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1. Introduction

1.1. The value of literacy

Reading literacy is a basic cultural technique. It constitutes a key qualification for occupational success and social integration. The Programme for International Student Assessment (PISA) of the Organisation for Economic Cooperation and Development (OECD) for example rates reading as one of the “skills that are essential for full participation in modern society” (OECD 2014). Sadly, the most recent assessment of reading performance by PISA 2012 showed that Austria lies below the OECD average and actually also performed poorly in comparison to the other German-speaking countries. Whereas Liechtenstein, Switzerland and Germany scored above the OECD average, only Luxembourg reached comparable scores (Table 1). The percentage of students, who performed below the baseline level of reading performance (Level 2) lies with 19.5% close to the OECD average. Still this percentage is quite disconcerting given that these students can, at best, “recognise the main theme or author’s purpose in a text about a familiar topic and make a simple connection between information in the text and everyday knowledge” (ibid.). The percentage of students, who are top performers, however lies with 5.5% below the OECD average. Top performers “can handle texts that are unfamiliar in either form or content and can conduct fine-grained analyses of texts” (ibid.). Since the first PISA assessment in 2000 in Austria no significant changes in reading performance could be assessed over the years (ibid.). Clearly, there is a need for reading promotions that effectively help students to improve their reading performance and raise reading literacy in Austria. Therefore any attempt to assess the effectiveness of reading promotions is helpful to provide effective means for the improvement of reading skills.

	statistically significantly above the OECD average
	not statistically significantly different from the OECD average
	statistically significantly below the OECD average

Mean score	Comparison country	Countries whose mean score is NOT significantly different from that comparison country's score
516	Liechtenstein	Switzerland, Germany
509	Switzerland	Liechtenstein, Germany
508	Germany	Liechtenstein, Switzerland
496	OECD average	
490	Austria	Luxembourg
488	Luxembourg	Austria

Table 1: Scores of reading skills in German-speaking countries in PISA 2014.

1.2. Indirect and direct evidence for positive effects of dogs on reading performance

Animal-assisted interventions (AAI), particularly the use of dogs in pedagogy, have increased over the last years. Boris Levinson, a US child psychotherapist, was one of the first to recognise and publish the potential of animals, especially dogs, for psychotherapeutic interventions. In the 1960ies he treated a child that would barely establish contact with his environment. As fate would have it its family came early, so that Levinson's dog "Jingles" was present. Thus, by a happy coincidence he witnessed how the child sought contact to the dog and from there on systematically used it as "icebreaker" (Beetz 2012, Jäger 2014). The same experience was the base for a recent book on "attachment to pets" (Julius et al. 2012). After that the involvement of animals for the purpose of well-being in humans gained more and more popularity, at first in the USA and followed also by the German-speaking region. At the beginning the animals were deployed without any pedagogic or therapeutic concepts behind, for example in dog visits at children's, nursing or special-care homes. Furthermore small animals were commonly kept in school classes as practical demonstration models, to teach the children responsibility as well as for the positive effects on the psychological well-being. Since the turn of the millennium dogs at schools also in the sense of animal-assisted pedagogy/education (AAP/AAE) became more and more frequent, particularly in the German-speaking region (Agsten 2009, Beetz 2012).

Early studies substantiated AAP/AAE by providing indirect evidence for positive effects of dogs on learning, including physiological, psychological, emotional and social effects.

1.2.1. Physiological effects

EXCURSUS: The “stress hormone” cortisol and the “binding hormone” oxytocin

In stressful situations two different physiological stress systems are activated. One is the fast reacting **sympatho-adrenergic stress axis** or **sympathic nervous system** (named after sympathetic cord of the *Nervus vagus*). It secretes adrenalin, which leads to an increase in heart rate and blood pressure, thus activating the cardiovascular circuit. The other system is the **hypothalamo-pituitary-adrenal (HPA) axis**, which produces the “stress hormone” cortisol, resulting in a mobilisation of energy reserves and makes the body ready for action with some time delay (Kotrschal 2012).

The “binding hormone” oxytocin is a neuropeptid consisting of nine amino acids and is produced in the hypothalamus. The mere presence of or pleasant body contact with intimate persons like parents, friends or partners triggers the secretion of oxytocin into the brain and bloodstream. Thereby it inhibits the stress systems, resulting in a decrease of cortisol and an enhancement in cardiovascular parameters, measurable as a decrease in blood pressure and heart rate and an increase in heart rate variability. Furthermore, psychological stress such as perceived fear and anxiety is reduced. Oxytocin therefore has a direct calming effect, increases social trust and even initiates the development of strong bonds, e.g. at birth between mother and child or during breastfeeding, at intercourse between sexual partners or simply between intimate persons or humans and their companion animals, especially during stroking but also during touch or warmth (Kotrschal 2012, Beetz et al. 2012).

The interaction with a friendly, calm dog or animal acts stress reducing, measurable in a decrease of various physiological variables like blood pressure, heart rate, heart rate variability, the level of the stress hormone cortisol, as well as on neurotransmitters such as epinephrine and norepinephrine. In their review Beetz et al. (2012) illustrated that most of the included studies could show that the presence of or interaction with familiar as well as unfamiliar friendly animals effectively reduced these variables or buffered increases in anticipation of a stressor (Beetz et al. 2012).

Talking to a friendly animal is associated with lower cardiovascular responses than talking to another person (Lynch 1985). When performing an arithmetic task female subjects showed a lower increase in three out of four physiological measures in the presence of their pets than in the presence of their friends. Subjects had little or no reactivity in skin conductance response

frequency, systolic blood pressure and pulse rate. No effects were seen for diastolic blood pressure (Allen et al. 1991). In a follow-up, pet owners had significantly lower heart rate and blood pressure levels during a resting baseline, showed lower reactivity to psychological and physical stress during a mental arithmetic and pain paradigm (the cold pressor task), and recovered faster. Among pet owners, the reactivity was lower and the recovery quicker in the presence of their pets than even their spouses (Allen et al. 2002). The presence of a companion animal reduced blood pressure in children, while they were resting or reading aloud (Friedmann et al. 1983).

In a study by Kaminski et al. (2002) hospitalised children taking part in a pet therapy group showed higher pre-intervention heart rates than children attending play therapy, which was interpreted as anticipatory excitement. Blood pressure and salivary cortisol, however, did not differ between these groups. Significant decrease in blood pressure and heart rate was found though by Nagengast et al. (1997) when a dog was present during a physical examination. An initial increase in blood pressure was documented as well, which too was interpreted as excitement during the initial contact with the dog. In a study by Vormbrock & Grossberg (1988) “subjects' BP [blood pressure] levels were lowest during dog petting, higher while talking to the dog, and highest while talking to the experimenter”. Concerning heart rate, results showed that it was lowest while either touching or talking to the dog than while both touching and talking to the dog. Heart rate variability as a measure of parasympathetic neural activity was investigated by Motooka et al. (2006). In their experiment healthy seniors had a higher heart rate variability when walking a dog compared to walking alone in a park for 30 minutes, indicating that “walking a dog shifts a person’s autonomic nervous activity in favour of parasympathetic activity”. Serum as well as salivary cortisol decreased in healthcare professionals following interaction with a therapy dog (Barker et al. 2005).

In boys with insecure/disorganised attachment patterns cortisol levels were significantly lower during and after a social stress test as well as over the whole test session (AUCi) in the presence of a dog compared to the presence of a toy dog or friendly adult (Beetz et al. 2011). Cole et al. (2007) investigated the effects of 12-minute dog visits compared to 12-minute visits from a volunteer on physiological and psychological (s. 2.2.) parameters in patients with advanced heart failure. They found a greater decrease in blood pressure, epinephrine and norepinephrine levels during and after the intervention. Odendaal (2000) investigated the effect of a dog on six neurochemicals involved with attention-seeking behaviour associated

with a decrease in blood pressure. Results indicated that both dog owners and people, who don't own a dog, as well as the involved dogs had significant increases in β -endorphin, oxytocin, prolactin, phenylacetic acid (metabolite of β -phenylethylamine) and dopamine, whereas the stress hormone cortisol decreased in the humans but not in the dogs after positive interactions.

1.2.2. Psychological effects

The interaction with a friendly, calm dog or animal not only results in a decrease of physiological but also perceived stress (Beetz et al. 2012). Cole et al. (2007) also found positive effects of dogs on self-reported state anxiety: After a 12-minute visit patients with advanced heart failure had a greater decrease in state anxiety when visited by a dog compared to a volunteer.

1.2.3. Emotional effects

The presence of a dog brightens mood, turning it into neutral to positive, and reduces depression (Beetz et al. 2012, Souter & Miller 2007). In a pediatric hospital mood of hospitalised children was assessed. Both children and parents viewed pet and play therapy as mood enhancing experiences. Furthermore, in the pet therapy group display of positive affect was enhanced in comparison to the play therapy group (Kaminski et al. 2002). In psychiatric inpatient children and adolescents even one animal-assisted therapy session improved not only intra-emotional balance but also all other dimensions, namely vitality, social extroversion, and alertness of the Basler Befindlichkeits-Skala, which measures general state of mind (Prothmann et al. 2006).

1.2.4. Social effects

Dogs also have a variety of positive effects on social aspects like the promotion of increased positive social attention, stimulation of social behaviour, reduction of aggression, promotion of social cohesion and increased trust and trustworthiness (Beetz et al. 2012, Wells 2009). Dogs promote social cohesion in a group, as shown in a study by Kotrschal & Ortbauer (2003): The presence of a dog in a classroom at an elementary school in Vienna lead to social homogenisation of the group due to decreased behavioural extremes like aggressiveness and hyperactivity, and enhanced integration of formerly withdrawn individuals. Furthermore the children paid more attention to the teacher. Dogs also facilitate interpersonal interactions by

promoting verbal and non-verbal communication, which is called the “social catalysis effect” or “social lubrication effect” (Wells 2009). Villata-Gil et al. (2009), for example, found that in an intervention program patients with schizophrenia perceived a significantly better quality of life due to increased social contact and also objectively improved their social contact abilities when a therapy dog was included in the intervention program. In a study by McNicholas & Collis (2000) being accompanied by a dog increased the frequency of social interactions, especially interactions with strangers. Furthermore, the effect was also perceived when the handler was scruffily dressed, although it was significantly stronger when the handler was smartly dressed.

Wells (2004) found that walking a dog lead to more social responses by strangers than when alone, with a teddy bear or a plant. The appearance of the dog influenced the amount of social responses too: a Labrador Retriever pup or adult elicited more social responses than an adult Rottweiler in total, smiles and verbal responses in particular. People, who are accompanied by a dog, are perceived as more trustworthy. Schneider & Harley (2006), for example, found that people were more generally satisfied with a therapist shown on a videotape and more willing to disclose personal information to him, when he was accompanied by a dog. Also Gueguen & Ciccotti (2008) showed that people were more helpful and trustful when the experimenter was with a dog: In a situation, where either a male or a female experimenter solicited people for money, they were more willing to give it to him/her, when the experimenter accidentally dropped some coins people were more willing to help him pick them up, and when the experimenter asked young women in the street for their phone number they were more willing to give it to him.

These effects mostly influence the preconditions for learning, affecting several aspects. Learning is only effective in concentration, attention, motivation, a neutral to positive mood, the absence of stress or fear, an environment that promotes learning and a positive reading self-concept. Physiological as well as psychological stress, for example, compromises performance by a negative impact on executive functions like impulse control, self-reflection, self-motivation and meta-cognitive strategies for optimisation of the working memory (Heyer & Beetz 2014).

More recent studies could also show direct effects of dogs on learning:

1.2.5. Cognitive effects, learning

In the presence of a dog tasks are performed in a more concentrated, autonomous, exact and fast way (Beetz et al. 2012). Gee and colleagues conducted a number of studies, where they could show positive cognitive effects of dogs on language-impaired or developmentally delayed children and on typical pre-schoolers: The children performed faster in motor skill tasks when a dog was present compared to when it wasn't, without compromising accuracy (Gee et al. 2007). In another study they adhered better to instructions in one out of three motor skill tasks, where they were asked to emulate the behaviour of a model when a dog was present compared to another human, toy dog or alone. However, in the second task, where they were asked to do the tasks in tandem with a co-performer, the children "adhered to instructions best when they performed the task with a human, followed by the stuffed dog (as manipulated by a human), the real dog, and worst when they were asked to perform the tasks alone". In the third task the kind of co-performer did not make a difference on speed, where the children were instructed to do the task faster than a competitor (Gee et al. 2009). The presence of a therapy dog also affected accuracy in an object categorization task. "The children were asked to complete a match-to-sample task in which they had to choose a picture of an object that "goes with" another. The presence of the real dog resulted in significantly fewer irrelevant choices than either the stuffed dog or the human conditions." (Gee et al. 2010 a). Moreover, children required fewer instructional prompts in a memory task in the presence of a real dog compared to the conditions with a stuffed dog or a human, whereas no effects were found for object recognition performance because of ceiling effects (Gee et al. 2010 b). In a follow-up, where the researches tried to avoid the ceiling effect by including a condition with increased task difficulty through increased distraction by four "distracters" compared to one in the other condition, the preschool children performed the object recognition task faster and more accurately in the presence of a dog than a human (Gee et al. 2012 a). Last-mentioned, children categorized animate objects better in comparison to inanimate objects in the presence of a real dog compared with a stuffed dog or a human (Gee et al. 2012 b).

Hediger & Turner (2014) measured attention and concentration performance in 24 children between 10 and 14 years of age via a memory task and three neuropsychological attention tests as well as frontal brain activity via passive infrared hemoencephalography (PIR HEG) measuring prefrontal cortex activity as a biological correlate of attention. Before the tests the children interacted with a therapy dog or the robotic dog AIBO for 15 minutes in a cross-over design. In the condition with the therapy dog the children showed a significantly enhanced

learning effect, which the authors explained as better performance in the second test session when a dog was present, in the memory test as well as in one of the three attention tests. Furthermore, frontal brain activity (PIR HEG) decreased over time in the presence of AIBO during one of the three attention tests, which was not the case in the presence of the therapy dog, where brain activity was significantly higher in all three attention tests.

By now there are also specific studies on reading performance in particular, mostly combined with physiological variables:

1.2.6. Effects on reading performance

Studies without control group

READ (Reading Education Assistance Dogs), is one of a number of similar reading programs in the USA. Its founder Sandi Martin tested 10 children aged 5 to 9 years, who were classified as at-risk-youth and reading below grade-level, in a pilot study. Once a week each child read approximately 20 minutes to a dog plus its handler. Not only did all children improve their reading scores significantly, some also exceeded their grade level after 15 months (Martin 2001). Bueche (2003) states that “all the participants improved by at least two grade levels, and some went up by as much as four grade levels”.

A similar study was conducted by Newlin (2003) with 15 second-graders, who tested below grade level in fluency and reading tests. Once a week they read age-appropriate material to a dog and its handler for 20 minutes. “Most participants improved their reading skills by at least two grade levels over the course of an entire school year.”

Pilot studies with control group

Smith (2010) determined the impact of animal-assisted oral reading intervention on reading performance within a sample of 26 home-schooled students in the third grade. All children had to read aloud for 30 minutes a week, half of them in the presence of a dog plus its handler, the other half alone, for 6 weeks. The students, who had a dog present, significantly improved the reading rates, whereas the control group did not. The overall reading quotient (ORQ), which is a measure of overall reading ability that was calculated from the combination of fluency and comprehension scores, however, did not differ between the two groups.

Heyer & Beetz (2014) too, investigated whether a dog could support children in promoting reading skills in a dog-assisted intervention compared to a control group with a plush toy dog. In 12 weekly sessions of one hour duration 4 children with minor reading skills in each of the groups practiced their reading skills in a variegated program, which was integrated in a detective background story. Reading competence was tested before, in the middle and after the intervention as well as 8 weeks after the end of the intervention, which was after the summer holidays. The children, who attended the intervention with a real dog, reached higher scores in two of three subtests (sentence and text understanding but not word understanding) and the overall reading competence at the end of the intervention, and in all subtests plus overall reading competence after the summer holidays, and also showed a stronger improvement over the 8 weeks of summer holidays. Additionally, the authors found positive socio-emotional effects on school-related motivation, self-confidence, emotions concerning school and class climate.

Studies with control group

Wohlfarth et al. (2014) conducted a study with 12 second graders, 6 to 7 years old, who were instructed to read a text in the presence of a therapy dog and a similar text in the presence of a human supporter in another session in a cross-over design. In the presence of the dog the children's reading performance improved in three out of four parameters in comparison to the human supporter: correct word recognition, correct recognition of punctuation marks and correct line breaks. No improvement was found for the fourth parameter, which was reading time. However, there was no correlation between the reading parameters and the duration of eye or body contact with the dog.

1.3. Different hypotheses for the positive effects of dogs

Several hypotheses have been deployed to explain the mechanisms behind the positive effects of the presence of or interaction with a dog on cognitive performance or learning, which often are linked to each other. These are anxiety and stress buffering (Julius et al. 2012), social enhancing (McNicholas & Collis 2000), attachment promoting (Zilcha-Mano et al. 2011), social support providing (Collis & McNicholas 1998), self-efficacy enhancing (Berget & Ihlebaek 2011), motivation promoting (Olbrich 2009 a, b), which could also include a specific arousal effect via the activation of the appetitive positive affect system (Burgdorf & Panksepp 2006) due to the presence of the dog, and attention and concentration promoting (Hediger & Turner 2014).

1.3.1. Anxiety and stress buffering

One suggested mechanism is that the interaction with animals acts on “physiological parameters that are associated with the activation and deactivation of the stress axes [s. 1.2.1.]” (Julius et al. 2012). On the psychological level, interacting with an animal can also reduce self-reported anxiety and fear (ibid.; s. 1.2.2.). Therefore, cognitive performances like learning might be enhanced when interacting with an animal because of its anxiety and stress reducing effect.

1.3.2. Social enhancing

Animals, especially dogs, act as catalysts for social interactions between people, enhancing contacts, increasing or strengthening social networks and social provisions, which might also promote a feeling of social integration, thus elevating psychological well-being. (McNicholas & Collis 2000). This might in turn have an influence on cognitive performance, the presence of a dog providing an environment that supports learning. Thus dogs might positively shape the preconditions for learning.

This catalysing effect has been explained by the dog acting as an “ice breaker” by providing a neutral and safe opening for conversation, removing or permitting the circumvention of inhibitions against striking up casual conversations (ibid.). “A different kind of explanation is that perceptions of a person’s likeability may be increased by the presence of a dog” (ibid.).

1.3.3. Attachment promoting

“One of the assumptions of attachment theory (Bowlby, 1973, 1980, 1982) is that social interactions with significant others (called attachment figures in the theory) are internalized in the form of conscious and unconscious mental representations of self and relationship partners (internal working models of self and others). These models influence emotion regulation strategies and behavior in close relationships throughout life (Mikulincer & Shaver 2007). To summarize the theory briefly, interactions with attachment figures who are available and supportive in times of need foster the development of both a sense of attachment security (which Sroufe & Waters 1977, called felt security) and internal working models that are positive and optimistic, thereby contributing to self-worth, adaptive emotion-regulation strategies, effective psychosocial functioning, and favorable mental health (Mikulincer & Shaver 2007). When attachment figures are rejecting or unavailable in times of need, felt security is undermined, negative models of self

and others are formed, and the likelihood of later emotional problems and maladjustment increases. [...]

The literature on human–pet bonds clearly indicates that they often meet the four prerequisites for an attachment bond: proximity seeking, safe haven, secure base, and separation distress (Ainsworth 1991; Hazan & Zeifman 1994). Hence, pets can be viewed as attachment figures”.

From Zilcha-Mano et al. 2011

As in therapeutic settings dogs in AAI may become one of many attachment figures that provide some sort of safe haven and secure base for the child, though probably without fulfilling the strict criteria of full-blown attachments towards humans (Zilcha-Mano et al. 2011). However, the underlying mechanism, which in terms of attachment is mostly addressed in animal-assisted therapy (AAT), has not been clearly identified yet.

1.3.4. Emotional social support providing

Another hypothesis explains the positive effects of animals by “the nature of the relationship between the owner and pet” (Collis & McNicholas 1998). The pet is perceived as a “significant relationship and a provider of social support and affection” (ibid.). This explanation probably only fits for pet owners and their own pets, but it could be possible that permanent school dogs the children are used to may also have a substantial relationship to the children and thus also function as social supporters. It has been reported by practitioners as well as AAI research that in animal-assisted reading interventions children felt more supported by the dog because it represented a non-judgemental, friendly companion (Wohlfarth et al. 2014, Friesen 2010), achieving improvements sometimes even in the first session with an unfamiliar dog. Thus probably even unfamiliar dogs without existing relationships to the child may provide emotional social support.

1.3.5. Self-efficacy enhancing

Bandura (1977) defines self-efficacy as the judgement “of how well one can execute courses of action required to deal with prospective situations” (Bandura 1977, cited from Berget & Ihlebaek 2011). It “is a major determinant of motivation for and choice of activity” (Berget & Ihlebaek 2011). Therefore it “affects the amount and duration of effort a person will allocate in order to cope in a situation or with a task” (ibid.). Social cognitive theory states that a person’s cognition is linked to his/her behaviour and environment. The goal of therapy is to

alter a person's behaviour through positive changes of self-perception by improving self-efficacy, self-esteem and locus of control (ibid.). "Benefits of AAI is often ascribed as the ability of animals to act as living, interactive tools that can be used to help people see both themselves and the world in new ways, and add new skills and responses to their behavioural repertoires" (Nebbe 2000, cited from Berget & Ihlebaek 2011). Children with low self-efficacy concerning reading would avoid reading, "lower their goals, and seek less support from others. Failures would make them lose faith in themselves, and in turn contribute to lowered mood and depression" (Bandura 1982, 1986, 1997; cited from Berget & Ihlebaek 2011). Animals thus may increase self-efficacy in activities that children used to believe to exceed their coping capacities, like reading, resulting in better mood and higher motivation.

1.3.6. Motivation promoting

Motivational research in recent years has brought up the theory of a dual behaviour-guiding system divided in "an automatic, non-verbal, hedonically oriented implicit motive system and an effortful, language-based, socially oriented explicit goal pursuit system" (Schultheiss et al. 2008). Explicit or self-attributed motives "respond to social incentives ["affectively charged stimuli that elicit goal-directed, motivated action" (Schultheiss et al. 2012)] and influence respondent behaviors (i.e., behaviors in response to a specific social demand or expectation)" (Schultheiss & Brunstein 2010). "Self-concept, personal goals, and enduring values provide humans with conscious, explicit routes for regulating their goal-directed behavior in harmony with the demands and affordances of the sociocultural context they live in and with ways to experience their pursuit of incentives as meaningful and rewarding" (Schultheiss et al. 2012). "Implicit motives are non-conscious dispositions to experience specific types of incentives as rewarding" (Schultheiss et al. 2008). The implicit motive system, furthermore, is conceived as an "associative network that connects situational cues with basic affective reactions and implicit behavioural tendencies" (Schultheiss et al. 2012, cited from Wohlfarth et al. 2013). Wohlfarth et al. (2013) expanded this terminology by that the fulfilment of any implicit motive in AAI is also associated with task enjoyment and intrinsic motivation. In any case, if explicit and implicit motives are congruent, it results in "low intrapersonal conflict, high intrinsic motivation, and successful performance – the preconditions for happiness, well-being and health" (Schultheiss & Brunstein 2010, cited from Wohlfarth et al. 2013). Explicit and implicit motive systems might, however, also conflict with each other, resulting in high intrapersonal conflict, and therefore reducing intrinsic motivation and successful performance. Schultheiss et al. (2008) also explained that "the pursuit of goals that are supported by a

person's implicit motives represents a hot and affectively engaging mode of goal-striving, whereas the pursuit of goals that are not supported by a person's implicit motives represents a cold, affectively neutral mode" (cited from Wohlfarth et al. 2013). Therefore, "implicit motives influence non-declarative measures such as task performance, attention orienting, and physiological changes, but not declarative measures such as choices, attitudes, and judgements, and the reverse is true for explicit motives" (Schultheiss & Köllner 2013, cited from Wohlfarth et al. 2013). Concerning AAI, implicit motives were proposed to be an important mode of action, since they are mainly processed by the experiential system, which codes stimuli of an animal's world, "such as the sight of a friendly dog, the waving of a tail or the fur touching one's skin", the meaning of which is coded by positive emotional-motivational states, such as curiosity, affection, or joy" (Wohlfarth et al. 2013). Furthermore, Wohlfarth et al. (2013) believe that a dog, which seems to listen to the child reading a story, might trigger the achievement motive, as a friendly tail-waving dog may trigger the affiliation motive. Beetz (2012) too suggested that dogs may stimulate intrinsic motivation to learn and increase curiosity and attention. Berridge & Robinson (2003) write that "Stimuli attributed with incentive salience [the subconscious psychological component of motivation, also subconscious 'wanting'] become motivational magnets, eliciting appetitive approach and even consummatory behaviour". In respect to dog-assisted reading, this means that dogs could represent the stimuli that activate the appetitive system. Moreover, subjectively experienced affective states are said to be commonly accompanied by emotional and motivational arousal (Burgdorf & Panksepp 2006). In summary dogs may serve as affectively hot stimuli (the child's intrinsic motive matches its goal), and thus arouse strong implicit motives for achievement or learning, implicit behavioural impulses, and curiosity and attention. "Dogs, therefore, may represent catalysts and accelerators for the activation of implicit motives, which enhances motivation and further performance" (Wohlfarth et al. 2013).

1.3.7. Attention and concentration promoting

Several biological and psychological mechanisms have been suggested underlying the increase in attention and concentration. Hediger & Turner (2014) collected the reduction of stress, the stimulation of the dopaminergic systems, both correlated with the improvement of cognitive functions, and the stimulation of the intrinsic motivation to learn coupled with increased curiosity and attention. Connections between the dopaminergic system and the subconscious psychological component of motivation (incentive salience or subconscious 'wanting') were also shown in the neuroscience of reward (Burgdorf & Panksepp 2006,

Berridge & Robinson 2003). Whereas many teachers are convinced of the attention and concentration enhancing effect of dogs, direct measures for concentration performance are scarce. Hediger & Turner (2014) measured concentration performance via three neuropsychological concentration tasks plus passive infrared hemoencephalography (PIR HEG) as a biological correlate and found positive effects. Other studies, however, mostly interpreted indirect measurements as indicators, like improved performance at different cognitive or motor skill tasks, for increased attention or concentration. Nevertheless is improved attention and concentration a valuable hypothesis to explain positive effects of dogs.

1.3.8. Connections between these hypotheses:

Most of these hypotheses cover different levels of explanation and are not independent of each other. The mechanism connecting all or at least most of them was proposed to be the oxytocin system (Figure 1; Beetz et al. 2012, Julius et al. 2013, Uvnäs-Moberg 2003). Stress is known to inhibit learning, memory, attention and concentration performance by inhibiting the executive functions (i.e. cognitive control functions like impulse control, self-reflection, self-motivation or meta-cognitive strategies for optimising performance of working memory) in the prefrontal cortex (Howland & Wang 2008, Kim et al. 2006, Wolf et al. 2011, Diamond & Lee 2011, Miyake et al. 2000). Likewise, the reduction of stress facilitates learning, etc. The presence of or interaction with an animal now releases the so called “binding hormone” oxytocin into the brain and the bloodstream, inhibiting stress systems (resulting in a decrease of the so called “stress hormone” cortisol, an enhancement in cardiovascular parameters and reduction of perceived fear and anxiety) and providing a direct calming effect that improves capacity and receptiveness (s. 2.1. EXCURSUS). The connection between stress, the executive functions, the oxytocin system and attention, concentration, motivation and learning is not the only connection that was found. The presence of or interaction with an animal also leads to an increase of dopamine and serotonin, alterations of which also correlate with attention and concentration performance (Odendaal & Meintjes 2003) and the activation of the explorative/appetitive system in the brain (Burgdorf & Panksepp 2006, Berridge & Robinson 2003). Additionally, concerning motivation, implicit motives are said to be closely tied to regions of the “emotional brain” (Le Doux 1996). “The impact of interaction with animals on neurohumoral agents, like the decrease of cortisol (Beetz et al. 2012) and the increase of serotonin and dopamine (Odendaal & Meintjes 2003) might constitute the link between the motivational and the stress system” (Wohlfarth et al. 2013).

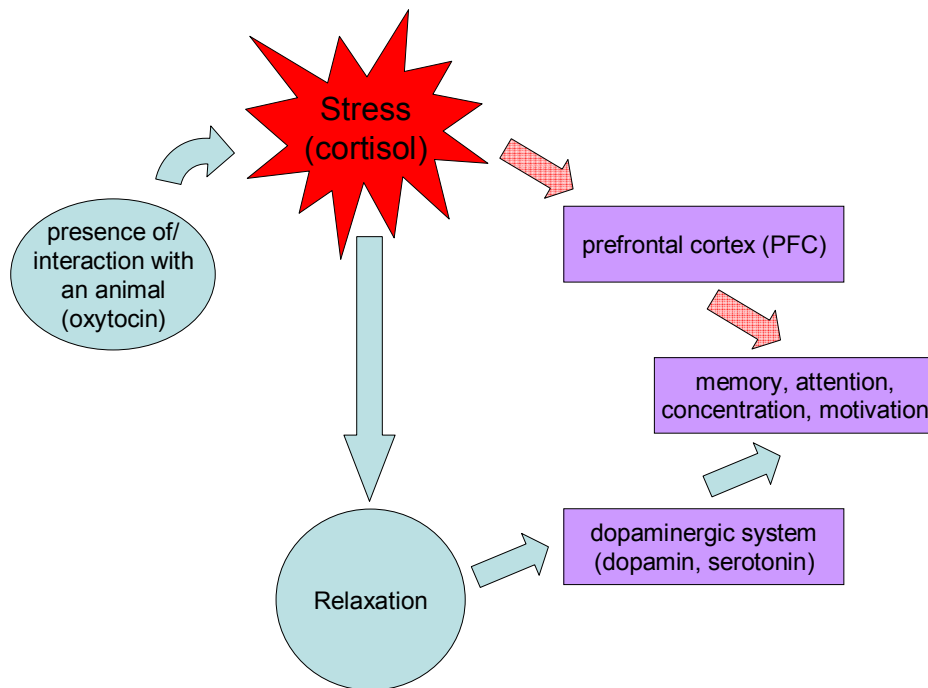


Figure 1: Connections between stress, prefrontal cortex, dopaminergic system and cognitive functions like memory, attention, concentration and motivation and the stress-reducing influence of the presence of or interaction with an animal. Blue arrows indicate a positive effect, red arrows a negative effect. It has to be noted that this scheme only accounts for stressful situations, since the effect of cortisol is dose-dependent and some level of cortisol even is beneficial for cognitive performance like learning and memory (Haley et al. 2006, Rimmele et al. 2010).

1.4. Animal-assisted intervention (AAI)

“An Animal Assisted Intervention is a goal oriented and structured intervention that intentionally includes or incorporates animals in health, education and human service (e.g., social work) for the purpose of therapeutic gains in humans. It involves people with knowledge of the people and animals involved. Animal assisted interventions incorporate human-animal teams in formal human service such as Animal Assisted Therapy (AAT), Animal Assisted Education (AAE) or under certain conditions Animal Assisted Activity (AAA).”

From IAHAIO White Paper 2014

1.4.1. Animal-assisted pedagogy/education (AAP/AAE)

“Animal Assisted Education (AAE) is a goal oriented, planned and structured intervention directed and/or delivered by educational and related service professional. AAE is conducted by qualified (with degree) general and special education teacher. Regular education teachers who conduct AAE must have knowledge of the animals involved. An example of AAE delivered by a regular education teacher is an educational visit that promotes responsible pet ownership. AAE, when done by special (remedial) education teachers is also considered therapeutic and a goal

oriented intervention. The focus of the activities is on academic goals, prosocial skills and cognitive functioning. The student's progress is measured and documented. An example of AAE delivered by a special education teacher is a dog-assisted reading program.”

From IAHAIO White Paper 2014

1.4.2. Animal-assisted therapy (AAT)

“Animal-assisted therapy is carried out by a therapist with education in a recognised type of therapy (psycho-, physio-, ergotherapy, etc.) and an expertise in the utilised animal species. The intervention is oriented at a therapeutic perspective. The utilised animals are specifically socialised and trained for the work with humans.”

From IAHAIO White Paper 2014

1.4.3. Animal-assisted activity (AAA)

“AAA is a planned and goal oriented informal interaction and visitation conducted by the human-animal team for motivational, educational and recreational purposes. Human-animal teams must have received at least introductory training, preparation and assessment to participate in informal visitations. Human-animal teams who provide AAA may also work formally and directly with a healthcare, educator and/or human service provider on specific documentable goals. In this case they are participating in AAT or 6 AAE that is conducted by a specialist in his/her profession. Examples of AAA include animal assisted crisis response that focuses on providing comfort and support for trauma, crisis and disaster survivors, and visiting companion animals for ‘meet and greet’ activities with residents in nursing homes.”

From IAHAIO White Paper 2014

Concerning the use of dogs in schools, dogs are differentiated in *school dogs (presence dogs)* and *(school) visit dogs*:

1.4.4. School dogs (presence dogs)

School dogs regularly spend some time in the class room, also during classes. They are handled by a teacher, who is also educated in the pedagogic use of dogs. The dogs are tested for their suitability, specially trained and are regularly inspected at school, the place of action. The main pedagogic objectives of the use of school dogs are their contribution to the

improvement of the social fabric in the classroom, the teacher-student relationship, the classroom climate and the individual social competence of the students (freely translated from Beetz 2012).

1.4.5. (School) visit dogs

School visit dogs visit school classes once or several times for an hour. They are handled by an external accompanying person that is educated in the pedagogic use of dogs. The dogs are tested for their suitability, specially trained and are regularly inspected. The main objectives are the age appropriate transfer of knowledge concerning dogs (adequate dog ownership, care, costs and training, in particular the forms of expression like body language, vocalisations) as well as animal welfare concerns (e.g. animal-friendly education, cruelty to animals, breeding under poor conditions, etc.; freely translated from Beetz 2012).

Sometimes also the term *therapy dog* is used in the school setting. Therapy dogs are specially trained and typically used for therapeutic perspectives. This designation is justified if the dog is used for therapeutic reasons like ergotherapy or physiotherapy. If the dog is mainly used in a pedagogic setting, this term is deceptive because it is unclear in which way the dog is used. However, school dogs don't need therapy dog training for their pedagogic use (Beetz 2012).

2. Methods

2.1. Participants

36 children of the 3rd grade aged 9 to 10 years took part in the study: 17 boys and 19 girls. The study was approved by the Vienna Municipal Education Authority and the head masters of the schools. Three different schools in Vienna were involved: VS Münnichplatz, OVS Rothenburgschule and OVS Christian Bucher Gasse. The parents were informed via an information sheet and could give their written consent. The children, whose parents approved, were selected by their teacher, whereby poor reading skill was preferred. Not all of the children, who took part, exhibited poor reading skills, since not all the parents gave their consent. None of the children reported or showed fear of dogs. Furthermore the children in this study reported to have a neutral to positive attitude towards dogs.

2.2. Settings – with and without dog

Children were tested separately in two test sessions in a cross-over design – once with a dog and once without a dog present (Table 3). In both settings the child was sitting on a blanket and a pillow on the floor. One of two investigators (one of two female university students) was present in both settings as well and instructed the child through the whole test session. The test rooms were located at the schools and were not used by others during the time of testing.

Four different dogs took part in the study: one poodle (“Grappa”), one Australian Shepherd (“Jeanna”), one Staffordshire Bullterrier (“Beetlejuice”) and one Staffordshire Bullterrier-German Shepherd mix (“Toni”). All were members of the association “Schulhund.at – Rund um den Hund“ in cooperation with “IEMT“ (Institut für interdisziplinäre Erforschung der Mensch Tier Beziehung) and are used to visiting children in schools. During the test sessions they were placed next to the child on the blanket and were allowed to move freely in order to enable free interactions between child and dog. The child was encouraged to call the dog or approach it during the task-free phases. The dog handlers were also placed on the edge of the blanket but were instructed to turn away from the test situation and only interfere if necessary. In the setting without dog only an investigator was present and the times for interactions with the dog were replaced with time to draw.

2.3. Procedure

After a short welcome the first salivary cortisol measurement was taken and the heart rate belt and watch were adjusted. In a brief instruction the investigator gave a short outlook on the test procedure. Then the children had 4 minutes time to interact with the dog in the setting with dog or draw in the setting without dog, respectively. The second salivary cortisol measurement followed right after that. Then the first reading test Repeated Reading (RR) was conducted. In this reading test the children were asked to read a short text loudly in a given time of 2 minutes (run 1) whereby making as few errors as possible and reading as fast as possible. After a short training phase, in which the children could practice the words they didn't read correctly, they had to read the same text again in a second run. RR was followed by the third salivary cortisol measurement and the second reading test ELFE (Ein Leseverständnistest für Erst- bis Sechstklässler) with its two subtests ELFE sentence understanding and text understanding as well as with instructions at the beginning and in between and followed by the fourth salivary cortisol measurement. At the end of the test

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session the children could interact with the dog in the setting with dog or draw in the setting without dog during two relaxation phases, which were separated and completed by the fifth and sixth salivary cortisol measurement (Table 2).

Minute	Activity
0-1 (1)	• welcome
1-2 (1)	• 1 st salivary cortisol measurement (minute 1)
2-4 (2)	• adjusting heart rate belt and watch
4-5 (1)	• instruction
5-9 (4)	• get adjusted to dog (stroke dog, etc.)
9-10 (1)	• 2 nd salivary cortisol measurement (minute 9)
10-11 (1)	• Repeated Reading instruction
11-13 (2)	• Repeated Reading run 1
13-14 (1)	• write down words
14-17 (3)	• practice words
17-19 (2)	• Repeated Reading run 2
19-20 (1)	• 3 rd salivary cortisol measurement (minute 19)
20-22 (2)	• ELFE instructions 1
22-25 (3)	• ELFE sentence understanding
25-27 (2)	• ELFE instructions 2
27-34 (7)	• ELFE text understanding
34-35 (1)	• 4 th salivary cortisol measurement (minute 34)
35-42 (7)	• relaxation with dog/by drawing sth.
42-43 (1)	• 5 th salivary cortisol measurement (minute 42)
43-50 (7)	• relaxation with dog/by drawing sth.
50-51 (1)	• 6 th salivary cortisol measurement (minute 50)

Table 2: Test Procedure

2.4. Instruments

2.4.1. Assessment of Reading performance

2.4.1.1. ELFE (Ein Leseverständnistest für Erst- bis Sechstklässler)

ELFE (Ein Leseverständnistest für Erst- bis Sechstklässler) is a standardised reading test containing three subtests: word understanding, sentence understanding and text understanding. In this study only two subtests were conducted: sentence understanding and text understanding. For the sentence understanding the children had to choose the right word out of four options that fits in the sentence. In the text understanding they had to read a short text and mark one or more sentences that fit to the text with regard to contents. For each of the subtests the number of correctly solved tasks was counted. There are two ELFE forms: form A and form B. In the first test session the children conducted form A and in the second test session they conducted form B, irrespective of the order of the settings they were assigned to (Table 3).

2.4.1.2. Repeated Reading (RR)

Repeated Reading (RR) was used as a stressor and additional non-standardised reading test. Two text passages were selected from an age-appropriate children's book and slightly modified to achieve the same number of words for both texts. The children had to read this short text out loud in a given time of 2 minutes and were instructed to make as few errors as possible and read as fast as possible. After a short training phase, in which the children could practice the words they didn't read correctly, they had to read the same text again. For the analyses the number of words the children achieved to read in these 2 minutes time were divided by the time the children needed (words/sec), since some children finished the text before time. All children were given text 1 in the first test session and text 2 in the second test session, irrespective of the order of the settings they were assigned to (Table 3).

36 children (17 ♂, 19 ♀) of 3 rd grade aged 9 to 10, randomly assigned to		Test Session 1	Test Session 2
	Group 1 6 ♂, 10 ♀	without dog ELFE form A RR Text 1	with dog ELFE form B RR Text 2
	Group 2 11 ♂, 9 ♀	with dog ELFE form A RR Text 1	without dog ELFE form B RR Text 2

Table 3: Study Design

2.4.2. Behaviour observation

All test sessions were video-taped and the duration of certain behavioural variables was coded via Solomon Coder beta 15.02.08 from the instructions of RR on to the end of the test session divided into ten phases. These phases were instructions RR, RR run 1, training phase (including writing down and practicing the words the child did not read correctly), RR run 2, ELFE instructions 1, ELFE sentence understanding, ELFE instructions 2, ELFE text understanding, relaxation 1 and relaxation 2 (Table 6 Appendix). Behavioural observations were not made during the salivary cortisol measurements. The observed behavioural variables were talk, nervous movements and self-manipulation for both settings. For the setting without dog the duration of drawing was assessed too. For the setting with dog the distance of the child to the dog (small/great) and the type of interaction (friendly/no/avoiding) of the child towards the dog as well as of the dog towards the child were quantified as durations too. Small distance was defined as the distance within which the child was able to touch the dog

from its position if stretching out his/her arm or leg, great distance as not being able to touch the dog from its position if stretching out his/her arm or leg. Body contact was coded whenever the child and the dog sat or lied in direct body contact to each other. An interaction of the child or dog was counted as friendly for example when it touched (like stroking) or approached the other, as no interaction when it did not react to an interaction of the other, and as avoiding when it held off the other (like leaning away) (Table 5 Appendix). For inter-observer reliability an uninvolved master student of the human-dog relationships research group of the University of Vienna, who was trained in video coding with the program Solomon Coder, coded all ten phases (of the videos of ten different children) in the dog setting as well as in the no dog setting. Hence, each of the ten phases was coded twice for inter-observer reliability – once in the setting without dog and once in the setting with dog. Durations of the behavioural variables coded by the two different observers were correlated via Spearman's rank correlation coefficient and correlated well with correlations coefficients of at least 0.903 and p values of $< 0,001$ for all behavioural variables.

2.4.3. Assessment of cortisol level

Six saliva samples were taken over the whole test session from the children. The first one right at the beginning, the second between stroking the dog or drawing and RR, the third one between RR and ELFE, the fourth one between ELFE and the first relaxation phase, the fifth between the first and the second relaxation phase, and the sixth at the end of the test session after the second relaxation phase. For each saliva sample the children took a mouthful of grape juice to stimulate salivation and then held a cotton swab in their mouth for about one minute. The cotton swab was put back into the salivette and cooled in a cool box before being put into a freezer at the laboratory, where at the end of data taking all were analysed via Enzyme Immunoassay.

2.4.4. Assessment of Heart Rate (HR) and Heart Rate Variability (HRV)

The heart rate (HR) (ms) was measured with the heart rate belt plus watch “polar pro trainer 5” ®, which the children wore over the whole test session. The automatic correction of the associated software was used to eliminate outliers. Heart Rate Variability was assessed via the programm Kubis HRV 2.2 from the corrected heart rate data.

2.5. Statistical Analysis

Comparisons were made between children, who had a dog present, and children, who had not, for the first and second test session separately. Additionally, potential differences between first and second test session irrespective of the setting were analysed. For ELFE both subtests were analysed separately, while for RR the two runs were merged to a mean for the analysis. Data were analysed with PAWS Statistics 18. All data were tested for normal distribution using the Shapiro-Wilk-Test prior to the further statistical analyses. Statistical significance was determined based on an alpha level of 0.05. Effect size was estimated by Cohen's *d* (Cohen, 1988) using the effect size calculator on the homepage <http://www.uccs.edu/~lbecker/>. The customary definitions of effect size are small (0.2), medium (0.5) and large (0.8). All correlations were calculated via Spearman's rank correlation coefficient (Spearman's *r*).

3. Results

3.1. Test Session 1 vs. 2

Comparing the two test sessions independent of the setting (whether a dog was present or not), there was no difference found for the physiological variables (cortisol AUC_i, cortisol trend, mean HR and HRV) and the behavioural variables (total durations of talk, nervous movements and self-manipulation). Variables of the two reading tests, though, did differ between the first and the second test session independent of the setting. In ELFE the children performed better in the second test session than in the first test session, whereas in RR they read more words per second in the first test session compared to the second.

(ELFE sentence understanding test session 2-1: *N* = 36; *Z* = 0,072; Wilcoxon: *p* = 0,001; Cohen's *d* = 0.447; effect-size *r* = 0.218; ELFE text understanding test session 2-1: *N* = 36; *Z* = 0,404; T-Test for dependent samples: *T* = -3,335; *p* = 0,002; Cohen's *d* = 0,301; effect-size *r* = 0,149; RR difference test session 2-1: *N* = 36; *Z* = 0,151; T-Test for dependent samples: *T* = 2,765; *p* = 0,009; Cohen's *d* = 0,140; effect-size *r* = 0,070)

3.2. ELFE (Ein Leseverständnistest für Erst- bis Sechstklässler)

In this study only two subtests were conducted: sentence understanding and text understanding. For the sentence understanding the children had to choose the right word out of four options that fits in the sentence. In the text understanding they had to read a short text

and mark one or more sentences that fit to the text with regard to contents. For each of the subtests the number of correctly solved tasks was counted.

There were no differences found in the number of correctly solved tasks between the group that had a dog present and the group that did not, neither in the first nor in the second test session and neither in the sentence nor text understanding subtest. It did not make a difference on how many tasks the children solved correctly with dog compared to without dog, whether they had a lower cortisol AUCi with a dog present compared to the test session without dog or a higher cortisol AUCi with a dog present compared to the test session without dog, alike; neither in the sentence nor text understanding subtest and neither in test session 1 nor 2.

3.3. Repeated Reading (RR)

Repeated Reading (RR) was used as a stressor and additional non-standardised reading test. The children had to read a short text out loud in a given time of 2 minutes and were instructed to make as few errors as possible and read as fast as possible. After a short training phase, in which the children could practice the words they didn't read correctly, they had to read the same text again. For the analyses the number of words the children achieved to read in these 2 minutes time were divided by the time the children needed (words/sec), since some children finished the text before time. All children were given the same text in the first test session and another text in the second test session.

There were no differences between the children, who had a dog present, and those, who had not, in words/sec (mean of the two runs); neither in test session 1 nor 2. It did not make a difference on how many words/sec (mean of the two runs) the children read in RR with dog compared to without dog, whether they had a lower cortisol AUCi with a dog present compared to the test session without dog or a higher cortisol AUCi, alike; neither in test session 1 nor 2.

However, the children with a dog present, showed a greater improvement in the first (Figure 2), but not in the second test session. For the children, who had a lower cortisol AUCi with a dog present compared to the test session without dog, their improvement from run 1 to run 2 did not differ whether they had a dog present or not; neither in test session 1 nor 2. The children, who had a higher cortisol AUCi with a dog present compared to the test session

without dog, tended to show a greater improvement in the presence of a dog compared to without dog in the first test session (Figure 3), but not in the second.

(difference run 2-1 test session 1: without dog: $N = 16$; $Z = 0,009$; with dog: $N = 20$; $Z = 0,103$; Mann-Whitney-U-Test: $p = 0,048$; Cohen's $d = 0,707$; effect-size $r = 0,333$; the children, who had a higher AUCi with a dog present than with no dog present: difference run 2-1 test session 1: without dog: $N = 8$; $Z = 0,370$; with dog: $N = 8$; $Z = 0,048$; Mann-Whitney-U-Test: $p = 0,074$; Cohen's $d = 0,984$; effect-size $r = 0,442$)

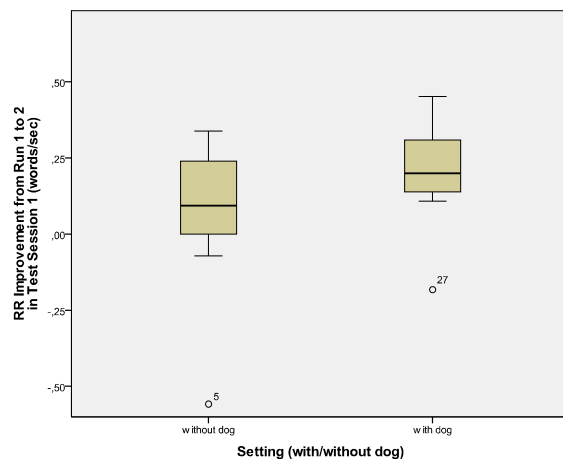


Figure 2: RR improvement from run 1 to 2 in test session 1 – comparison of the two settings

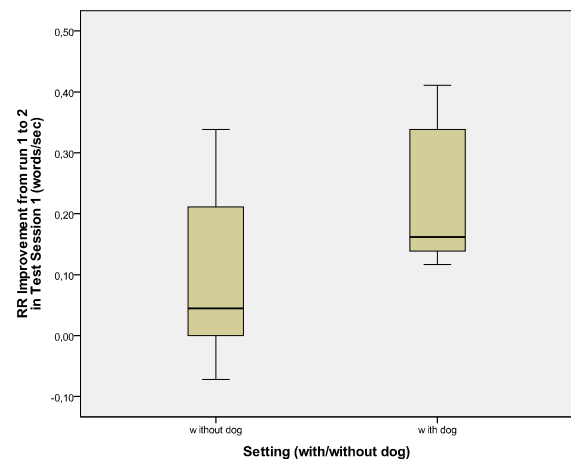


Figure 3: RR improvement from run 1 to 2 in test session 1 – comparison of the two settings for the children, who had a higher cortisol AUCi with a dog present compared to without dog

3.4. Behaviour

The behavioural variables talk, nervous movements and self-manipulation were coded from the begin of the instruction for Repeated Reading until the end of the test session and were tested for a difference between the children, who had a dog present during the test session, and those who had not, for both test session 1 and test session 2 separately.

3.4.1. Test Session 1

The children, who had a dog present, showed less nervous movements and also tended to talk less than the children, who had no dog present (Figure 4, Figure 5). They did, however, not show significantly less self-manipulation.

(test session 1: talk: without dog: $N = 16$; $Z = 0,673$; with dog: $N = 20$; $Z = 0,073$; Mann-Whitney-U-Test: $p = 0,075$; Cohen's $d = 0,672$; effect-size $r = 0,319$; nervous movements:

without dog: N = 16; Z = 0,583; with dog: N = 20; Z = 0,016; Mann-Whitney-U-Test: p = 0,020; Cohen's d = 0,790; effect-size r = 0,367)

3.4.2. Test Session 2

The children, who had a dog present, showed more self-manipulation than the children, who had no dog present (Figure 6). For the two variables talk and nervous movements there was, however, no difference between the settings (whether a dog was present or not).

(test session 2: self-manipulation: without dog: N = 20; Z = 0,016; with dog: N = 16; Z = 0,390; Mann-Whitney-U-Test: p = 0,012; Cohen's d = 0,966; effect-size r = 0,435)

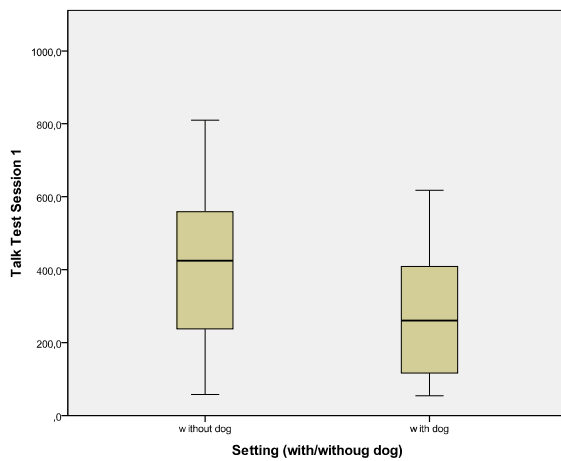


Figure 4: Duration of talk in test session 1 – comparison of the two settings

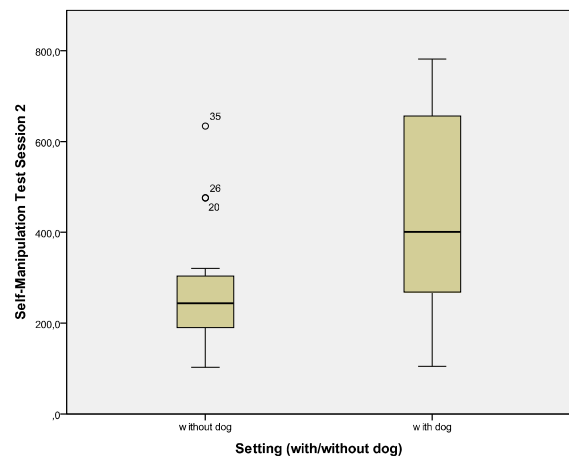


Figure 6: Duration of self-manipulation in test session 2 – comparison of the two settings

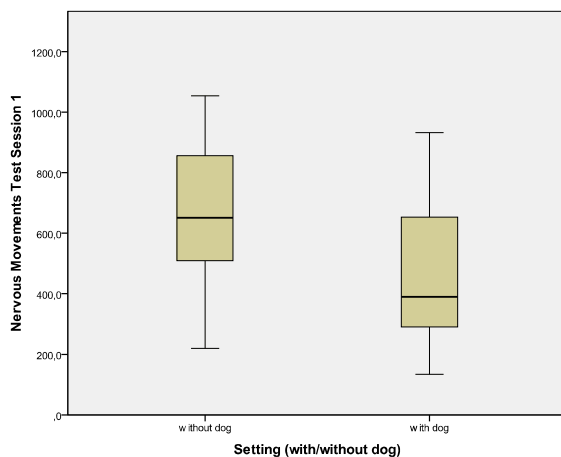


Figure 5: Duration of nervous movements in test session 1 – comparison of the two settings

3.5. Cortisol

3.5.1. Area Under the Curve increase (AUCi)

In the second test session the children had a lower cortisol AUCi without a dog present than with dog (Figure 7). There were, however, no differences in the AUCi between the children, who had a dog present, and those, who had not, in the first test session. Also when compared to themselves the children did not show different AUCi in the two settings (with/without dog).

The four dogs that were used for this study did not generate different AUCi.

(AUCi (MW pg/ μ l) test session 2: without dog: N = 20; Z = 0,029; with dog: N = 16; Z = 0,146; Mann-Whitney-U-Test: p = 0,028; Cohen's d = 0,693; effect-size r = 0,327)

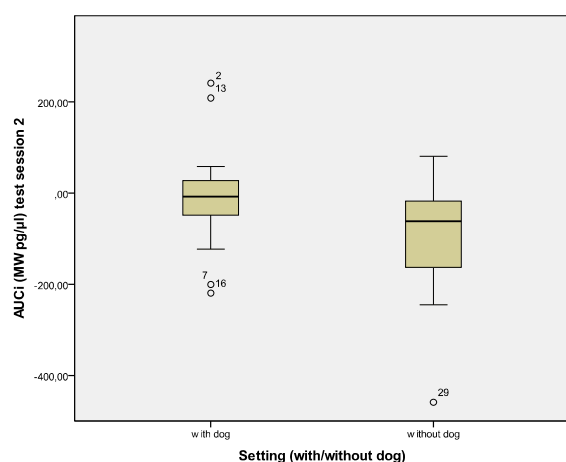


Figure 7: Cortisol AUCi in test session 2 – comparison of the two settings

3.5.2. Cortisol Trend (Δ Cortisol)

In addition to the cortisol AUCi the cortisol trend (Δ cortisol) over the test session was calculated, which is the difference between the mean of the 5th and 6th saliva sample minus the mean of the 1st and 2nd saliva sample. Neither in the first nor in the second test session a difference was found between the group of children that had a dog present and the group that had not.

3.6. Heart Rate (HR) and Heart Rate Variability (HRV)

Mean HR (interbeat intervals in ms) and HRV were assessed as a way to determine the children's arousal (either stress or excitement) for both of the two test sessions (with and without dog) separately. Since the HR was corrected with the automatic correction of the program Polar Pro Trainer 5, the more exact variable RMSSD was used to describe HRV. In addition the less exact but more robust variable pNN50 was assessed to see if these two variables point into the same direction. Both mean HR and HRV were calculated over the

entire test session. Only the end of the measurements was cut off and adjusted to the shortest one to achieve the same duration of measurement for all children, which is essential for HRV but was also used for HR.

3.6.1. mean HR

There was no difference in the mean HR between the children, who had a dog around during the test session, and those, who had not; neither for the first test session nor for the second. There was, however, a trend for a difference found in the difference of the mean HR of test session 2-1 for the children, who in the first test session had a dog present, and those, who had not. The children, who in the first test session had a dog present, showed a higher difference between test session 1 and 2 or the setting with dog and without dog than the children, who had the first test session without dog. When looking at the means, both groups had a higher HR with dog than without dog: The children, who had the first test session without dog, showed a higher HR in test session 2 (with dog) than in test session 1 (without dog). The children, who had the first test session with dog, showed a higher HR in test session 1 (with dog) than in test session 2 (without dog).

(Mean HR (ms) difference test session 2-1: the children, who had no dog present in the first test session: $N = 16$; $Z = 0,073$; the children, who had a dog present in the first test session: $N = 18$; $Z = 0,520$; Mann-Whitney-U-Test: $p = 0,078$; Cohen's $d = 0,508$; effect size $r = 0,246$)

3.6.2. HRV: RMSSD (ms) and pNN50 (%)

There was no difference in the HRV between the children, who had a dog present during the test session, and those, who had not; neither for the first test session, nor for the second.

3.7. Correlations

3.7.1. Correlation cortisol trend (decrease/increase) – ELFE sentence and text understanding

There is no correlation between the cortisol trend (decrease/increase) and ELFE sentence or text understanding in test session 1. There is, however, a significant correlation between the cortisol trend and ELFE sentence understanding as well as text understanding in test session 2. The children, who had a cortisol decrease, solved more tasks correctly than the children, who had a cortisol increase, in both subtests (Figure 8, Figure 9).

(test session 2: cortisol trend (decrease/increase): N = 34; Spearman-Rho: ELFE sentence understanding (correctly solved tasks): N = 36; correlations coefficient = 0,340; p = 0,049; ELFE text understanding: N = 36; correlations coefficient = 0,412; p = 0,015)

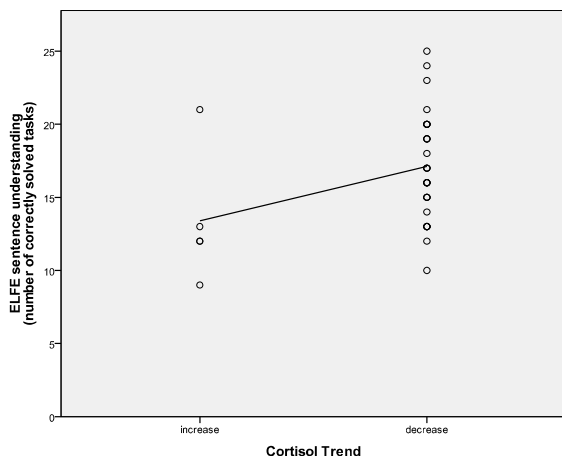


Figure 8: Correlation between ELFE sentence understanding and cortisol trend in test session 2

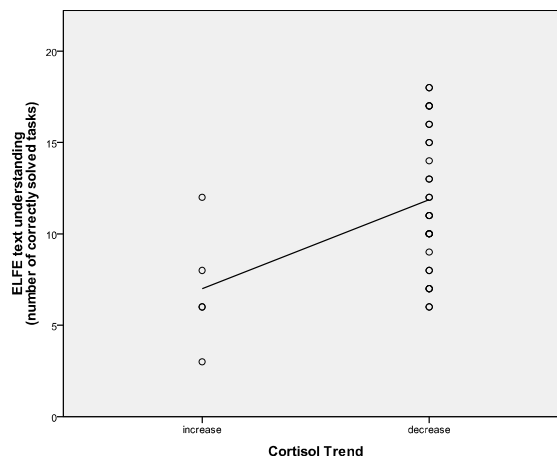


Figure 9: Correlation between ELFE text understanding and cortisol trend in test session 2

3.7.2. Correlation cortisol AUCi – behaviour

There are no correlations between the cortisol AUCi and the duration of talk, nervous movements and draw in test session 1 for the children, who had no dog present. However, the children tended to show more self-manipulation the lower the cortisol AUCi in the first test session without dog (Figure 10). For the children, who had a dog present, there were no correlations between cortisol AUCi and the duration of talk, nervous movements, self-manipulation, great distance, small distance, body contact and the interactions of the child or the dog (friendly, no, avoiding) in the first test session.

(test session 1: the children, who had no dog present: AUCi (MW pg/ μ l): N = 16; Spearman-Rho: Self-manipulation (sec): N = 16; correlations coefficient = -0,465; p = 0,070)

There are no correlations between the cortisol AUCi and the duration of talk, nervous movements and draw in test session 2 for the children, who had no dog present. However, the children tended to show less self-manipulation the higher the cortisol AUCi in the second test session without dog (Figure 11). The children, who had a dog present, showed more self-manipulation the higher the cortisol AUCi (Figure 12). In addition the more avoiding interaction the dog showed the lower the cortisol AUCi in the second test session (Figure 13). (test session 2: the children, who had no dog present: AUCi (MW pg/ μ l): N = 20; Spearman-Rho: Self-manipulation (sec): N = 20; correlations coefficient = -0,490; p = 0,028; the

children, who had a dog present: AUCi (MW pg/ μ l): N = 16; Spearman-Rho: Self-manipulation (sec): N = 16; correlations coefficient = 0,582; p = 0,018; Avoiding Interaction Dog (sec): N = 16; correlations coefficient = - 0,545; p = 0,029)

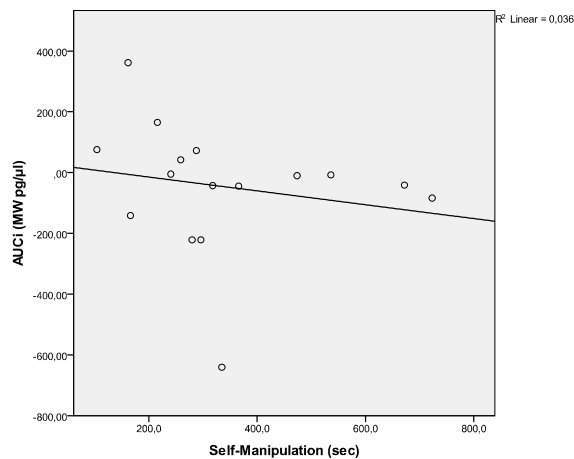


Figure 10: Correlation between cortisol AUCi and duration of self-manipulation in test session 1 without dog

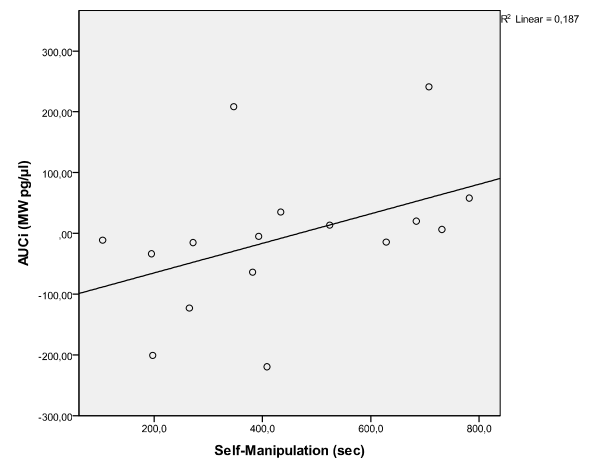


Figure 12: Correlation between cortisol AUCi and duration of self-manipulation in test session 2 with dog

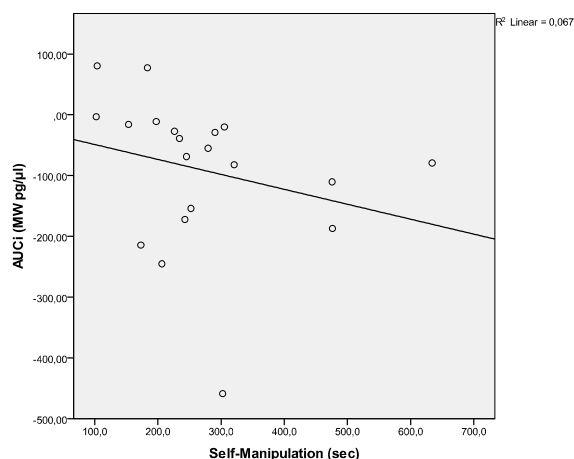


Figure 11: Correlation between cortisol AUCi and duration of self-manipulation in test session 2 without dog

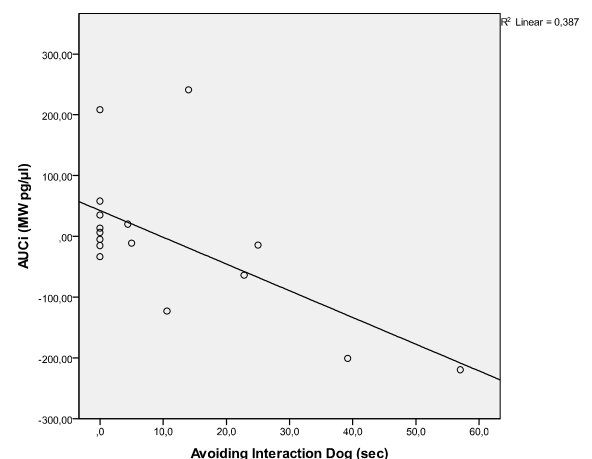


Figure 13: Correlation between cortisol AUCi and duration of avoiding interaction dog in test session 2 with dog

3.7.3. Correlation ELFE – behaviour

ELFE sentence or text understanding was correlated with the behavioural variables separately for the first and the second test session, as well as for the group of children, who had a dog present, and the group that had no dog present.

3.7.3.1. ELFE sentence understanding – behaviour

The children, who had a dog present, tended to solve more tasks correctly the more they talked (Figure 14) in the second test session. There were no other correlations between ELFE sentence understanding and the relevant behavioural variables for both groups (with/without dog) in neither of the two test sessions.

(test session 2: the children, who had a dog present: Spearman-Rho: ELFE sentence understanding (correctly solved tasks): N = 16; Talk (sec): N = 16; correlations coefficient = 0,458; p = 0,075)

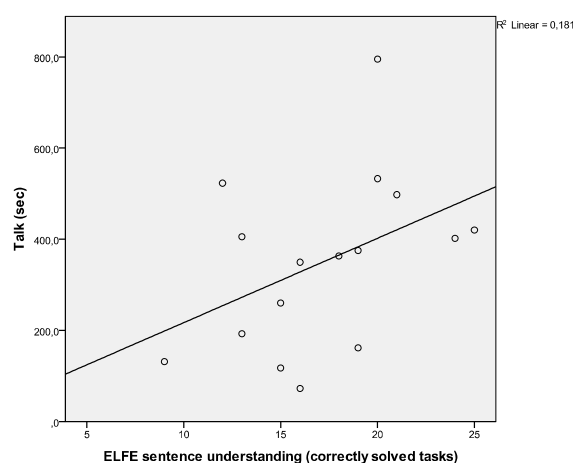


Figure 14: Correlation between ELFE sentence understanding and duration of talk in test session 2 with dog

3.7.3.2. ELFE text understanding – behaviour

The children, who had a dog present, tended to solve more tasks correctly the less body contact they had with the dog in test session 1. There were no other correlations between ELFE sentence understanding and the relevant behavioural variables for both groups (with/without dog) in neither of the two test sessions.

(test session 1: the children, who had a dog present: Spearman-Rho: ELFE text understanding (correctly solved tasks): N = 20; Body Contact (sec): N = 20; correlations coefficient = - 0,406; p = 0,075)

4. Discussion

<i>Effect of the dog</i>	Test Session 1	Test Session 2
ELFE	no effect	no effect
RR	no effect	no effect
RR improvement	stronger improvement	no effect
behaviour	calming effect (less nervous movements, less talkative)	arousing effect (more self-manipulation)
cortisol (AUCi)	no effect	arousing effect
cortisol trend (Δ cortisol)	no effect	no effect
HR	no effect	no effect
HR difference between test sessions	arousing effect (higher for the children, who had the dog in the first test session)	no effect (but both groups not sign. more aroused with dog than without)
HRV	no effect	no effect
<i>Effect of the dog (AUCi lower with dog)</i>	Test Session 1	Test Session 2
ELFE	no effect	no effect
RR	no effect	no effect
RR improvement	no effect	no effect
<i>Effect of the dog (AUCi higher with dog)</i>	Test Session 1	Test Session 2
ELFE	no effect	no effect
RR	no effect	no effect
RR improvement	stronger improvement	no effect
<i>Effect of the Test Session (independent of the setting)</i>		
ELFE	better in test session 2	
RR	better in test session 1	
behaviour	no effect	
cortisol (AUCi)	no effect	
cortisol trend (Δ cortisol)	no effect	
HR	no effect	
HRV	no effect	
<i>Correlations</i>	Test Session 1	Test Session 2
cortisol trend – ELFE	no correlation	more calm – better reading performance
cortisol (AUCi) – behaviour	<i>without dog:</i> more aroused – less self-manipulation <i>with dog:</i> more aroused – more self-manipulation more aroused – less avoiding interactions by the dog	<i>without dog:</i> more aroused – less self-manipulation <i>with dog:</i> no correlation
ELFE – behaviour	better reading performance – less body contact	better reading performance – more talkative

Table 4: Summary of the main results

These results suggest that at least in one of the two reading tests, i.e. RR, the presence of a dog had a positive effect on the improvement of reading performance measured in words/sec in a new situation, though not in an already known situation, since the children, who had a dog present, showed a stronger improvement compared to the children without dog in the first test session, but not in the second. Furthermore, the same accounts for the children, who had a higher cortisol AUCi when a dog was present: they too tended to show a greater improvement in the presence of a dog compared to without dog in the first test session, but not in the second. This might also depict an activation of the appetitive system, i.e. an arousing effect of the dog coupled with increased motivation (s. 1.3.6., 1.3.7. and 1.3.8.).

In line with this, it seems that the presence of a dog caused even more arousal in the children than the confrontation with an unknown, new situation, since the children, who in the first test session had a dog present, showed a higher difference in mean HR between the two test sessions (or the two settings respectively) than the children, who in the first test session had no dog present. If looking at the means, both groups had a higher HR with a dog present compared to without. This means that the presence of a dog reinforced the children's already existing arousal in the first test session that is due to an unknown, new situation, which might be the cause for the especially high difference between the two test sessions in this group compared to the group that only had the dog in the second test session. This kind of excitement also occurred in a study by Kaminski et al. (2002), where the HR of hospitalised children increased prior to and following an animal-assisted therapy, and also speaks for the activation of the appetitive system.

Also in respect to the behavioural variables it seems that the presence of a dog had a positive, calming effect in the first test session (the children showed less nervous movements and also tended to talk less in the presence of a dog), when again the situation was unknown. In the second test session, however, the presence of a dog had an arousing effect, probably because of the activation of the appetitive system once more, since the children showed more self-manipulation in the presence of a dog than without dog. Observations by Hansen et al. (1999) showed less behavioural distress of 2-6 year old children undergoing a standard physical examination in the presence of a friendly dog compared to another group without dog.

Cortisol AUCi also indicates an arousing effect of the dog, thus the activation of the appetitive system, but only in the second test session. This aligns with the behavioural results:

In the first test session there was no difference in cortisol AUCi and a calming effect of the dog concerning the behavioural variables, whereas in the second test session an arousing effect was detectable in both. Previous studies mostly have found a calming effect though (Beetz et al. 2012). Odendaal and Meintjes (2003) for example found a significant decrease in the cortisol level of dog owners after positive interactions with their own or also an unfamiliar dog, but not when quietly reading a book. Also children with insecure attachment representations showed lower cortisol levels during and after a social stress test when supported by a friendly dog than by a toy dog or a friendly human (Beetz et al. 2011). In her bachelor's thesis with a very similar set up Jäger (2014) found no significant difference in cortisol levels for the children, who had a dog present, compared to those, who had not, either. As a consequence of her diverse results for cortisol levels she argued that increased cortisol levels might be either due to insecurity or arousal in terms of pleasant anticipation for the dog.

Furthermore, the fact that the children, whose cortisol AUCi decreased over the test session, showed a better reading performance in both subtests of ELFE than the children, whose cortisol AUCi increased over time, in test session 2 indicates that reading performance is better in the absence of stress (s. 1.2.).

The trend that children, who had a dog present, showed a better reading performance the more they talked in ELFE sentence understanding in the second test session could result from a more relaxed state of the children or mean that children, who are quite talkative, probably show a better reading performance.

Physiological and behavioural variables indicated that there was no difference between test session 1 and 2 (independent of the presence of a dog). Performance in RR and ELFE did differ though. Concerning ELFE, where the children performed better in the second test session compared to the first, they might either have gotten used to this kind of test procedure or the two ELFE forms could be too similar. In respect to RR, the children read more words per second in the first test session compared to the second, although the two texts were derived from the same children's book. Therefore it seems unlikely that the children might have perceived text 2 as more difficult than text 1. The reason behind this effect thus remains unclear.

In spite of the indication for increased motivation due to the activation of the appetitive system by the presence of a dog, the dogs had no effect on the children's performance in ELFE. Heyer & Beetz (2014), who used the same reading test to assess reading performance over the course of a school term on a group with reading promotion with dog and another group without dog, found significantly higher values and improvement for the children, who had the reading promotion with dog, at the end of the term as well as eight weeks later after the summer holidays.

Absolute values for RR were not affected by the presence of a dog either. In the first test session this seems to be due to a difference in starting performance: the children, who had a dog present, started out reading less words/sec in the first run than the children, who had no dog present. In the second run the performance of the two groups turned around and the children, who had a dog present, read more words/sec than the children, who had no dog present. Thus it is likely that an effect has been eliminated by calculating the mean of the two runs. It is not clear whether the difference in starting performance was due to the setting or some other factor. Wohlfarth et al. (2014) did not find a significant influence of the presence of a therapy dog compared to the presence of a friendly female student on reading time either, although an improvement in correct word recognition, correct recognition of punctuation marks and correct line breaks was evident.

Whereas the presence of a dog had no impact on mean HR or HRV, indicating no difference in the children's state of arousal between the settings, most studies on the effect of dogs on HR or HRV depict positive effects though, which occur both in the absence and presence of a stressor and in the presence of both familiar and unfamiliar friendly animals (Beetz et al. 2012). In a study by Nagengast et al. (1997) 3-6 year-old children showed a lower HR during a standardised physical examination when accompanied by a friendly dog than alone. Some studies could not find any effect of the presence of a dog on HR either. For example, during a stressful speech task male students did not show a lower HR when a friendly, unfamiliar dog was present compared to others, who had no dog present (Straatman et al. 1997). Also concerning HRV, positive effects of dogs are documented. Motooka et al. (2006), for example, found that in healthy elderly adults HRV was higher when walking with an unfamiliar dog for 30 min than without.

In both test sessions the children without dog showed less self-manipulation the higher the cortisol AUCi. On the contrary the children, who had a dog present, showed more self-manipulation the higher the cortisol AUCi. These contradictory findings allow no clear interpretation. The negative correlation of avoiding interactions by the dog and cortisol AUCi in the child in the second test session probably occurred because the higher the cortisol AUCi the less the children focused on the dog, resulting in a less stressful situation for the dog. No other correlations were found between the behavioural variables and the AUCi of cortisol.

Furthermore, the results of this study indicate that direct body contact to a dog impairs reading performance, although physical contact with the dog was found to reduce stress (cortisol level) in other studies (e.g. Beetz et al. 2011) and was proposed as a main factor for the dampening of physiological stress parameters in connection with activation of the oxytocin system by Beetz et al. (2012). However, Wohlfarth et al. (2014) did not find significant correlations of four different reading parameters including reading time with total length of eye or body contact with the dog either. They even mentioned a medium negative but not significant correlation between the reading time and the duration of petting the dog. Thus the more the children petted the dog the longer the reading time. Since the other three variables for reading performance showed no significant correlations with visual or body contact to the therapy dog, they concluded that the presence of a dog does not distract children when performing a cognitive task but pointed out that intensive interaction with a dog might still reduce reading performance. Our results though seem to document a distracting effect even in the nonappearance of intensive interactions given that the correlation only existed for direct body contact, whereas active interactions like petting did not correlate with reading performance. Demello (1999) found that stroking a pet significantly decreased HR indeed after a cognitive stressor but decreased even more when the animal was present but no tactile contact allowed. Since the results of this study are only trends and occur solely in one of the two test sessions, the informative value is questionable. There were no other correlations between the two subtests of ELFE and the relevant behavioural variables for both groups (with/without dog) in neither of the two test sessions.

Children with a negative or fearful attitude towards dogs might not profit from interactions with a dog at all. Furthermore, familiarity with dogs in general might have an impact on the effect of a dog on children. “Although it may not be necessary to own a dog or to already have a relationship to a dog to profit from a dog’s presence in the classroom” (Hediger &

Turner 2014), children with no experience with dogs might be cautious or sceptical and may therefore benefit less of the presence of a dog too. Having a personal relationship with the dog, like with a permanent school dog, might still have the best effects. Odendaal (2000) for example found that people interacting with their own dog showed a higher increase in oxytocin than people, who interacted with an unfamiliar dog.

Limitations of this study are the absence of an additional person in the setting without dog as substitute for the dog handler. Although the dog handlers kept out of the situation, their presence is a confounding factor, which was not controlled for by another person in the setting without dog.

The strengths of this study are the non clinical sample of normally developing children with various backgrounds including not only origin but also dog ownership, which allows for a transfer of the results to a majority of school-aged children, the control for daytime effects, and the combination of different techniques of measurement.

In future studies particular attention should be paid to whether familiarity with dogs in general and with the particular dog plays a role for the usability of dogs as a promoter of performance or its prerequisites for children. Furthermore the impact of different dog breeds should be addressed. Concerning the cortisol levels it is not clear whether high levels are due to arousal in terms of pleasant anticipation or insecurity/precaution concerning the dog. Future studies also should investigate other age groups too. Probably older students are resistant to this kind of performance promotion. It would also be interesting to investigate to what extent the different hypotheses lie behind the positive effects of animal assisted interventions. Therefore a lot of different variables must be obtained including also self-reported mood, motivation and satisfaction, displayed affect and blood pressure. Not least the effect of dogs on the promotion in other learning fields like mathematics is desirable.

5. Conclusion

The overall impression is that the dogs activated the appetitive system in the children and thus caused an arousal or excitement that is coupled to increased motivation. This specific arousal was detectable in a higher difference in mean HR between the two test sessions and more self-manipulation and a higher cortisol AUCi in the second test session for the children, who had a dog present. Reading performance, however, was not directly enhanced in the presence of a dog in this short-term experiment. Within the first test session the children improved their

performance in RR though, probably indicating the potential of short-term increase of reading performance. Thus, for an actual improvement of reading performance a longer intervention with a dog might be needed. Immediate effects don't seem to occur.

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Appendix

Subject	Class	Behaviour	Type	Code	Description
Child	Talk	Talk	State (duration)	t	Child talks with investigator, both persons coded when talking. Child talks to dog handler. 3 sec break included. (Dog handler talks to child or investigator is coded as internal interruption, not as talk.) Not coded for phases RR 1 and RR 2, no instructions (but questions and answers to these).
Child	Nervous Movements	Nervous Movements	State (duration)	n	Child coughs or clears its throat, child jiggles with his/her foot/feet and/or leg(s), any part of the child's body moves unreasonably fast or erratic, child plays with/ fumbles/ strokes objects (like a pen, sheet or board), child shifts position at least 2 times in a row (within 3 sec), but coded at the 1 st time when movements seem redundant or unnecessary (like fumbling with paper, seesawing, moving his/her foot/hand/finger, returning to initial position after shifting). Child follows the words with its hand while reading is not coded as nervous movement. Coded as new event when there was a pause of 3 sec in between and no other nervous movements occurred in these 3 sec.
Child	Self- manipulation	Self- manipulation	State (duration)	s	For all self-manipulation accounts: Coded as new event when there was a pause of 3 sec in between and no other self-directed behaviour occurred in these 3 sec. Only coded when movement is visible, not when movement seizes (except for moments in between that are shorter than 3 sec). Only touching per se is coded, not movement before or after self-manipulation.
					Scratch: Child scratches any part of his/her body.
					Fumble: Child chews on fingernails, has his/her fingers in/at his/her mouth, picks his/her nose.
					Chew: Child chews, licks or bites on lips.
					Fiddle: Child fiddles on his/her clothes either by picking, grabbing, stroking or smoothing them.
					Self-comfort: Child holds him-/herself (encompasses a part of his/her

					body with his/her hand) but not if this is a natural, easy and casual appearing position (like sitting with hand on thigh or rest chin on fist/hand), strokes him-/herself (moves hand or finger(s) in a sliding movement over a part of his/her body), holds his/her own hand or plays with his/her fingers/hands.
Child	Distance	Great	State (duration)	dg	Dog is in a distance greater than the child's arm's and leg's length. 3 sec break included.
		Small	State (duration)	ds	Dog is in a distance within the child's arm's and leg's length. 3 sec break included.
Child	Body Contact	Body Contact	State (duration)	b	Child sits or lies in direct body contact to dog, their bodies touch. 3 sec break included
Child	Interaction with dog	Friendly interaction	State (duration)	if	Child touches dog (strokes, scratches, pets, hugs, cuddles, kisses dog, rubs dog with face, or rests his/ her hand on dog), addresses dog verbally (calls dog by its name, speaks to dog), makes a gesture towards dog like tapping on his/ her thigh, waving dog over to him/ or nodding his/ her head towards dog in order to make him come closer, approaches dog, plays with dog (for example child gives the dog a treat, hides a treat, gives a command – also gesture – to the dog), or watches dog. 3 sec break included.
		No interaction	State (duration)	in	Child does not interact with dog and shows no or only subtle and/ or short reactions (startled jumping, short glance at dog but immediately after turning away again, lets dog rest on him/ her), even after contact seeking by dog. 3 sec break included.
		Avoiding interaction	State (duration)	ia	Child shoves dog away, prevents dog from coming closer for example by stretching out an arm or other parts of body, averts head, turns or leans away, pulls back his/ her hand like afraid, moves away, “tells” dog to stay away, makes protesting noise. 3 sec break included.
Child	Self-motivated activity	Draw	State (duration)	d	Child looks at the paper or coloured pencils as if thinking about what to paint, takes or holds a coloured pencil in hand, sorts them, touches them as if not sure which to chose, draws on the paper. 3 sec break included.

Dog	Interaction with child	Friendly interaction	State (duration)	if	Dog touches child or indicates/ intends to touch child without actually touching it (nudges child with its muzzle, licks child's hand, face or other parts of his/ her body, reaches out with forepaw towards person, comes close, leans or rubs body or part of body against child – but not if asleep, leaps/ jumps up on child, fixates child and wags its tail, lies on back or side and offers belly), searches or gets a treat, obeys to a command or just seems to be attentive towards the child, even if he doesn't obey. 3 sec break included.
		No interaction	State (duration)	in	Dog does not interact with child and shows no or only subtle and/or short reactions (startled jumping, short glance at child but immediately after turning away again, move or twitch ear, sleep while in body contact with child or being touched by child), even after contact seeking by child. 3 sec break included.
		Avoiding interaction	State (duration)	ia	Dog growls (utters a low, guttural, menacing sound, with or without showing the teeth), yawns during interaction, averts its head, turns body away revealing its back or side, avoids touch/stroke by leaning or ducking away, moves away. 3 sec break included.
Child, Dog	Marker	Test phase Begin	Instant Event	tb	begin of test phase
		Test phase End	Instant Event	te	end of test phase

Table 5: Coding Configuration.

Coding Phases	Test phase begin	Test phase end
1. Instructions RR	investigator begins with instructions to RR	investigator quits instructions (incl. test related questions and answers to these as well as potential waiting times)
2. RR 1	investigator presses “start” on the command “Los!”	investigator terminates the test on the command “Stop!” or after the last word of the text in case the child finishes the text before time
3. Practice phase	investigator begins to write down the words that are to be practiced (begin when pen first touches paper)	investigator terminates practicing by taking back the sheet (moment of transfer from the child)

4. RR 2	investigator presses “start” on the command “Los!”	investigator terminates the test on the command “Stop!” or after the last word of the text in case the child finishes the text before time
5. Instructions ELFE 1	investigator begins with instructions (incl. sentence understanding and exercise examples as well as test related questions and answers to these)	investigator quits instructions (incl. test related questions and answers to these, questions like “All clear?”, “Did you understand everything” or “Do you have any questions?” and potential waiting times)
6. ELFE sentence understanding	investigator presses “start” on the command “Los!”	investigator terminates the test on the command “Stop!”
7. Instructions ELFE 2	investigator begins with instructions (incl. exercise examples as well as test related questions and answers to these)	investigator quits instructions (incl. test related questions and answers to these, questions like “All clear?”, “Did you understand everything” or “Do you have any questions?” and potential waiting times)
8. ELFE text understanding	investigator presses “start” on the command “Los!”	investigator terminates the test on the command “Stop!”
9. Relaxation 1	investigator takes back 4 th saliva sample (moment of transfer from the child)	investigator begins to take 5 th saliva sample by handing the child a cup of grape juice (moment of transfer to the child)
10. Relaxation 2	investigator takes back 5 th saliva sample (moment of transfer from the child)	investigator begins to take 6 th saliva sample by handing the child a cup of grape juice (moment of transfer to the child)

Table 6: Coding phases with definition for begin and end of the phases.

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Zusammenfassung

Lesevermögen ist eine Kulturtechnik, die sowohl dem Informationsgewinn als auch zur Kommunikation dient. Daher stellt es einen Schlüssel für beruflichen Erfolg und soziale Integration dar. Viele Kinder haben jedoch geringe Lesefähigkeiten und sind somit benachteiligt. Zunehmend werden Tieren, speziell Hunden, indirekte als auch direkte positive Effekte in Studien nachgewiesen. Diese sind physiologischer, psychologischer, emotionaler, sozialer und kognitiver Natur und setzen an verschiedenen Punkten an, wodurch sie Lernumgebung, emotionalen Zustand und Wohlfühlfaktor, Stress- und Angstzustände, Motivation, Konzentration und Aufmerksamkeit als Voraussetzungen für kognitive Leistungen, wie z.B. Lernen, verbessern. Darauf basierend erfreut sich hundegestützte Pädagogik immer größerer Popularität. Erste Studien zeigen positive Effekte von Hunden auf die Leseleistung (Smith 2010, Heyer & Beetz 2014, Wohlfarth et al. 2014). In dieser Studie wird der Effekt von Hunden auf die Leseleistung von 36 Kindern der 3. Klasse Volksschule in Kombination mit physiologischen Parametern für Stress (Herzrate, Herzratenvariabilität und Kortisol) sowie Verhaltensvariablen in zwei Konditionen – mit und ohne Hund – in einem cross-over design mit zwei Testungen untersucht. Zur Messung der Leseleistung wurden zwei verschiedene Lesetests verwendet: der standardisierte „ELFE“ mit zwei Untertests für Satz- und Textverständnis und „Repeated Reading“ (RR) - Kinder lesen einen kurzen Text in zwei Durchgängen laut vor, die Leserate (Wörter/sec) wird erhoben. Obwohl der Hund keinen Effekt auf die Absolutwerte der beiden Lesetests hatte, verbesserten sich die Kinder innerhalb der ersten Testung von Durchgang 1 auf 2 in Anwesenheit eines Hundes, jedoch nicht ohne Hund. Das Verhalten der Kinder zeigte einen beruhigenden Effekt des Hundes in der ersten Testung durch weniger nervöse Bewegungen, und weniger Gesprächen, und einen anregenden Effekt in der zweiten Testung durch mehr Selbstmanipulation. Der Hund hatte keinen Einfluss auf Herzrate und Herzratenvariabilität, obwohl sich die Aufregung über den Hund in Kombination mit der unbekannten Situation in der ersten Testung in einer höheren Differenz zwischen den zwei Testungen für die Kinder zeigte, die den Hund in der ersten Testung hatten. Was den Kortisolspiegel anbelangt, zeigte die area under the curve increase (AUCi), dass die Kinder in der zweiten Testung mit Hund aufgeregter waren als die Gruppe ohne Hund. Ansonsten konnten keine Unterschiede zwischen den Settings festgestellt werden. Auch der Cortisoltrend über die gesamte Testung unterschied sich nicht zwischen den beiden Gruppen. Die Korrelationen zeigten, dass die Leseleistung am höchsten war, wenn der Kortisolspiegel über die Testung abfiel, der Körperkontakt mit dem Hund gering war und vor allem Kinder betraf, die gesprächig waren. Korrelationen zwischen Kortisol (AUCi) und

Verhalten gaben ein widersprüchliches Bild: ohne Hund zeigten die Kinder weniger Selbstmanipulation je höher die Kortisol-AUCi, wohingegen sie mit Hund mehr Selbstmanipulation zeigten je höher die Kortisol-AUCi. Zusammengefasst maßen physiologische Parameter bei Anwesenheit eines Hundes Aufregung in den Kindern, wobei dennoch ein Beruhigungseffekt eintrat, der sich in den Verhaltensvariablen sowie der kurzfristigen Verbesserung der Leseleistung in RR während einer neuen, herausfordernden Situation zeigte, nicht jedoch in einer schon bekannten und nicht in den absoluten Werten der Leseleistung.

Abstract

Reading literacy is a cultural technique that serves for information as well as communication. Therefore it constitutes a key qualification for occupational success and social integration. However, an increasing number of children lack acceptable reading skills. There is growing evidence that animals, especially dogs, have indirect as well as direct positive effects. These are of physiological, psychological, emotional, social and cognitive nature and address different angles to improve learning environment, emotional state and well-being, stress and anxiety levels, motivation, concentration and attention as prerequisites for cognitive performances as learning. On this basis, dog-assisted pedagogy is getting more and more popular. First studies also show positive effects of dogs on reading performance (Smith 2010, Heyer & Beetz 2014, Wohlfarth et al. 2014). In this study the effect of dogs on reading performance of 36 children of the third grade combined with physiological measures for stress (heart rate, heart rate variability and cortisol) and behavioural variables in two settings – with and without dog – in a cross-over design with two test sessions was investigated. To assess reading performance two different reading tests were used: the standardised ELFE with two subtests for sentence and text understanding, and Repeated Reading (RR), where the children had to read a short text out loud in two runs and reading rate (words/sec) was calculated. Although the dog had no effect on absolute values for the two reading tests ELFE and RR, within the first test session the children improved from the first to the second run of RR when a dog was present but not without dog. The behaviour of the children indicated a calming effect of the dog in the first test session with less nervous movements and the children being less talkative, and an arousing effect in the second test session with more self-manipulation. The dog had no impact on heart rate and heart rate variability, though the excitement about the dog in combination with the unknown situation in the first test session showed in a higher difference between the two test sessions for the children, who in the first test session had a dog present, compared to the children, who had the dog in the second test session. Concerning cortisol levels, the area under the curve increase (AUCi) indicated that in the second test session the children were more aroused with a dog present than with no dog present. Otherwise no differences between the settings were found for the AUCi. The cortisol trend, which was calculated over the whole test session, did not differ between the two groups either. The correlations indicated that reading performance was highest when cortisol decreased over the test session (cortisol trend), if body contact with the dog was limited and in relatively talkative children. Correlations between cortisol (AUCi) and behaviour gave a rather inconsistent picture: without dog the children showed less self-manipulation the higher

the cortisol AUCi, whereas with dog they showed more self-manipulation the higher the cortisol AUCi. In conclusion, physiological measures indicate excitement of the children in the presence of a dog, nevertheless leading to a calming effect shown in the behavioural variables and short-term improvement within a new and challenging situation but not in an already known one and not in absolute measures of reading performance.

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Training and further education

2013 - 2015	Master thesis in the framework of the Human-Animal Relationship research group on: “The psycho-physiological and learning benefits of dog-assisted reading” Supervisor: Univ.-Prof. Mag. Dr. Kurt Kotrschal Department for Behavioural Biology, University of Vienna
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