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„Baby Talk or Command: How humans talk to their dogs“

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Contents

1. Zusammenfassung

Die Geschichte der Mensch-Hund Beziehung nahm ihre Anfänge vor über 35.000 Jahren (Germonpré 2009) und entwickelte sich zu einer engen Partnerschaft mit dem Hund als Sozialpartner. Durch die Anpassung seines Sozialverhaltens und seiner lebenlangen Abhängigkeit von seinem Besitzer (Archer 1997) sowie seiner Fähigkeit dessen Fürsorgesystem zu aktivieren (Prato-Previde et al. 2003; Topál et al. 1998; Palmer and Custance 2008; Gácsi et al. 2009), kann die Beziehungstheorie, die von Bowlby (1958, 1969) ursprünglich zur Beziehung zwischen Mutter (oder Bezugsperson) und Kind beschrieben wurde auch auf die Mensch-Hund Beziehung übertragen werden. Um Einblick in die Sprache zu erhalten, die von Hundehaltern gegenüber ihrer Tiere verwendet wird, wurden 53 Mensch-Hund Dyaden in einem Stresstest nach Ainsworth einem stetig steigenden mentalen Stresspegel ausgesetzt um sowohl das Fürsorge- als auch das Bindungssystem zu aktivieren.

Die Ergebnisse zeigen, dass Besitzer eine Vielzahl an sprachlichem Ausdrucksverhalten verwenden, das in fünf Komponenten unterteilt werden kann: „Hohe Lautäußerungen“, „Interaktive Lautäußerungen“, „Laute Lautäußerungen“, „Befehlende Lautäußerungen“ und „Babysprech“. Den größten Einfluss auf die Komponente „Laute Lautäußerungen“ und „Hohe Lautäußerungen“ hat die Geschlechterzusammensetzung der Dyade, wobei „Befehlende Lautäußerungen“ hauptsächlich durch das Fürsorgeverhalten des Besitzers beeinflusst werden. Die Komponente, die den geringsten Anteil der akustischen Kommunikation von Halter zu Hund ausmacht ist „Babysprech“. Weder das Geschlecht des Hundes noch des Halters oder deren Bindungstyp zeigen Einfluss auf die Häufigkeit der Verwendung. „Babysprech“ (im Englischen „Motherese“) bei Kindern ist durch ihre häufigen Satz- und Wortwiederholungen sowie sanfte Stimme und hohe Tonlage gekennzeichnet. Im Rahmen dieser Arbeit konnten sowohl die häufigen Wiederholungen sowie die sanfte Stimmlage bestätigt werden. Für die Erfassung der höhren Tonlagen dieser Komponente wäre jedoch eine Anpassung der Methoden angebracht um eine Gleichstellung mit dem bei Kindern verwendeten „Motherese“ zu ermöglichen.

2. Abstract

The roots of the human-dog companionship reach as far back as 35,000 years (Germonpré 2009) and evolved into the dog being a social partner by adapting not only its behaviour but social capabilities as well. Bowlbys attachment theory (1958; 1969) originally described the bond between infant and mother (or caregiver), but due to a dogs lifelong dependency on its owner (Archer 1997) as well as its ability to activate the owners caregiving system the model can be applied on human-dog dyads as well (Prato-Previde et al. 2003; Topál et al. 1998; Palmer and Custance 2008; Gácsi et al. 2009). By testing 53 human-dog dyads in the Strange Situation Test, which continually raises the mental stress and therefore triggers the attachment and caregiving system I gathered insight on the humans language used towards their pet dogs.

I found that dog owners use a diverse array of vocalisations which can be categorized in five major components: talking high pitched, interactive utterances, talking loud, commanding utterances and motherese. The main influence on talking loud and talking high pitched is to be found in the dyads gender/sex composition whereas commanding utterances are dependent on the owners' caregiving behaviour. The component with the smallest impact on the acoustic communication between owner and dog is motherese. Neither gender of the owner nor the dogs sex or their attachment type show any influence on its use. Motherese used in context with children is characterized by a high repetitiveness, soft voice and high frequency. Within the framework of this thesis I could find the repetitiveness as well as the soft voice, but not the high frequency used with motherese. An adaptation of my methods to capture the high voice within motherese as well would allow motherese used with dogs to be put on the same level as the one used with children.

3. Introduction

3.1. Neighbours to partners

The ancient partnership between humans and dogs may only has provoked the scientific research interests in the recent years, but its roots reach as far back as 35,000 years (Germonpré 2009). The recent work of Frantz et al. (2016) suggests that the domestication of our dogs' ancestors was not a singular event but took place twice: with the dog being domesticated from separate and now extinct wolf populations in Western and Eastern Eurasia. Cooperation with humans in this early arrangement of cooperation and toleration morphed into a complex relationship and led to the dogs being the first domesticated animal spreading all around the globe throughout many different cultures (Perri 2016). With humans continuing to tame and further on selectively breed dogs for specific tasks and purposes the foundation for our modern breeds was laid out (Larson 2012). Nowadays the FCI, the Fédération Cynologique Internationale registers 344 breeds of dogs (FCI; www.fci.be; 13.9.16).To allow for the dogs evolution into being a companion and social partner for humans, dogs not only adapted their behaviour but social capabilities as well. A high social compatibility (Curley and Keverne 2005) combined with the conservative organisation of the vertebrate brain as well as similar physiological mechanisms and social behaviour (Goodson 2005; Nelson and Panksepp 1998) were the base of this adaptation.

Bowlbys attachment theory (1958, 1969) originally built on the idea to classify and describe the bond between infant and mother (or caregiver). Mental representation (inner working model) and the physiological bonding mechanisms combined are the foundation for this model, that was further on discussed by the scientific community to be applicable on adult relationships as well (Ainsworth 1989). Cassidy (1999) described four components essential for attachment: proximity maintenance (not wanting to separate from the attachment figure as well as wanting to stay close), separation distress (not wanting to leave the attachment figure behind or be left behind), safe haven (a place to return to and find comfort) and secure base (from which on one can explore).

Based on these four components of the caregiving system Ainsworth and Wittig (1969) created a test procedure, that continuously raises the mental stress level and therefore allows activation of the parents caregiving system and the childs attachment behaviour. Three major attachment types were described: secure, ambivalent and avoidant. Main and Solomon (1990) introduced the category "disorganized" as another attachment bond for children that tried to get into contact with their caregiver but failed to elicit a response or showed behaviours like freezing as well as intense fearfulness or dissociation.

With most of our dogs living as family members without any active purpose or task to fulfil and their lifelong dependency on their owner similarly to a child while growing up (Archer 1997) and the dogs ability to activate its owners caregiving system we can safely suggest, that Bowlbys attachment theory and therefore the outlined strange situation test procedure can be applied on human-dog dyads as well (Prato-Previde et al. 2003; Topál et al. 1998; Palmer and Custance 2008; Gácsi et al. 2009). Attachment behaviour in general is influenced by both individuals (Zilcha-Mano et al. 2011) and seems to be formed quicker in an environment of social deprivation (Gácsi et al. 2001). Several studies allowed insight into the owners' perception of their relationship with their dog, indicating that owners view their dogs as a safe haven in case of distress, and as a secure base from which to interact with their surroundings as well as feeling discomfort while being separated from their companion dog (Kurdek 2008; Prato-Previde et al. 2006).

The human-dog companionship not only has a dampening effect on the humans stress response especially in securely attached dyads (Schöberl et al. 2016) but also affects the overall health positively (Beetz et al. 2012).
The HPA (hypothalamic–pituitary–adrenal) axis, responsible for the stress response and part of the neuroendocrine system, prepares the body for a fight or flight reaction (Koolhaas et al. 2011). Activation of the HPA axis can be triggered by mental discomfort like separation from the attachment figure, physical pain as well as unfamiliar situations, stressful environments, and social interactions (McIntyre et al. 1999; Horváth et al. 2007; Bowlby 1969; Ainsworth and Bell 1970; Ahnert et al. 2004; Palestrini et al. 2005). The responses intensity depends on the individually perceived level of threat or discomfort (Beerda et al. 1998).

Oxytocin, a peptide hormone especially important to facilitate bonding mechanisms, is released during pleasant social interactions, and works as an antagonistic response to the HPA axis by inhibiting the hormone releasing cascade in the hypothalamus as well as the adrenal cortex (Uvnäs-Moberg 1998; Heinrichs et al. 2003; Detillion et al. 2004; Beetz et al. 2011; Julius et al. 2012). The release of oxytocin, which also can be correlated with reduced anxiety and aggression (DeVries et al. 2003; Neumann 2008) was recorded to be triggered simply through eye contact between dog and owner (Nagasawa et al. 2009).

3.2. Vocalisations

Dunbar (1998) suggested the evolution of language and our social brain arose out of the necessity to create an efficient way of keeping up with and nurturing ones relationships within a large group. Thus language had its primary function as means of maintaining friendly contact, with secondary functions in conveying and manipulating information (Falk 2004). Since the humans evolution was not only driven by the spoken word but also vice versa human evolution further developed our language, it is no surprise that throughout different cultures and nations we try to get in contact with animals and non-living objects by talking to them (Mitchell and Edmonson 1999; Urquiza-Haas and Kotrschal 2015). Language in general can be considered a reliable indicator for the kind of relationship two individuals share: it offers insight into the motivation behind actions as well as the emotional state of mind (Rendall et al. 2009). Therefore a direct connection between the animals' physiology and its vocalisation can be expected (Owren and Rendall 2001).

As outlined above a secure attachment provides an optimal foundation for caregiving behaviours (Mikulincer et al. 2005) such as motherese, which are defined by the usage of a high pitch and a redundancy of simple words and sentences, with some convergence over cultures (Mitchell 2001). This type of vocalisation and interaction provides children and babies with a basis for the development of verbal communication (Mitchell 2004). Apart from that, similar utterances have been reported in the language used with dogs seemingly sharing quite a lot of features like a high frequency of the voice and repetitiveness (Mitchell 2001). The dogs ability to process our vocalisations in two pathways by differing between the emotional and

phonemic content (Ratcliffe and Reby 2014) allows the assumption that dogs and humans do have a great impact on and understanding of each other's emotions and vocalisations (Miklósi et al. 2000; Müller et al. 2015).

3.3. Hypothesis

Hence I ask if motherese are indeed used with dogs as they are with children, although there is no need for teaching dogs any basic understanding of language. I assume that motherese are an integral part of the caregiving system and therefore are equally transferrable to the owner-dog relationships as the mother-infant attachment model.

The Ainsworth Strange Situation was adapted and used to trigger the caregiving and attachment system and offer insight on our main three research questions about the complex system of acoustic communication between owner and dog:

- **What kind of vocalisations do dog owners use while talking with their dogs?**
  Studies investigating owners' acoustic communication to their dogs have shown, that women tend to talk more with their pet dogs than men do (Mitchell 2004). Also owners' vocalisations differ between playing in an emotional neutral or emotional positive context (Horowitz and Hecht 2016).
  Hypothesis #1: Vocalisations are greatly driven by gender and dyad composition and differ according to the goal wanting to be achieved (e.g.: calming the dog, engaging the dog in play).

- **Do humans indeed use baby talk ("motherese") while comforting their companion dogs in a stressful setting?**
  Baby talk is considered to be part of the caregiving behaviours which activate during stressful situations. The strange situation procedure was designed to provoke such a stress response in mother-infant dyads and is expected to trigger an analogous or similar strategy in our human-dog dyads.

Hypothesis #2: Motherese will be used equally by men and women while comforting the dogs regardless of their dogs' sex.

- **Is it possible to measure the type and quality of the human dog relationship through the humans' vocalisations?**

  Since motherese are part of the caregiving response we expect, that the amount of motherese used should allow to draw conclusions on the attachment type between dog and owner.
  Hypothesis #3: A secure attachment is predictable through the amount of motherese used.

4. Methods

4.1. Subjects and project affiliation

My thesis is part of the University of Vienna human-animal interaction research groups FWF-Waltham project. This project is based on audio files collected from 53 human-dog dyads during the ASST (Ainsworth Strange Situation Test).

These dyads were invited to join this study after already working on preceding FWF human dog projects. Out of 132 teams, 58 dyads got invited and selected to represent an equal ratio of all 4 gender and sex combinations within the dyads. Out of the 58 dyads from which audio files were recorded, 5 teams had to be rejected from further analysis due to poor quality, missing parts or technical problems.

The participating dyads all lived in Vienna or in the surrounding area. Over the course of the preceding FWF projects the owners already filled in multiple questionnaires, providing a great and detailed picture of background and personal information, personality and characteristics of themselves as well as their dog.

For comparing this works results with human character traits the NEO FFI (Neuroticism-Extraversion-Openness Five-Factor Inventory) questionnaire was completed by all owners in the preceding FWF studies. Furthermore the amount of caregiving towards the dog was rated and the attachment behaviour was categorized prior to this study during the preceding FWF study analysis and will be used to interpret this studies data.

4.2. Data collection

The humans' vocalisations were recorded during an Ainsworth Strange Situation Test and a prior reading of a text as a reference of what can be considered a "neutral voice".

4.2.1. Ainsworth Strange Situation Test (ASST)

The Ainsworth Strange Situation Test was first introduced by Mary Ainsworth in the 1970s and originally designed to test the type of attachment between mother and child.

For this study the procedure was changed to accommodate our setting and test situation with dogs and their owners. The experiment was composed out of a total of 10 episodes (Figure 1): an introduction, an exploration, two calls, two separations, two encounters with a stranger and two reunions. Due to the works focus on the owners' vocalisations, only the episodes in which the owner was in the room with the dog or called the dog in front of the door were analysed further. Episodes where the owner and the stranger or experimenter were present at the same time were included in the overall behaviour coding, but were excluded from further analysis with Praat (a scientific computer software package for the analysis of speech in phonetics) to guarantee a reliable output since the program can´t differentiate between one individuals' vocalisations of two people talking (e.g.: owner and stranger in episode 3, the 1st encounter).

The first episode (introduction) encompasses the experimenter entering the prepared room with the owner and dog, introducing the owner to the seating arrangement and toys available for playing with the dog. With the experimenter leaving the room and closing the door episode two (exploration) starts. In this phase the owner is allowed to freely interact with the dog or to take a seat for the duration of three minutes. The opening of the door marks the beginning of the third episode (1st encounter with stranger) where the owner of the dog has to take a seat if not already sitting while the strange person entering the room sits down as well. After being completely ignored by the stranger for one minute, the stranger starts to engage the owner in small talk for a minute. The last of the three minutes the stranger tries to engage the dog in play while telling the owner to leave the room at the end of minute three. During the fourth episode (1st separation), lasting another three minutes, the owner waits outside the room while the stranger stays with the dog. The fifth episode (1st call) only lasts a few seconds and starts with the owner calling the dog in front of the door and ends as soon as the owner enters the room. The sixth episode (1st reunion)

lasts another three minutes and allows for the dog and owner to reunite and to interact however they choose to, ending with the owner being buzzed on a mobile phone to be reminded to leave the room. The closing of the door marks the beginning of episode seven (2nd separation) in which the dog has to stay alone in the room for three minutes. After these three minutes episode eight (2nd encounter with stranger) begins with the stranger entering the room and leaving after three minutes. Episode nine (2nd call) is identical to the first call episode with the owner standing in front of the door and calling the dogs name. As soon as the door is opened by the owner episode ten (2nd reunion) starts, lasting another three minutes and allowing the dyad to reunite again and interact however they want to. After the tenth episode the test is finished and the dog is given water ad libitum while the owner and experimenter work through questionnaires.

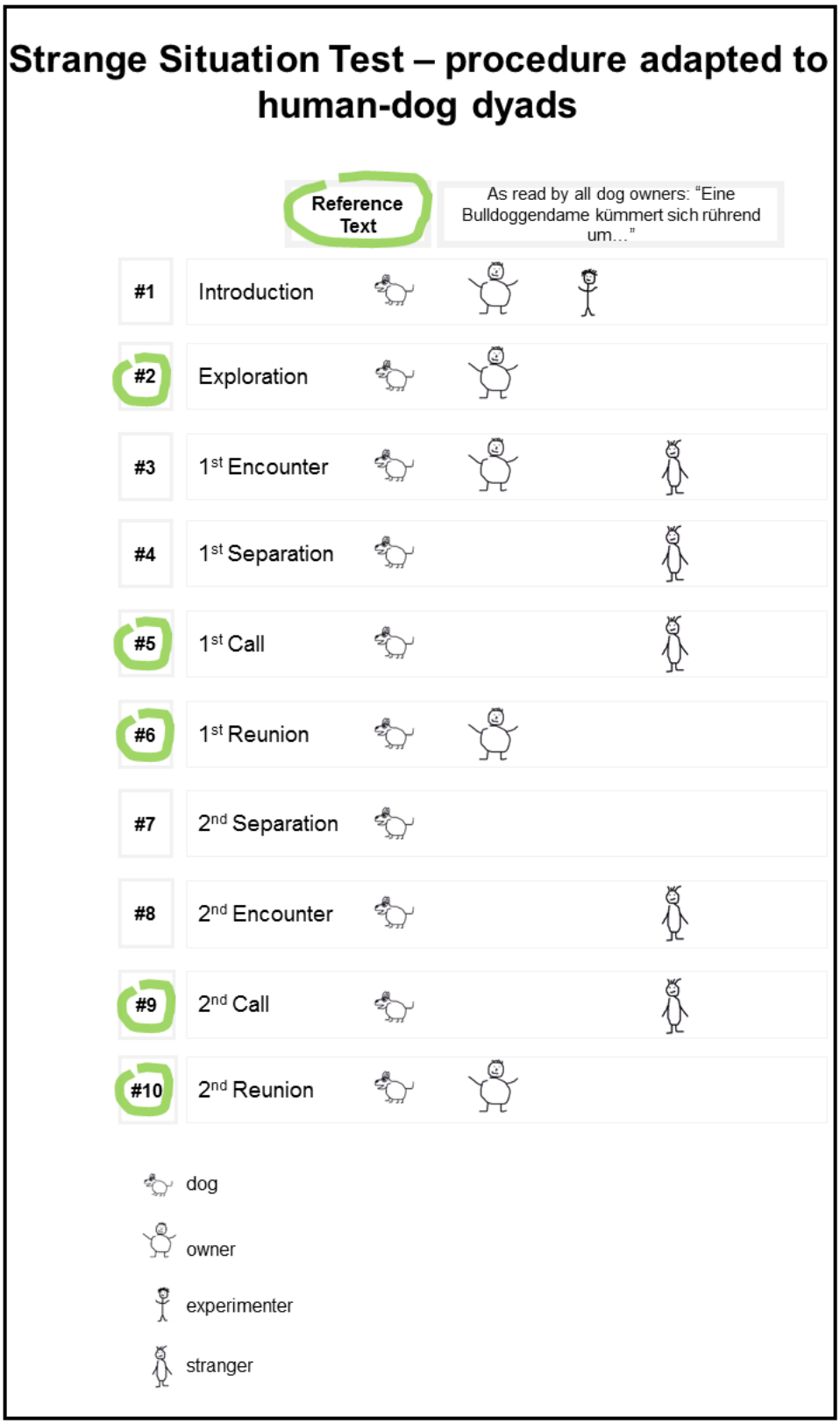


Figure 1: Episodes of the Ainsworth Strange Situation Test adapted to test the attachment behaviour between humans and their pet dogs. The episodes marked with a green marker were used for further analysis whereas episodes without a mark were excluded.

4.2.2. Audio recording

The audio files were recorded with a standard H4N recording device with a microphone fixed to the owners' upper body clothing.

4.3. Audio analysis

A total of 58 dyads participated in this study. Five teams had to be excluded due to malfunctions of the recording unit or audio files which could not be analysed. Hence a total of 53 dyads were integrated into further analysis.

The audio recordings were analysed via two different approaches: The first one was observer coding via the Solomon coder © (András Péter) to determine changes in intensity and frequency as well as content over the whole period of the strange situation test with Solomon Coder © by ear. The second approach was to measure intensity and frequency over defined time spans at the beginning of the relevant episodes with Praat (Paul Boersma and David Weenink, Phonetic Sciences, University of Amsterdam).

4.3.1. Solomon

Prior to analysing the audio files with the Solomon coder © a system was created that allows the listener to code the humans' voice in three main categories: pitch, intensity and content. Each of these categories was again divided in three possible options. Pitch could either be "high", "neutral" or "deep", intensity could be "loud", "neutral" or "low". "High" in pitch describes the voice being higher than the comparison in the neutral text as well as "deep" stands for the voice being deeper than in the neutral text. The behaviour "loud" in intensity describes the voice being louder than the neutral text, whereas "low" characterises the voice having less intensity than the neutral comparison. "Neutral" in pitch and intensity would mean, that the voices pitch/intensity matches the pitch/intensity of the neutral text.

Content was to be defined as "babble", "signal" or "command". "Babble" includes utterances that don´t necessarily have any meaning (e.g.: "uiuiuiui") as well as

cooing, repetitions of interactive sentences (e.g.: “What a nice toy! Such a nice toy! So many nice toys!”), questions directed towards the dog (“Oh what do we have here?”, “What´s that?”, “Do you like playing with the ball?”) and every other combination of the above. The behaviour “command” describes every utterance directed towards the dog without an alleviating context (e.g.:”Balu, sit!”, “Down!”, “Stop it!”, “Search, fetch!”). The dogs name is considered of being a command if it’s used without context or if it is used to get the dogs attention or to reprimand it while or before doing something unwanted. The behaviour “signal” is used as a mediating group between “babble” and “command”. It describes commands being wrapped in an alleviating context or “babble” with steering qualities (e.g.: “Ben, please sit down, you know you have to behave don´t you? Would you just stop that?”).

After coding all the audio files the coding sheets were exported to Excel with an output of how many seconds each of the 9 behaviours of the 3 categories (Tab. 1) was used during each episode. Due to human error and slightly different test durations the time spent showing each behaviour was set in relation to the whole duration of each episode and to the total time spent talking.

Table 1: Behaviours of all three main categories used for coding with Solomon:

CATEGORY:	Intensity	Pitch	Content
BEHAVIOURS	loud	high	command
	neutral	neutral	signal
	low	deep	babble

4.3.2. Praat

Before analysing the audio files with Praat, a way of measuring the humans’ utterances without interferences from background noise and errors in the fundamental frequency measurement due to the strong fluctuations and quick changes in the F0 (fundamental) frequency (Tab. 2) had to be established.

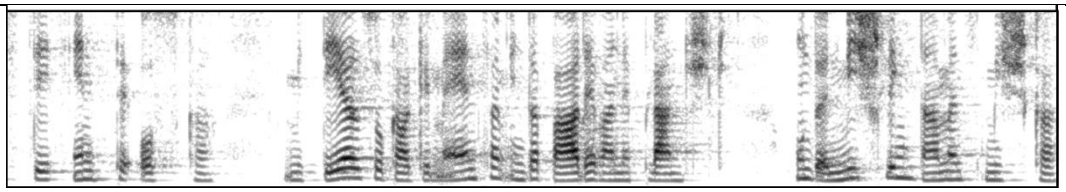
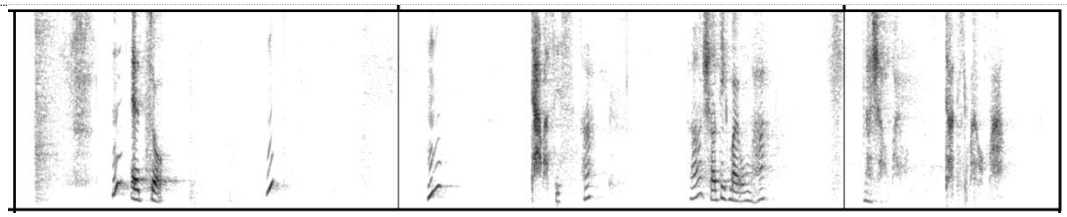
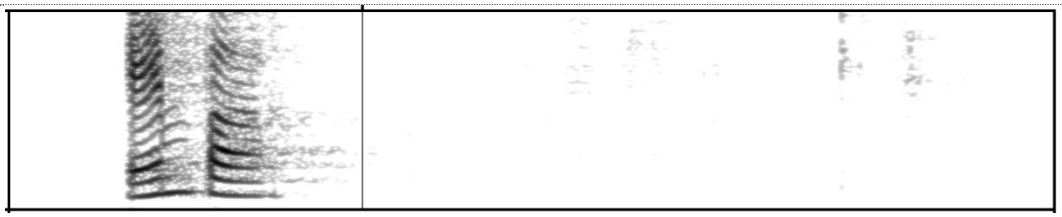
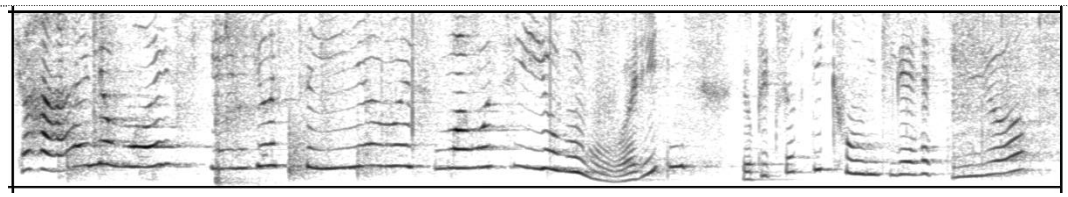
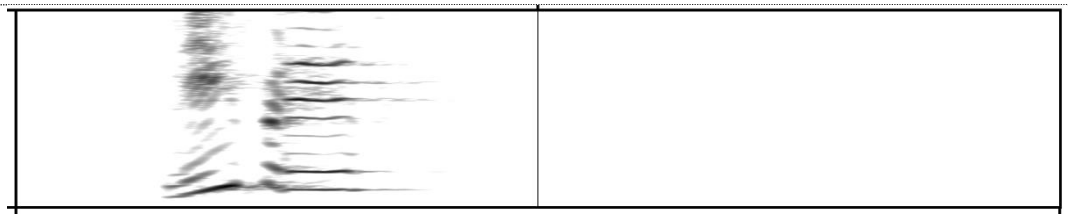
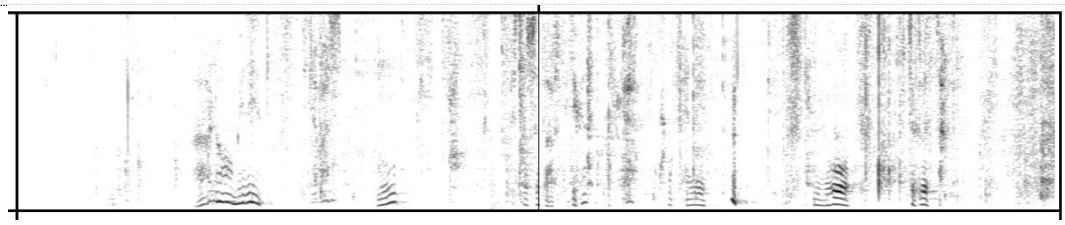
To make sure that the measurements were taken at the same time and over the same period the measurement always started at the beginning of each relevant

episode. The duration of the measurement differed between the episode types. For the short call episodes a time span of 3 seconds was chosen due to the short duration of the episode. For the neutral text, exploration and reunion a duration of 15 seconds was chosen. With this wider span of a collection period there was a higher chance of catching the owner speaking with their dogs since it was not obligatory for them to talk to their dogs at all.

After applying these time spans on each episode the program Audacity ® (Dominic Mazzoni) was used to select these small sections out of the whole recorded ASST session to guarantee, that always the same part of the file is analysed later on. These smaller audio files were uploaded in Praat, where all background noises were cut and cleaned out of the file to make sure, that only the owners utterances were affecting the output of the intensity (dB) and fundamental frequency (Hz measurement of F0).

The Praat settings were adapted to accommodate every single audio snippet as well as individual person to guarantee for a correct measurement of the fundamental frequency without falsely measuring any other frequency than F0. Measurements for the frequency were taken every 0.2 seconds. Intensity measurements were taken every 0.01 seconds. To achieve measurements at the same time interval I exported all the data in Excel and wrote a formula to extract the intensity at an interval of every 18.74^{th} measurement. The intervals in which frequency measurements were taken was chosen to balance slight shifts in the timelines and measurement points. Afterwards the intensity and frequency measurements were collected in a file to be further analysed statistically.

Table 2: Overview of a few examples for every episode of the ASST. The quality of the recordings varies due to intensity and frequency used as well as the location of the attached microphone. N=Neutral Text/Reference Text, E2=Exploration, E5=1st Call, E6=1st Reunion, E9=2nd Call, E10=2nd Reunion

N Reference text	
E2 Exploration	
E5 1st Call	
E6 1st Reunion	
E9 2nd Call	
E10 2nd Reunion	

4.4. Statistical analysis

IBM SPSS Statistics 23 was used to statistically analyse the collected data. The analysis was conducted in three parts: the data collected with Solomon © and Praat each got handled separately at first. Afterwards they were combined and searched for overall components and the factors driving them.

Starting with the Solomon variables a nonparametric correlation with Spearmans Rho was done to get an overview of the data set. Variables with a promising correlation were tested further with the nonparametric Mann-Whitney U test or with a linear regression model (Anova) according to the variables scale of measurement.

The Praat variables were tested for any significant differences towards each other or the neutral reference text with nonparametric Wilcoxon Signed Ranks tests.

The combination of the two data sets was analysed with a principal component analysis to offer insight in the general structure of the data set and to have a look at the speeches possible components. The whole dataset got normalised to range between -1 and 1 to allow for an easier use of the PCA. Missing data points were filled in via the SPSS function impute missing data values with the automatic imputation method and a maximum of 5 imputations per subject. The PCAs results were further on checked for correlations with a nonparametric correlation test after Spearmans Rho. Promising variables were again tested with Kruskal-Wallis and Mann-Whitney U tests or linear regression models (Anova) according to their scale of measurement.

5. Results

5.1. Speech in its fractions

Before combining both data sets from the Praat and Solomon © analysis via a PCA both were analysed separately:

5.1.1. Content of speech

The amount of “babble“ used by the owners in relation to the whole duration of the ASST declines with an increasing caregiving score (Fig. 2, linear regression: F=4.524, p=0.038), whereas the proportion of “babble” decreases the higher a person is in the NEO FFI dimension “Openness” (Fig. 3, linear regression: F=4.475, p=0.039).

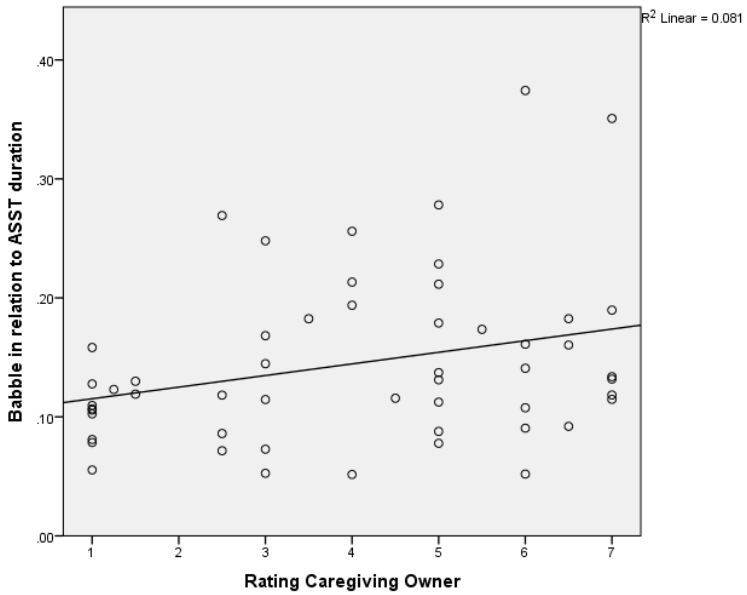


Figure 2: The Y-axis shows the amount of babble used (measured in seconds) put in relation to the whole duration of the ASST (measured in seconds). The X-axis depicts the owners caregiving behaviour rated in seven categories. n=53

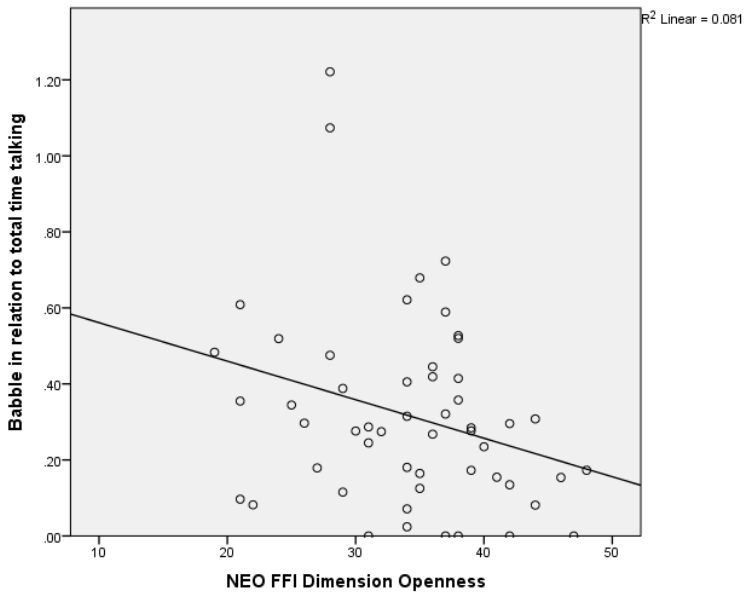


Figure 3: The Y-axis shows the amount of babble used (measured in seconds) in relation to the total time spent talking (measured in seconds). The X-axis depicts the owners scoring in the NEO FFI dimension Openness. n=53

The amount of commands used decreases with a higher score in caregiving behaviour in relation to the whole ASST duration (Fig. 4, linear regression: F= 8.629, p= 0.005).

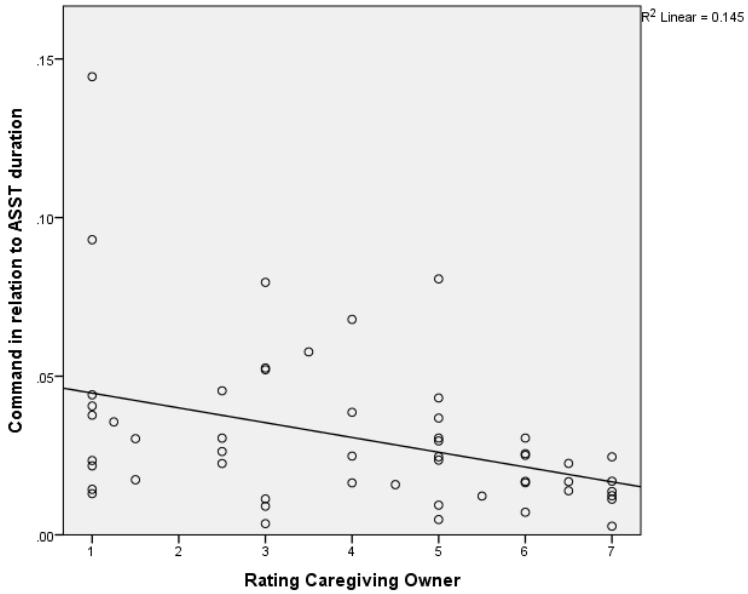


Figure 4: The Y-axis shows the amount of commands used (measured in seconds) put in relation to the whole duration of the ASST (measured in seconds). The X-axis depicts the owners caregiving behaviour rated in seven categories. n=53

5.1.2. Frequency and intensity adjustment

Vocal frequency increases during the call episodes and is significantly higher in comparison to the neutral voice (Fig. 5) E5: Wilcoxon Signed Ranks Z= -6.33, p< 0.0001; E9: Wilcoxon Signed Ranks Z= -6.33, p< 0.0001), the reunion episodes (E6: Wilcoxon Signed Ranks Z= -5.67, p< 0.0001; E10: Wilcoxon Signed Ranks Z= -5.93, p< 0.0001) and the exploring episode (E2: Wilcoxon Signed Ranks Z= -4.9, p< 0.0001).

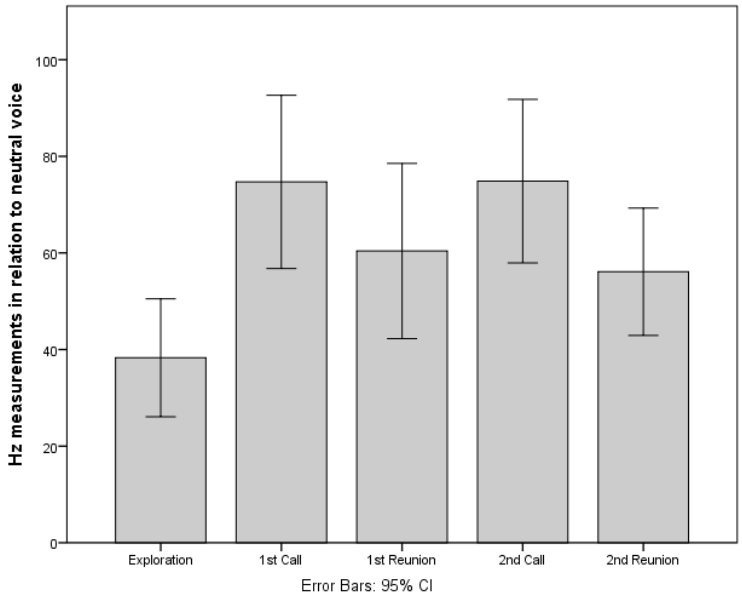


Figure 5: Hz measurements of episode 2 (exploration), 5 (1st call), 6 (1st reunion), 9 (2nd call) and 10 (2nd reunion) in relation to the owners' neutral voice. The relative pitch increase in comparison with reading a reference text (neutral voice) is shown. The Y-axis shows the fundamental frequency, measured in Hz. n=53

In parallel to frequency, intensity is decreased in a stressful situation (Fig. 6). Only in the "call" episodes the owner vocalizations were significantly louder than during neutral reading: (E5: Wilcoxon Signed Ranks Z= -2.6, p= 0.009; E9: Wilcoxon Signed Ranks Z= -2.96, p= 0.003). In both, the reunion episodes (E6: Wilcoxon Signed Ranks Z= -4.55, p< 0.0001; E10: Wilcoxon Signed Ranks Z= -4.07, p< 0.0001) and the exploring episode (E2: Wilcoxon Signed Ranks Z= -5.88, p< 0.0001) owners talked less loudly than during neutral reading.

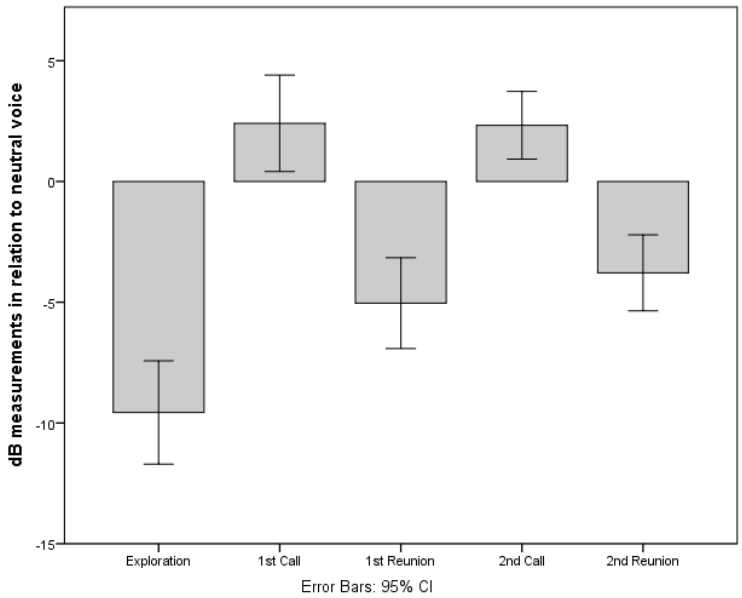


Figure 6: dB measurements of episode 2 (exploration), 5 (1st call), 6 (1st reunion), 9 (2nd call) and 10 (2nd reunion) in relation to the owners' reading of the reference text. The graph shows the relative measurements of how much louder or lower the voice is in comparison to the reference text (neutral voice). The Y-axis shows the voices intensity, measured in dB. n=53

5.2. Components of speech

The coded variables (Solomon) "high", "low", "loud", "babble", "signal", "command" and all measured variables (Praat) of the dB and Hz measurements of the exploration episode (2), call episodes (5 and 9) and reunion episodes (6 and 10) were used as input for a principal component analysis (KMO 0.69, Varimax rotation and Kaiser Normalization). Five components were discovered, explaining a total variance of 71% (Tab. 3, Tab. 4):

Component 1, "talking high pitched" is explains a variance of 31.1% and includes the Hz measurements of the reunion and call episodes as well as the variable "high". Component 2, "interactive utterances" explains 12.3% of the variance and includes the dB measurements of both reunion episodes as well as the Hz and dB measurement of the exploration episode. Component 3, "talking loud" explains 10.7% and is built on the dB measurements of the call episodes and the variable "loud". Component 4, "commanding utterances", (10% of variance) consists of the

variables “signal” and “command”. Component 5, “motherese” (6.9% variance) includes the variables “low” and “babble”.

Table 3: Factor loadings of the rotated component matrix of all variables (relative values; normalized) used for the PCA.

	Component				
	1- talking high pitched	2- interactive utterances	3- talking loud	4- commanding utterances	5- motherese
Episode 5, 1st call Hz	**.909**		.174		
Episode 9, 2nd call Hz	**.886**	.120	.309		
Episode 6, 1st reunion Hz	**.630**	.179		.144	.418
High	**.585**	.231		.360	.325
Episode 10, 2nd reunion Hz	**.506**	.499	.110	.207	-.212
Episode 6, 1st reunion dB	.221	**.785**	.160	-.151	
Episode 10, 2nd reunion dB	.192	**.671**	.266		.273
Episode 2, exploration Hz		**.658**		.412	
Episode 2, exploration dB	-.126	**.534**	.467	.280	
Episode 9, 2nd call dB	.176	.334	**.849**		
Episode 5, 1st call dB	.345	.161	**.753**		.147
Loud			**.537**	.532	-.103
Signal	.290		-.182	**.791**	
Command	-.126	.125	.155	**.719**	
Low	-.125		.244		**.854**
Babble	.265	.258	-.116		**.820**

Table 4: PCAs reliability for each factor

PCA reliability	variance explained	Cronbachs Alpha
1. talking high pitched	31.1%	0.78
2. interactive utterances	12.3%	0.69
3. talking loud	10.7%	0.61
4. commanding utterances	10.0%	0.59
5. motherese	6.9%	0.64

5.3. Speech component analysis

A detailed look at the five components (1. talking high pitched, 2. interactive utterances, 3. talking loud, 4.commanding utterances, 5. motherese) reveals, that interactive utterances and motherese do not seem to be driven by any character trait (NEO FFI) or demography, contrary to talking high pitched, talking loud and commanding utterances.

5.3.1. Component 1 - Talking high pitched

Women talk with a higher relative frequency than man (Fig.7; Mann-Whitney-U: n= 53, Z= -3.36, p= 0.001). Since this is relative to the pitch of the owners' normal speaking voice, this means that women modulate their voice more towards higher frequencies than men when talking to their dogs in the ASST situations in question.

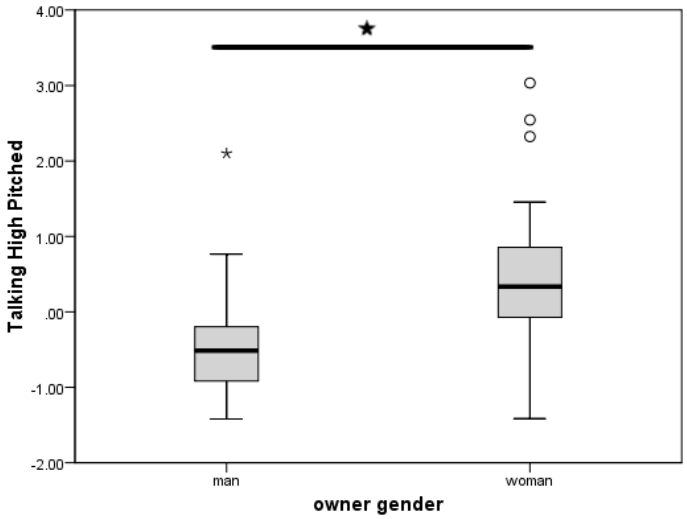


Figure 7: Talking high pitched (component 1) shows a significant difference (p=0.001) for the owners' gender. The Y-axis shows the scorings of PCA component 1, talking high pitched whereas the x-axis depicts the owner gender. n=53

Women talk significantly higher with their female dogs than men do (Fig. 8; Mann-Whitney-U: n= 53, Z= -3.03, p= 0.002).

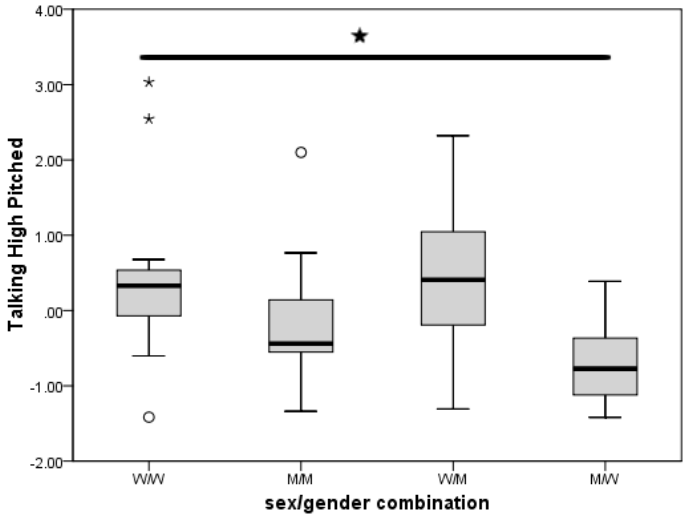


Figure 8: The dyads´ sex/gender combination influence on the factor scoring of talking high pitched (component 1). The Y-axis shows the scorings of PCA component 1, talking high pitched and the X-axis depicts the dyads sex/gender composition. n=53; W/W-owner female, dog female; M/M-owner male, dog male; W/M-owner female, dog male; M/W-owner male, dog female

The scoring in talking high pitched declines both with the dogs' age (Fig. 9; linear regression: F= 8.06, p= 0.006) and with its time living with the owner (Fig. 10; linear regression: F= 7.74, p= 0.008).

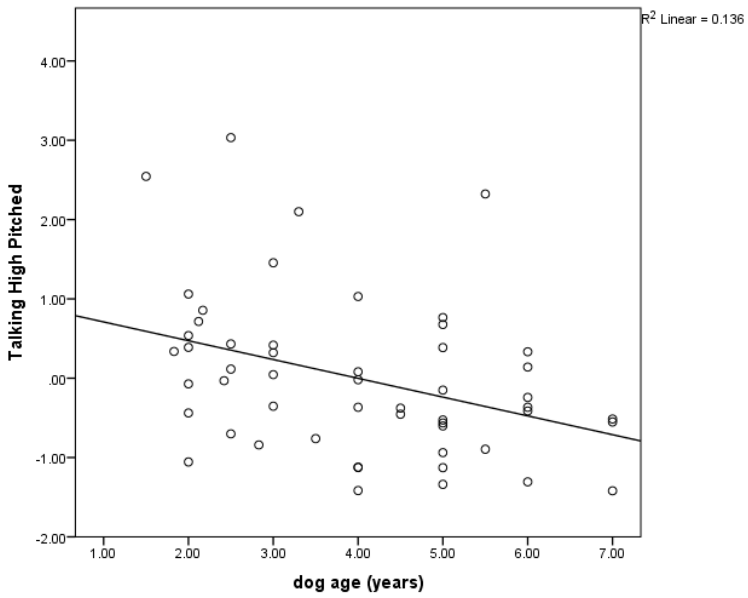


Figure 9: The usage of talking high pitched (component 1) decreases with the dogs age (in years). The Y-axis shows the scorings of PCA component 1, talking high pitched. The X-axis depicts the dogs age in years. n=53

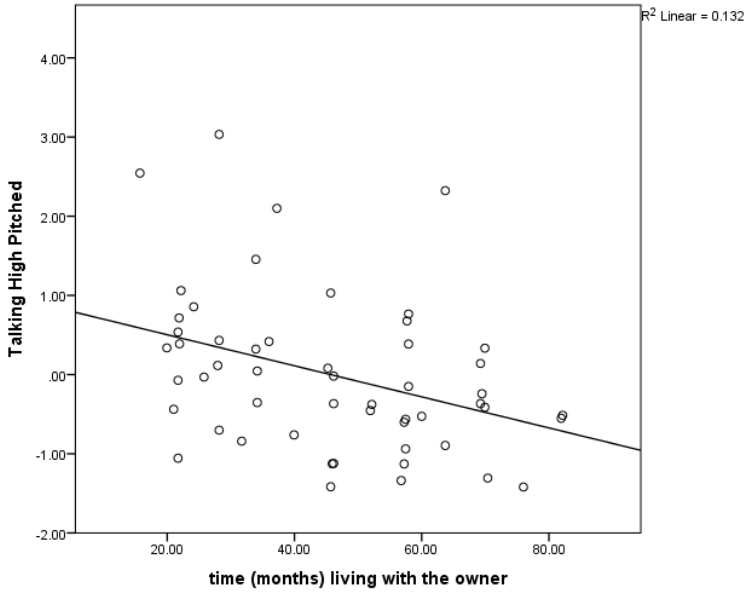


Figure 10: Influence of the dogs' time (in months) living with its' owner on the factor scoring of Talking High Pitched (component 1). The Y-axis shows the scorings of PCA component 1, talking high pitched. The X-axis depicts the dogs time spent living with its owner in months. n=53

5.3.2. Component 3 - Talking loud

Women tend to talk louder with male than female dogs (Fig. 11, Mann-Whitney-U: n= 26, Z= -3.24, p=0.001).

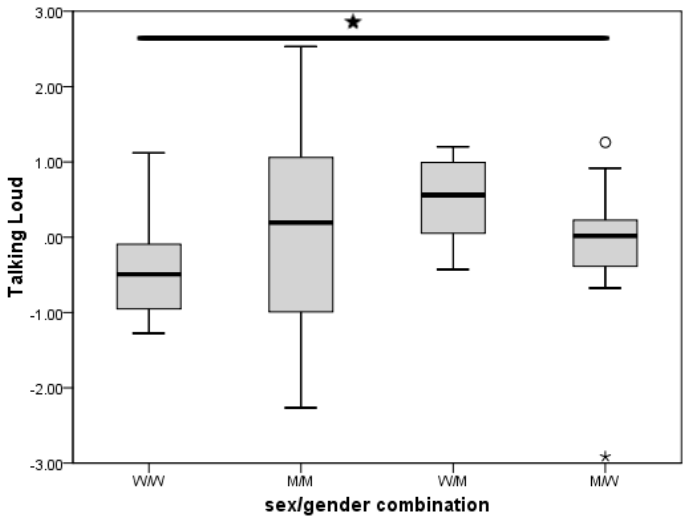


Figure 11: Influence of the dyads sex/gender combination on the factor scoring of Talking Loud (component 3). The Y-axis shows the scorings of PCA component 3, talking loud and the X-axis depicts the dyads sex/gender composition. n=53; W/W-owner female, dog female; M/M-owner male, dog male; W/M-owner female, dog male; M/W-owner male, dog female

5.3.3. Component 4 - Commanding utterances

Commanding utterances of the dog owners decreases the more caregiving behaviour the owner shows towards the dog (Fig. 12; linear regression: F= 4.33, p= 0.42) regardless of the dogs sex or owners gender.

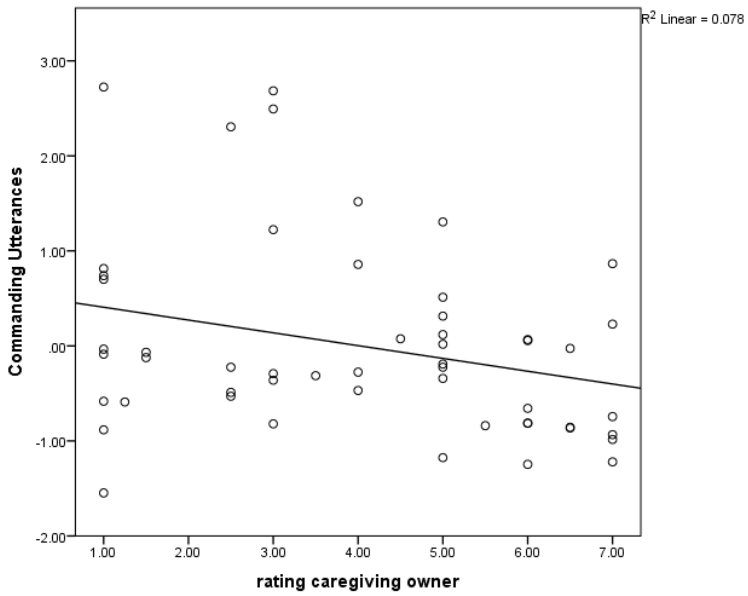


Figure 12: The amount of commanding utterances (component 4) decreases with an increase in the rating of the owners caregiving behaviour. The Y-axis shows the scorings of PCA component 4, commanding utterances. The X-axis depicts the rating of the owners caregiving behaviour in seven categories. n=53

6. Discussion

In a nutshell, humans' acoustic communication with their pet dogs is quite diverse and individual without actually being driven strongly by any of the owners' character traits. The dyads sex/gender composition (for talking high pitched – component 1 and talking loud – component 3) and the ability of the owner to provide caregiving behaviours (for commanding utterances – component 4) seem to be especially essential and crucial for the way owners talk to their dogs.

Kotrschal et al. (2009) were already able to show that the owners' gender has an influence on the dogs' personality: suggesting, that male dogs of male owners are more sociable than those of female owners. I found, that women with male dogs had higher scorings in component 3, talking loud than those with a female dog. A study by Kubinyi et al. (2009) could be seen as backing up these findings by stating that in their data set men generally had calmer dogs than women did. Therefore the influence of the dogs' sex on talking loud could rather be found in a primary influence of the owners' gender on the dogs' personality than simply in the dogs' sex.

Furthermore I found utterances that seem to fit the description of motherese in a child-caretaker context. I did name the component I found motherese, but I wouldn´t go as far as calling it analogous to motherese between caregiver and child. I was able to find the described repetitiveness and the soft voice, but none of the variables that would indicate a high pitch were compatible with component 5 "motherese". The easiest and most logical explanation would be the fact that Praat is only able to analyse and measure a voice when the vocal folds are vibrating. But while whispering or speaking very softly there is no vibration to be measured. So Praat was not able to give enough insight into these types of vocalisations. My second approach, observer coding by ear also proved to be difficult for these vocalisations since humans tend to perceive the frequency of a low speaking voice differently than that of a high intensity (Fletcher and Munson, 1933).

After listening and working through all these audio files I still feel that the use of motherese in dogs goes hand in hand with a combination of a low voice, repetitive sentences and a higher speech register. The methods used did not allow capturing this characteristic of a higher pitch within the low voice. By investigating this specific

acoustic behaviour with a more appropriate method I could imagine, that motherese used with dogs can indeed be put on the same level as the one used with children.

6.1. Conclusion on the research questions

6.1.1. What kind of vocalisations do the dog owners use while talking with their dogs?

Hypothesis #1: Vocalisations are greatly driven by gender and dyad composition and differ according to the goal wanting to be achieved (e.g.: calming the dog, engaging the dog in play).

I was able to identify five different components dog owners used while talking to their dogs. Talking loud (component 3) and talking high pitched (component 1) seem to be driven by the dogs' sex and owners gender while commanding utterances (component 4) correlate with the owners rating in caregiving behaviours. Interactive utterances (component 2) and motherese (component 5) did not seem to be dependent on any demographic characteristic or NEO FFI character trait. So I can confirm the first hypothesis and maybe add, that the amount of caregiving provided has an equal influence on the vocalisation as the dyad composition.

6.1.2. Do humans indeed use baby talk ("motherese") while comforting their companion dogs in a stressful setting?

Hypothesis #2: Motherese will be used equally by men and women while comforting the dogs regardless of their dogs' sex.

I extracted a component during a PCA that seems to be similar to motherese used with children. It is composed of the acoustic behaviours "babble" and "low". These two variables describe a repetitive content with a soft spoken voice explaining a variance of 6.9 % and therefore the smallest component of the owners' vocalisations. I could find no significant evidence that women would use more motherese than men do and therefore I can confirm our second hypothesis as well.

6.1.3. Is it possible to measure the type and quality of the human dog relationship through the humans' vocalisations?

Hypothesis #3: A secure attachment is predictable through the amount of motherese used.

Since I found strong correlations between the amount of babble or commands used in regards to the ratings in caregiving I can indeed assume, that a first assessment of the dyads relationship quality can be done by just analysing the owners speech content. Ainsworth suggested, that different scorings in the caregiving behaviours are connected with the attachment type between child and attachment figure. This would allow the assumption that a behaviour like babble, that's strongly dependent on caregiving could also indicate the type of attachment.

I indeed found, that with an increase in the owners caregiving behaviour the languages content shows an increased amount of babble with a decrease in commands used, but I couldn´t find a significant connection in regards to the attachment types. Therefore I have to reject the third hypothesis and adapt it by saying the amount of motherese used allows insight into the owners caregiving behaviour.

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First and foremost I want to thank my supervisor Univ.-Prof. Mag. Dr. Kurt Kotrschal for giving me the opportunity to work on such a fantastic thesis topic. I got the chance to explore, to learn and to grow as a person unlike ever before. The opportunity to incorporate my ideas, your feedback and lessons will always be of great value to me and I for sure will keep them with me forever. I also want to thank Mag. Iris Schöberl, who as well always offered great advice and help when needed. My dearest friend, Isabella: You always have my back, you never fail to support me, you are always honest and always there for me, you keep me grounded and yet make me fly. Words cannot express how much it means to me to be able to call you my best friend and accomplice for life. Last but not least I want to thank my mum for always having an open ear, good advice and strength that allowed me to grow, my dad for being the optimist and storyteller, who made me dream and my brother Fabian for being the brutally honest and warm-hearted person giving me courage like nobody else can.

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