triggers empirical investigation of how children may or may not evaluate the behavioral signs of our canine companions. A recent study (Meints et al., 2010) showed that 4-, 5- and even 6-year olds misinterpret the facial expressions of the dogs: they often think that aggressive dogs were truly happy. Given that the above mentioned study used static portraits as stimuli, one can ask whether the result would be the same with acoustic signals of dogs.

The ability to recognize emotions in humans is crucial for social functioning across the lifespan. This is achieved

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through utilizing complex forms of cues as well as signals like facial expressions, hand gestures, body postures, verbal utterances and non-verbal vocalizations as well. Although emotions are generated and controlled mostly and automatically by the unconscious brain, the recognition and categorization of emotions changes and develops from birth (Batty and Taylor, 2006).

Numerous studies revealed that facial expression recognition develops rapidly during infancy and improves with age during the preschool years (Thomas et al., 2007). One of the most interesting features of this ontogenetic process is the unequal speed at which the recognition of different basic emotions (e.g. anger, happiness) develops. Although newborns have rudimentary perceptive abilities allowing them to distinguish several facial expressions, it is only at the end of their first year that infants are able to understand some of the emotional signals (Durand et al., 2007). This understanding of facial expressions is very broad in infants at the beginning, as it is limited to the judgment of emotional valence. Understanding becomes more specific between the second and third year of life, as children begin to categorize facial signals in terms of discrete emotions. While the facial expressions of happiness, anger and sadness are accurately categorized by the third year, the categorization of expressions of fear, surprise and disgust shows a much slower developmental pattern (Gosselin, 2005).

Emotions are expressed usually by more than one modality. Even though they are conspicuous and typically regarded as 'human', the role of facial expressions cannot be regarded as solely dominant. De Silva et al. (1998) found that adults recognize anger, happiness and surprise rather on the basis of visual information, whereas auditory stimuli are more important when they categorize sadness and fear. Young children (between 2 and 7 years of age) showed better performance when an emotion was presented to them with a word (verbally) than presentation with visually expressed emotions (Russell and Widen, 2002a,b).

The development of recognition of acoustic emotion expressions was studied in young children as well. Batty and Taylor (2006) found that not only the age of the child, but the familiarity of the source (stranger or family member) and life history (earlier physical abuse), can affect a child's ability to recognize emotions. In the case of very young babies and pre-verbal children, the common method in these studies is to use pictures or photographs of humans with easily recognizable facial emotions and the participants have to pair each sound recording with a picture of the corresponding emotion. Using this paradigm, a bias was found towards dominant/aggressive emotions instead of sadness by Berk et al. (1983), who compared the performance of language-delayed children with normally developed children. The language-delayed participants could not correctly match sad utterances with the pictures of sad people; they confused them with angry ones. Not only young children, but 7 months old babies showed enhanced attention when they were presented with correct picture-sound pairs of angry or happy people, compared to mismatched audiovisual presentations (Walker-Andrews, 1986).

According to the results of comparative studies, Morton (1977) stated that so-called structural-motivational rules apply universally to the affective vocalizations in birds and mammals. The basis for this comes from the physical connection of body size and some acoustic parameters of vocalization, such as the fundamental frequency and tonality. Therefore, as Morton concluded, younger, smaller and subordinate specimens usually vocalize with higher frequency (pitch) and higher tonality, while bigger, older, dominant animals emit deeper, harsher sounds. It follows that the recognition of these signals has also an evolutionary origin since signaling behavior of the sender and recognition by the receiver should emerge hand in hand. Empirical data show that these observations could apply also to humans. Linnankoski et al. (1994) tested the ability of children of three age groups (5–6, 6–7, 9–10, respectively) to discriminate various macaque (*Macaca mulatta*) calls. The results showed that even the youngest children could recognize basic affective states like aggression, fear, and general 'positive emotion', and also submission and dominance. During the tests children had to match each macaque vocalization with a picture of a human face, showing typical emotions. Performance of the oldest group was similar to that of adults, while younger children had problems mostly with recognizing 'fear'—they marked fearful calls rather dominant or commanding.

As a continuation of our ethological research about interspecific communication between humans and dogs, in this study we compared the abilities of 6–10-year old preadolescents with that of adults to categorize basic inner states and contexts of different dog barks. Our main questions were: (1) Are children able to classify dog barks according to the original recording context and can they attribute inner states to these vocal signals? (2) Does the recognition of inner states and context depend on the age and/or the previous experience with dogs? (3) Does the accuracy of recognition depend on the context of the signal? (4) Do younger children recognize 'fear' less effectively than other inner states?

2. General methods

2.1. Participants

We tested participants in four age groups: 6 years old, 8 years old, 10 years old and adults (over 18 years) as a control group. In each age group there were 10 participants who had a family dog in the household and 10 who never had one. The 6-year-old group was tested in kindergartens, the 8 and 10-year-old groups were tested in elementary schools. The adult group was recruited from university students. The sex ratios of each group were balanced. The mean ages of dog-owner and non-dog-owner adults were 23.80 ± 1.33 and 24.10 ± 3.19 years, respectively.

2.2. Play-back material

Barks from the Mudi breed (a Hungarian sheepdog listed at the 238th Standard of the FCI (Fédération Cynologique International)) were used for this study. We recorded bark samples from eight adult individuals (male/female: 3/5,

Table 1
Averages with standard deviations of the main acoustic parameters of the bark samples which were used in the playback experiments. Start, middle (mid.) and end frequency averages refer to the corresponding frequency values of the beginning, middle and the end phase of an individual bark. HNR is the abbreviation of harmonic-to-noise ratio.

Parameter	Stranger	Alone	Play
Duration (ms)	175.55 ± 21.14	140.32 ± 22.65	169.97 ± 40.31
Interbark interval (ms)	496.84 ± 447.59	1481.79 ± 2713.28	1057.14 ± 1791.54
Start freq. (Hz)	726.46 ± 123.27	1144.36 ± 211.78	881.96 ± 156.62
Mid. freq. (Hz)	765.67 ± 141.95	1179.61 ± 279.17	881.56 ± 127.05
End freq. (Hz)	729.69 ± 129.26	1050.52 ± 288.83	870.60 ± 187.51
Mean freq (Hz)	740.61 ± 107.26	1124.83 ± 209.44	878.04 ± 125.94
HNR	26.85 ± 4.82	38.26 ± 6.59	27.82 ± 4.53

age: 4.13 ± 2.30 years) in three behavioral contexts as follows (see also Pongrácz et al., 2005). Table 1 shows the averages (+SDs) of the main acoustic parameters of the bark samples.

'Stranger' context: The experimenter (male, age 23 years), was the unfamiliar visitor for all the dogs and appeared in the garden of the owner or at the front door of his/her apartment in the absence of the owner (who waited in the house or in another room of the apartment). The experimenter recorded the barking of the dog after his arrival and intrusion into the garden or apartment for 2–3 min, from a distance of approximately 2 m.

'Alone' context: The owner leashed the dog to a tree in a park and walked out of the dog's sight range. The experimenter remained with the dog and recorded its barking, so the dog practically was not 'alone'—we refer here to the fact that the owner left the dog. The presence of the experimenter is necessary because the microphone needs to be pointed towards the head of the dog to provide high quality sound recordings (Frommolt and Gebler, 2004).

'Play' context: The owner was asked to play with the dog a usual game, such as tug-of-war, chasing or wrestling. The experimenter recorded the barks emitted during this interaction.

Recordings were made with a Sony TCD-100 DAT Tape Recorder and a Sony ECM-MS907 microphone on Sony PDP-65C DAT tapes. During recording of the barks, the experimenter held the microphone within 2–3 m of distance from the dog. The experimenter tried to stand in front of the dog as much as possible. The recorded material was transferred to a computer, where it was digitized with a 16-bit quantization and a 44.10 kHz sampling rate, using a TerraTec DMX 6fire 24/96 sound card.

Each bark sequence was 10 s long. They contained a slightly different number of individual barks, according to the different bark rates, which is typical to the different contexts (Pongrácz et al., 2006). We did not manipulate the acoustic structure and temporal patterning of the bark sequences, thus they reflected the natural variation of these vocalizations.

In each experiment we played 12 such bark sequences to the participants (four samples from each situation, recorded from different individuals). We chose randomly from a pool containing 48 bark sequences prior to the test. The barks were played in a randomized order.

2.3. Procedure

Two experiments were conducted, and every subject participated in both. In both experiments 12 bark samples were played back to each subject and the individual participants received the same 12 samples in both experiments (but in a different order). We did not tell the participants that they would hear the same 12 bark samples in the second experiment. The two experiments were conducted in a fixed order, with a 1 min long break between them.

2.3.1. Experiment 1 (classification of context)

Participants were asked to classify the barks according to the contexts of recordings. The three possible context categories were the 'Stranger', 'Alone', and 'Play'. Before the test, the experimenter told the participants that their task will be to categorize the barks one by one. They were told the three potential situations at least five times, each time in an altered order. The test was started after the subject was able to report on all the three possible contexts without any help. The participants listened to the bark recordings one by one, as the experimenter operated the CD player. After each bark the player was stopped and the subject was asked to name the situation that he/she thought was the most appropriate. The experimenter insisted on that the participants should name unambiguously one of the three situations in each case. For avoiding the possible influencing of the participants, the experimenter did not know the correct answers (although we can not exclude the possibility that the experimenter also recognized the context of the bark samples). When the subject responded, the experimenter praised them for answering by saying "Congratulations!", "Bravo!", "Very good!", regardless of the correctness of the answer. We rewarded verbally any choice made by the participants, because in comparison with adults, maintaining the motivation of children to participate in a relatively long experiment is more difficult. In our previous experiments with bark playbacks to adults (as in Pongrácz et al., 2005) the participants did not get information about the correctness of their answers during the test, either.

To ensure that the participants remembered the potential situations all along we asked the participants to repeat the three potential answers after the fourth and eighth bark. The experiment was continued only if the subject was able to list all three contexts without any help.

2.3.2. Experiment 2 (characterization of the inner state)

The task of participants was to characterize the inner state associated with the barking by the means of three photographs, each showing a human portrait with one of the following emotions on his/her face: anger, fear, happiness. The depicted persons' facial expressions were

Table 2
Results of the three-way ANOVA, performed on the number of correct answers in the context categorizing experiment.

Fixed factor	*df*	*F*	*p*
Age	3, 216	14.48	0.001
Experience	1, 216	0.31	0.59
Situation	2, 216	13.00	0.001
Age × Experience	3, 216	0.59	0.63
Age × Situation	6, 216	1.46	0.19
Experience × Situation	2, 216	0.01	0.99
Age × Experience × Situation	6, 216	1.15	0.34

Table 3
Results of one-sample *t*-tests when participants' performances in context categorizing were compared to the chance level (degrees of freedom: 19).

Group, context	*t*	*p* (2-tailed)
6 years old, 'Stranger'	4.782	.000
6 years old, 'Alone'	1.970	.064
6 years old, 'Play'	.264	.795
8 years old, 'Stranger'	7.254	.000
8 years old, 'Alone'	3.077	.006
8 years old, 'Play'	.859	.401
10 years old, 'Stranger'	9.398	.000
10 years old, 'Alone'	5.428	.000
10 years old, 'Play'	4.013	.001
Adults, 'Stranger'	11.986	.000
Adults, 'Alone'	8.701	.000
Adults, 'Play'	8.237	.000

easily recognizable as 'angry' (a young man), 'fearful' (a young woman) or 'happy' (a different young man from the one that portrayed 'angry'). The emotional validity of these pictures was previously tested on a different sample. We presented the pictures to 55 adults and they matched them with anger, fear, and happiness significantly more often (Chi^2 tests: anger: $\chi^2(2)=37.91$, $P<0.001$; fear: $\chi^2(2)=50.27$, $P<0.001$; happiness: $\chi^2(2)=39.63$, $P<0.001$) than with other basic emotions (Ekman et al., 1982).

Before the bark playback the experimenter placed the photographs on the desk in front of the participants. Each subject was provided the same three pictures. The experimenter told the participants that the dogs could be 'Angry', 'Fearful' and 'Happy' just like people on the photos. After this the participants were asked to point at the pictures one by one, according to the emotion named by the experimenter. The experimenter mentioned the emotions in an altered order for each subject. The participants were told that the possible emotions were 'Fearful', 'Angry' and 'Happy' at least five times, each time in an altered sequence.

The test was started after the subject was able to tell all three possible emotions without any help. The experimenter operated the CD player. When a bark sequence ended, the player was stopped and the subject was asked to choose the picture from the three, which expressed the same emotion as the bark, by the subject's opinion. When the subject pointed at a picture, the experimenter complimented the answer again, regardless of the correctness of the answer and the experimenter wrote the answer on a questionnaire. To ensure that the participants remember the potential answers all along, after the fourth and eighth bark we asked the participants to repeat the three potential answers and the experiment was continued only if the subject was able to tell all three emotions and show the appropriate picture.

2.4. Data analysis

We tested the normality of the data with the Kolmogorov–Smirnov test and as we found Gaussian distribution, we performed parametric tests. The classification performances ("number of correct answers" as dependent variable) of different groups (Experiment 1) were compared using three-way ANOVAs where fixed factors were the age of participants, their experiences of dogs (owner or not), and the real context of the bark. We analyzed if the number of barks categorized into the correct situations in each age group and context differed significantly from chance level at 1.33 (four barks—three potential answers) using one-sample *t*-tests.

In Experiment 2 we analyzed the relationship between the recording contexts of barks and the chosen inner states by participants separately in each age group using χ^2 tests, in a contingency table where the rows represented the contexts of barks and the chosen inner states were in the columns. We also analyzed the connection between the participants' ages and their chosen answers separately in each situation of bark using similar χ^2 tests.

3. Results

3.1. Experiment 1 (classification of the context)

The performances of participants in different groups were compared using three-way ANOVA. ("Age"; "Experience": living with dog/never lived with a dog; and "Context") with Student–Newman–Keuls post hoc test. While 'Age' and 'Situation' had a significant effect on the performance of the participants, 'Experience' did not. We did not find significant correlations between the variables. Table 2 shows the detailed statistical results.

We compared the participants' performances to the chance performance level using one-sample *t*-tests. As the three-way ANOVA (see the detailed results above) showed that experience with dogs does not have a significant effect on the number of correct answers, we pooled the results of the participants living with a dog and those who do not live with a dog. We found that the performances in most cases were significantly higher than the chance level. Six-year-old children could categorize correctly only the 'Stranger' barks, and 8-year-old children could not categorize 'Play' barks over the chance level (Fig. 1; for detailed results of the *t*-tests see Table 3).

Ten-year-old participants classified barks correctly over the chance level in each context, while six-year olds could classify only the 'Stranger' barks over the chance level, and eight-year olds classified correctly the 'Stranger' and 'Alone' barks over chance level. Adult listeners classified barks correctly over chance level in each situation, but their performance was not significantly better than the ten-year-old children's. Participants gave significantly more correct answers in the case of 'Stranger' barks, than to the other two situations. See Fig. 1.

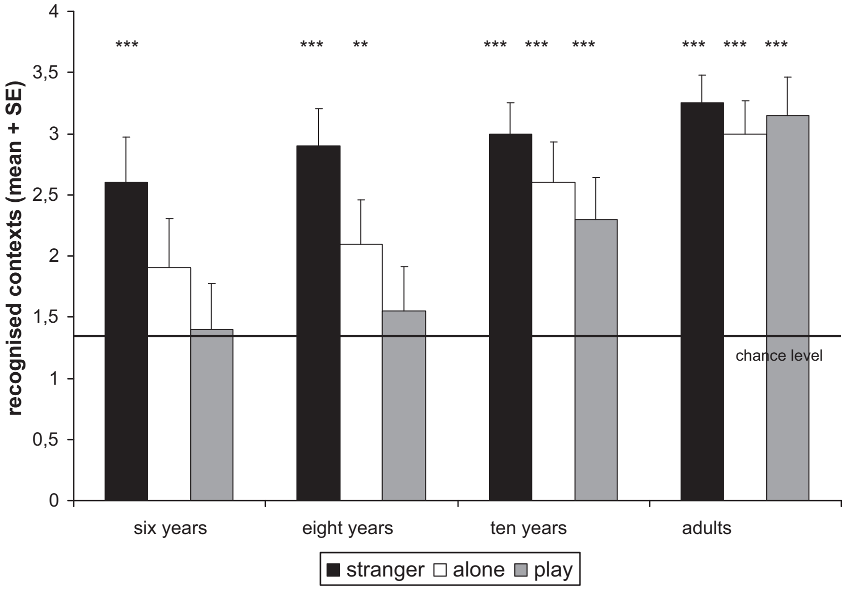

Fig. 1. Performance of three groups of children and a group of adults in categorizing dog barks according to their possible contexts. Chance level was at 1.33. Asterisks over the bars indicate a significant difference from the chance level in that group (one sample *t*-test). $^{**}P<0.01$, $^{**}P<0.001$.

3.2. Experiment 2 (characterization of inner states)

The participants' second task was to characterize the inner states of the barking dogs. First, we analyzed whether the participants' decisions on the inner states of dogs are in significant connections with the barks' recording contexts, separately in each age group. Since in Experiment 1 we hardly find any effect of previous experience with dogs, the results of owners and non-owners were merged for this analysis. Contingency tables (with the contexts in rows and inner state categories in columns) were analyzed using χ^2 tests. We found significant connection between the barks' contexts and the inner state categories chosen by the participants in each age group (6-year olds: $\chi^2(3)=37.09$, $P<0.001$; 8-year olds: $\chi^2(3)=106.80$, $P<0.001$; 10-year olds: $\chi^2(3)=41.97$, $P<0.001$; adults: $\chi^2(3)=108.70$, $P<0.001$). We compared the choices of inner state category in the different age groups. Contingency tables were analyzed with χ^2 tests separately according to the recording contexts of barks. In contingency tables, rows represented the inner state categories and columns represented the age groups. We found a significant effect of age on classifying inner states of barking dogs in cases of Stranger and Play barks, however this effect was not found in case of the Alone barks (Stranger barks: $\chi^2(6)=21.48$, $P<0.01$; Alone: $\chi^2(6)=7.82$, $P=0.25$ NS; Play: $\chi^2(6)=28.73$, $P<0.001$). See Fig. 2a–c.

Most participants in all age groups categorized the Stranger barks as 'Angry' and the Alone barks as "fearful". Children categorized more dog barks in the Stranger context as 'Fearful' than the adults. Children did not classify the dogs' motivational states so uniformly in case of Play barks. The six-year-old children categorized 41% of Play barks as 'Happy' but they also thought that 32% of playing dogs were 'Fearful'. The eight-year-old children categorized most playing barks into the 'Fearful' category and the ten-year olds classified them into the 'Angry' category. Only adult listeners thought that more than half of the playing dogs were 'Happy'.

4. Discussion

In Experiment 1, with the exception of the youngest children, all groups of participants were able to assign most barks to the correct situation significantly above chance level. Six and eight-year-old children could not classify 'Play' barks correctly over chance level. Each group of participants classified 'Stranger' barks correctly. The success rates of participants increased with their ages but there was no difference between the performances of dog owners and non-owners. These results give a clear 'yes' to our first question: in general, young pre-adolescents are able to categorize the vocalization of dogs according to simple emotional modalities—just as they did with the macaque calls (Linnankoski et al., 1994). We found that participants in each age group classified the possible inner states of the barking dogs differently according to the situation in which the barks were recorded. The inner states in 'Stranger' and 'Play' barks were categorized differently by children in different age groups, but we did not find significant age-dependent difference in classification of 'Alone' barks.

Before the detailed discussion of the results we should emphasize that when humans categorize dog barking as 'Angry', 'Fearful' or 'Happy', it does not mean necessarily that the dogs were exactly in these inner states. An alternative hypothesis can be that our participants just followed such commonly accepted stereotypes like 'the dog that barks at a stranger is angry'. However, as we asked the participants to categorize context and inner state during two separate playback sessions, it is unlikely that they marked a particular inner state according to the hypothesized context. Furthermore, from the studies of Pongrácz et al. (2005,

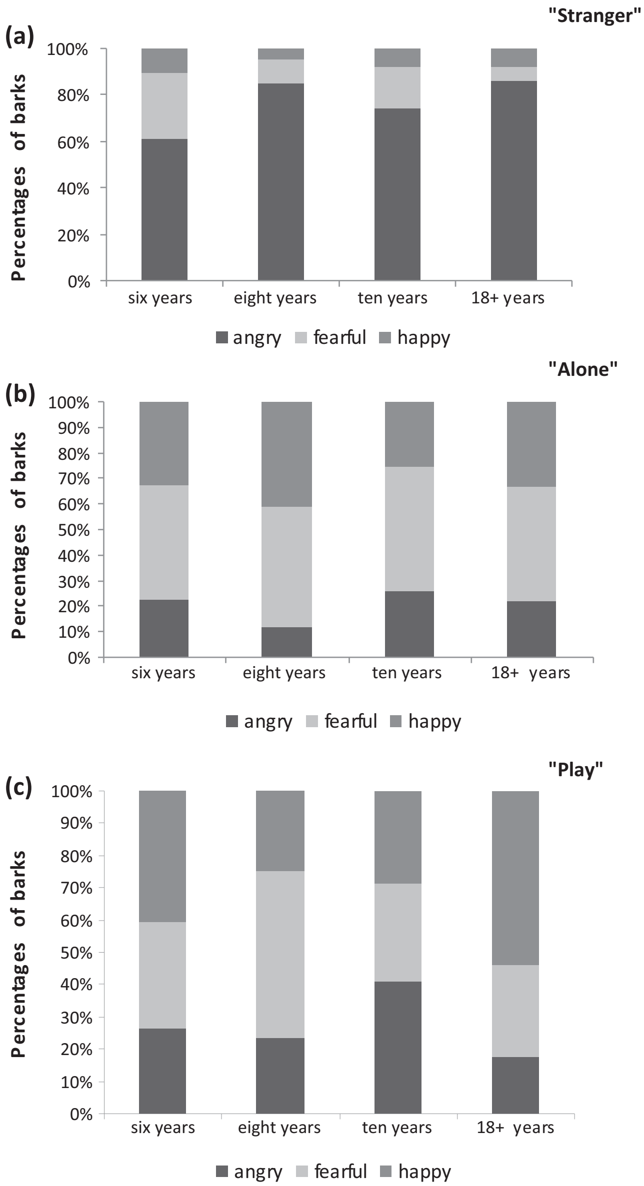

Fig. 2. (a–c) Percentages of barks classified as 'Happy', 'Fearful', or 'Angry' in three different contexts, respectively. Three groups of children (6, 8 and 10 years olds, respectively) and one group of adults were tested.

2006) we know that the acoustic parameters of dog barks correlate with the context, and they encode particular inner states the same way as it was found in many other mammalian and bird species (Morton, 1977). Therefore we think it is likely that dog barking signals reliably the inner states of dogs.

Fernald (1992) emphasized that maternal intonation of infant-directed speech has biological relevance for young children, regardless the meaning of the words. From other studies we know that humans can attribute emotions to such sounds which do not have explicit 'meaning' for them. For example, non-musician adults can decide easily whether a melody is 'sad' or 'happy' based on the music's mode (major or minor) and tempo (fast or slow). From these two factors the tempo proved to be more important for the audience in the emotional classification (Gagnon and Peretz, 2003). Basically the same result was found by Breitenstein et al. (2001), who tested American (English speaking) and German participants with the same sentences in German, which were read for them with different emotions, or tempo, or pitch. Both populations could evaluate the emotions of the text they had heard, independently from the understanding of the words themselves. The fast speaking reader they classified as happy or afraid, the slow speaker they classified as sad. If the pitch of the human speech varied considerably, listeners told it was happy, angry or fearful, while the less variable pitched speech they found sad. These results emphasize the role of tempo, or pulsing rate of acoustic signals in conveying information related to the emotions of the speaker. In our earlier papers (Pongrácz et al., 2005, 2006) we found also that inter-bark intervals are very important for adults for differentiating between contexts and emotions of dog barks. We used barks in this study with strongly different pulsing rates: barks from the 'Stranger' situation have the shortest inter-bark intervals, while 'Alone' and 'Play' situations are characterized by longer intervals, where the 'Alone' barks had the slowest pulsing rate. We think that tempo can be one of the major acoustic factors also in young children, which makes them able to decipher emotions in non-verbal or even non-human vocalizations.

We found that age of the children had a strong effect on their performance in classifying the contexts of dog barks. Children in the older age groups categorized situations with increasing success. Besides perhaps the obvious effect of the development of language competence, this could be an effect of experience. While the recognition of some of the basic emotions can be an inherited ability of children, supported also by mammalian homologies, connecting these inner states to certain situations may require real life experience. Importantly, we did not find significant differences between performances of children who live with dogs and those who do not, which is similar to the results of the adults and also in our previous experiments (Pongrácz et al., 2005). Our findings are consistent with the results of Linnankoski et al. (1994) who found that recognition of Macaque vocalizations was not affected by the pet owner status of the children. However, independently from the families' pet owning habits, experiences of children can originate from other environmental sources. The context had also significant effect on the success of classification. Only 'Stranger' barks were classified over chance level in each group, which can be explained by the fact that these barks were characterized mostly by the inner state 'Aggression' in our previous studies (Molnár et al., 2006; Pongrácz et al., 2005, 2006). The results of our second experiment shed more light on this question.

In the categorization of inner states children had difficulties with recognizing positive emotions. While adults categorized the 'Play' barks as 'Happy' barks in more than 50% of cases, the 6–10-year-old children classified them as 'Happy' only in 25–40% of instances. This can be surprising in the face of studies which almost uniformly reported that the recognition of positive emotions is quite accurate from early childhood (for example Gosselin, 2005; Herba et al., 2008; Lenti et al., 1999). However, we should mention that these studies worked with facial expressions and not with sounds and De Silva et al. (1998) showed that even adults rely more on visual than auditory cues when they categorize happiness. Another explanation for the poorer performance of children with classifying 'Play' barks as reflecting happy emotions comes from the complex nature of play signals. Play behavior is thought to be a mixture of out-of-context behavioral sequences and signals, which can also involve a series of emotion fragments, presented in the acoustic signals parallel with playing (see, for example Bekoff and Byers, 1981). Therefore the vocalizations during play might reflect different and varying motivational states. We found in our previous experiments with adult listeners, that 'Play' barks were among the most difficult ones to categorize (Pongrácz et al., 2005, 2006). We should not forget that although 'happy' seems to be an evident inner state for playful acoustic signals, there is no independent evidence that playing dogs (or even humans) are emotionally 'happy' at the same time. The barking of dogs during play can reflect more simply a kind of general excitement, for example. For making playful intentions more unambiguous, usually a distinct set of play-initiating visual signals evolved in dogs (Bekoff, 1995; Rooney et al., 2000, 2001).

The relatively high concordance in categorizing 'Stranger' barks as being aggressive suggests the importance of the recognition of this emotion even in young age. Aggressive or, more commonly, 'Angry' portraits, or drawings of people are common in such investigations which deal with the recognition of basic emotions in young children (e.g. Berk et al., 1983; Walker-Andrews, 1986). Recognizing aggressive emotion early, as in hearing vocal signals of it, is surely one of the most important social skills which make an individual a successful member of any group and understanding the signs of aggression can be also a key for survival. So during the evolution of perception of emotion, those humans who could recognize the aggression/hostility in the vocalization of an animal could have a greater advantage compared with others who did not.

Children in our study had some difficulties with categorizing barks as 'Fearful'. According to our previous studies on adults and also the results in the group of adult participants in this paper, barks from the 'Alone' situation are classified mostly with emotion of fear. In the case of children however, 'Alone' barks were the only ones which were not assigned with any of the three emotions in a significant extent. This can be the sign that young children do not have the capacity for classifying fear reliably. It would fit the results from the literature (for example Lenti et al., 1999), especially if we remember that in our study the participants had to evaluate emotions with the help of pictures of facial expressions, which can cause additional difficulty in the case of fear (see De Silva et al., 1998). As an alternative approach, we should also mention here that there is no empirical evidence for the truly existing 'fear' in the dogs, which were left alone by their owners in a park. There are hypotheses about the function of animal vocalizations, saying that at least some acoustic signals do not reflect primarily the inner state of the signaler, but affect receivers' behavior in a preferred way through conditioning (for example Markl, 1985; Owren and Rendall, 1997). Therefore our 'emotional categories' in this experiment, like 'fearful', 'angry', 'happy', which were based on the results of earlier experiments with adults (Pongrácz et al., 2005, 2006), might been less appropriate for children, as they were less experienced with dogs. Finally, we should mention that in the case of categorizing inner states behind dog barks we cannot consider particular answers as "correct" or "incorrect". It can be said only that there were differences between how the children and the adults categorized dogs barking in the 'Alone' context more or less fearful. On one hand there are no empirical data about the inner state of the dogs left alone in our tests, and on the other hand the younger children are less likely to be influenced by stereotypes (e.g., dogs left alone are afraid of something).

5. Conclusion

To conclude, we found that most children aged 6–10 could categorize dog barks into the correct situations above chance level and they classified barks from different situations with mostly different inner states. The above mentioned results altogether give an interesting contrast with the high rate of misinterpretation the ‘angry’ face expressions of dogs in children. Lakestani et al. (2005) found that children tend to disregard the body language of dogs, instead of this they look at mainly the dogs’ face. However, as Meints et al. (2010) reported, there is a high occurrence of such errors when children consider an aggressive face expression of a dog as being ‘happy’. This mistake can be explained with the different anatomy of the human and canine faces, which may make an aggressive dog’s bare teeth resembling to a happy human smile or grin. Our results at the other hand showed that dog barks are more unambiguous for the children, who can easily discriminate the aggressive and the positive inner states on the basis of the acoustic characteristics of the vocalizations.

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