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“Effects of positive reinforcement training on stereotypic behavior in Giraffes (*Giraffa camelopardalis*)”

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Effects of positive reinforcement training on stereotypic behavior in Giraffes (*Giraffa camelopardalis*)

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Abstract:

Stereotypies are a typical sign of poor mental well-being in captive animals and vary broadly in their expression and intensity. Suboptimal housing and environmental factors as a cause of poor mental well-being can induce or enforce such behavior. Animals in captivity usually lack the possibility to display the whole variety of actions that belong to the natural behavioral pattern of their species. For example, they do not have to search for food and mating partners actively and do not have to avoid predators. In most animals, normal activity patterns, the urge to establish a territory or to monopolize food or special areas are reduced either by the facilities or keeper intervention. This restriction of their normally broad spectrum of activities often has negative effects on the animal's behavior: problems in social behavior, repetitive behaviors, boredom, self-destructive behavior etc. can be the result. Stereotypies are expressed as dwarfed attempts to express certain behaviors that can not be shown in that form due to the life conditions in captivity.

To compensate for this lack of adequate mental stimulation, which is necessary for a stable state of mind, different kinds of environmental enrichment, training, and the animal's ability to influence and interact with their environment should be provided by keepers and trainers. Stereotypic behavior, shyness, stress and aggressive behavior can thus be reduced (Laule & Desmond, 1993).

This study took a close look at the effects of positive reinforcement training on the four Giraffes at the Vienna Zoo Schönbrunn in 2010. Several behavioral aspects, mainly stereotypies, were analyzed on training days and non-training-days. I hypothesized that stereotypies would be more intense on non-training-days and before training. A reduction of stereotypy was regarded as an increase in mental well-being.

The results show that training reduced oral stereotypies but triggered locomotor stereotypies as a short time effect: Licking non food objects was reduced in three of the four giraffes, whereas pacing was increased in three of the four. The training setup probably provided stimulus to tongue

movement due to treat access but restricted moving attempts inside the indoor enclosure, thus resulting in the shift.

Bad weather affected stereotypic behavior negatively by enhancing walking and pacing. The departure of the youngest male also led to changes in the behavioral pattern: pacing and licking were reduced for two giraffes, while licking was increased for one animal. Differences in daily activity and reduction of long term social stress can be the reasons for this. Overall, stereotypies made up only a minor percentage of the daily behavioral/activity pattern of the four giraffes.

1. Outline:

2. Introduction:

The complexity of an animals psyche and physiology is an extremely broad and interesting field. Since the foundation of the first modern zoo in 1752 in Vienna and during 258 years of keeping not only exotic animals, the insight has fortified amongst zoo keepers, scientists and visitors, that animal husbandry is more than providing the essential basics in diet and housing. Husbandry has improved over the years, resulting in larger and more natural enclosures, ideal diet-guidelines and socialization, etc. Today, one of the main objectives is ensuring the mental and also the "emotional" well-being of captive animals.

In this study concerning four giraffes (*Giraffa camelopardalis*) at the Tiergarten Schönbrunn, Zoo Vienna, the effects of training as an enrichment strategy countering stereotypy, which is regarded as mentally abnormal behavior, were investigated. To that effect, behavioral patterns on training-days and days without training were compared over a period of five months.

To provide basic information, the species "*Giraffa camelopardalis*" is introduced in chapter 2.1. An overview over knowledge and studies about training effects, the challenge to train giraffes, mental well-being, enrichment and stereotypic behavior is given in 2.2.
Chapter 3 – Material and Method - contains detailed information about the animals, the training, data collection and the analysis. The analysis with its results is described in chapter 4, followed by a thorough discussion of the outcome (5). The results are summarized in chapter 6, rounded out by a short conclusion.

2.1 General information about *Giraffa camelopardalis:*

The first captive giraffe, back than called "camelopard" as a mixture of camel and leopard, was recorded in roman times. It was imported by Julius Caesar in 46 BC. After the fall of the Roman Empire the first giraffe to be reintroduced in Europe was a gift from the sultan of Egypt to King Fredrick II in 1215. In the 19th century, the first specimen arrived in the United Kingdom and in France - Paris (after walking 550 miles from Marseille). Due to its extraordinary look, a giraffe has always been an attraction and a valuable addition to any Zoo (Dagg & Foster 1976).

2.1.1 Taxonomy and conservation status:

Giraffes are African, even-toed ungulate mammals, belonging to the order Artiodactyla and the family Giraffidae, which consists of two living genera and two species (*Okapia johnstoni & Giraffa*

camelopardalis). Furthermore, several different subspecies are known, although there are ongoing discussions amongst specialists about the exact number (nine or eight) and their relations. The currently agreed subspecies are listed here along with the respective numbers of individual animals living in captivity worldwide (2009).

- *Giraffa camelopardalis* "any subspecies" 170 male, 215 female, 10 unknown, 395 Total
- *G. c. angolensis* (Angolan or Smokey giraffe) 3 male, 6 female, 0 unknown, 9 Total
- *G. c. antiquorum* (Kordofan giraffe) 10 male, 27 female, 5 unknown, 42 Total
- *G. c. camelopardalis* (Nubian giraffe) 0 male, 0 female, 0 unknown, 0 Total
- *G. c. giraffa* (South African or Transvaal giraffe) 15 male, 27 female, 0 unknown, 42 Total
- *G. c. peralta* (Nigerian or West African giraffe) 0 male, 0 female, 0 unknown, 0 Total
- G. c. reticulata (Reticulated or Somali giraffe) 149 male, 245 female, 4 unknown, 398 Total
- *G. c. rothschildsi* (Ugandan, Baringo or Rothschild giraffe) 156 male, 235 female,2 unknown,393 Total
- *G. c. thornicrofi* (Rhodesian or Thornicroft giraffe) 0 male, 0 female, 0 unknown, 0 Total
- *G. c. tippelskirchi* (Masai or Kilimanjaro giraffe) 33 male, 57 female, 0 unknown, 90 Total

A total of 1,369 giraffes are kept in captivity worldwide. The IUCN classifies the species giraffe as "at least concern"– conservation dependant. Due to their wide distribution, relatively high number in the wild (over 100,000) and conservation projects there is no concrete risk of extinction. Only the subspecies *G.g. peralta*is is classified as threatened, as the actual number is only about 200 individual animals in the wild.

The biggest threats for the species are habitat loss, poaching and degradation due to human activities (http://zookeepersjournal.com/wiki/index.php?title=Giraffe).

2.1.2 Biology:

Diet: As ruminant herbivores of the African savannah, grasslands or open woodlands, giraffes browse on shrubs and trees. The food usually associated with giraffes is various kinds of Acacia. These thorny bushes are one of the most probable reasons why their extremely long (up to 50 cm) and flexible tongue has developed during evolution, thus being able to pluck the leaves off the branches without getting injured by the thorns. A giraffe's stomach has four compartments for the optimal digestion of a large amount of food. In the wild, giraffes need water only every few days, as they get most of their water supply with their food. In captivity, they usually drink daily.

Physical characteristics: The most prominent features are the elongated neck with the short, erect-standing dark mane and the long, slim legs with the massive, rounded hooves, which are used as powerful weapons. The front legs are slightly longer (10%) than the hind legs.

Female giraffes grow up to 4-4,8 meters in height and can weigh up to 1,180 kg with an average of 700 kg. Males are taller and heavier with up to 4.6-5.5 meters in height and a weight of 800-1,930 kg (average 1.100 kg). In captivity, they rarely grow taller than 5 meters. Giraffes are the tallest land living animals. Life expectation is up to 35 years in captivity and 25 years in the wild.

The tail is slim, tufted and reaches down to the hock. On the head, both sexes possess two short, blunt horns called ossicones, which are tufted and slim in females and usually bold and knobbed in males. Furthermore, bony lumps keep growing on the face of male giraffes over the course of their life due to calcium deposition. This results in heavier and more robust heads for male-male fights and gives the impression of them having up to five horns. The fights are usually conducted via necking and head-swinging against each other, normally without greater damage being caused.

Due to the long neck (with seven vertebras like most mammals), the heart must be able to pump blood all the way to the brain and adapt quickly to changing head positions. Therefore, the blood vessels of the neck are very elastic and the jugular veins have one-way-valves to prevent blood from flowing backwards. The large muscles holding head and neck attach to two large, forward facing dorsal spines on the thoracic vertebras four and five. These structures form the conspicuous shoulder humps.

Coloration is unique for each animal, highly variable and can work as a key characteristic in distinguishing the subspecies from each other: The body is covered in dark, brownish, irregularly shaped patches on lighter brown background.

Social behavior: Giraffes are social, polygamous and non-territorial animals. The only relationships that are intense and persistent are the mother-child bonds. The adult animals live in loose herds, differing in size and composition. Females rather tend to stick together, especially when leading young. Younger bulls group up in “bachelor” herds, while elder males usually live solitary. Hierarchy fights are normally conducted rather playfully via necking. In Zoos, mixed groups of one male with several females are ideal.
(http://zookeepersjournal.com/wiki/index.php?title=Giraffe; Jolly 2003)

2.1.3 Giraffes in captivity - general problems:

As with every animal in captivity, it is essential for the 1,369 giraffes under human care that a great effort is made to enable mental and physical well-being. This starts with appropriate housing and handling. Thanks to generalized husbandry and management guidelines, detailed information about housing, diet, medical treatment etc. is provided to Zoos. Based on my limited sources of information on other zoos, I am not able to tell how well these guidelines are followed in general. Thus I will not go into further detail here.

Though being the tallest land living animals, giraffes still are prey-animals. Therefore, their flight-instinct is well developed and they are extremely shy and careful. When feeling threatened, they kick with their powerful legs or bolt from the danger. This makes it very dangerous for keepers to get in close contact with the animals. Still this is necessary, if medical care is needed, if the animals have to be shifted to another enclosure, or need to be observed closely (Phelps & McCartney 2007).

For the safe handling of such a tall and powerful animal, there is no greater benefit than the animal willingly reacting to commands and being relaxed during human contact, thus accepting manipulation without resisting or fighting. If the animals refuse to cooperate and manipulation is necessary, the only ways to achieve access would be anesthesia or immobilization by force. Both is extremely dangerous for the animals as well as the involved persons and has already caused many deaths and injuries on either side. The animals may collapse and get injured during falling. Even when brought down safely, they may regurgitate or choke and the sensitive cardiovascular system may fail during lying in narcosis (Bush 2003).

Taking this into account, it is obvious that a great effort has to be made to encourage giraffes to willingly cooperate with keepers. Many Zoos have started training programs with their giraffes to make the animals familiar with a multitude of possible situations, persons and objects. Lots of reports of successfully gained training-goals show that proper training is an effective method for reducing stress and danger on both sides and improving animal-keeper cooperation (Phelps-Kinzley & McCartney 2006, Phelps & Mc Cartney 2007; Phelps 2004).

2.2 Operant conditioning / positive reinforcement training:

Basic ideas: To influence an animal's behavior through training, three basic alternatives are known: positive reinforcement, escape or avoidance, and punishment (Reynolds 1975, Pryor 1984). As the major goal of the training is to increase mental well-being and to create a trusting and relaxed relationship to keepers/trainers, neither punishment nor negative reinforcement are used. Thus,

negative emotions towards the training or the keepers are avoided. The animals shall join the training sessions on their own free will and gain self-confidence. Negative reinforcement or punishment would only be used in extreme situations, when a keeper's life was at risk (Laule & Desmond, 1993).

Positive reinforcement: The idea of "positive reinforcement" is, that the animals are rewarded with treats in the form of food, toys, voice change or other actions the animals enjoy, when they show the desired behavior. The learning process works step by step, beginning with gaining trust to the trainer/keeper and understanding the connection between an action and a reward, then figuring out the purpose of given commands (e.g. stand "steady", "move up", "move back"). As soon as an animal understands the basic principle of a training session, more complex actions can be demanded and the learning process accelerates (Laule & Desmond 1993: Phelps-Kinzley & McCartney 2006; Phelps & Mc Cartney 2007; Winhall 1994; Laule 1992).

Training giraffes: Regarding the special circumstances of handling a giraffe in captivity (described in 2.2.1), training these animals demands a lot of patience and a slow and gentle start. The Oakland Zoo is a great positive example, as it has an outstanding training program, beginning at birth of a giraffe calve. A fusion of operant conditioning and the Tellington Touch Equine Awareness Method (TTeam) is used to modify the giraffe's behavior in a way that keepers can safely handle them in a multitude of possible situations. This includes medical care, shifting, transport and daily husbandry issues.

During their training years, the giraffes are made familiar with touch and manipulation of the whole body, various objects, new situations and strange people. They willingly accept being led with halter and rope, physical examination and wound care, stethoscope investigations, blood draws, transabdominal sonograms, farrier work, radiography etc…

Thus anesthesia and immobilization can be reduced to a minimum, as the animals do not have to be forced into any kind of cooperation. This is also an improvement for the safety of the keepers, as the animals loose their fear and thus defensive or aggressive behaviors are extremely reduced. Even in entirely new situations, handling is easier as the giraffes experience novelty as less stressful and threatening based on their training and the established trust to their keepers. (Phelps-Kinzley & McCartney, 2006; Phelps & McCartney 2007; Phelps 2004). These facts have been proven in a broad variety of other species, especially cetaceans, pinnipeds and primates. (Winhall 1994; Laule 1992; Turkkan et al. 1989; Reinhardt and Cowley 1990; Reinhardt et al. 1990; Priest 1991; Laule et al. 1992; Luttrell et al. 1994).

With all the differences in methods, the objectives are overall the same where training is conduced: Through training, the keepers want to achieve that animals have a “less sensitive startle reflex, reduced fear of unknown people and unfamiliar objects and increased body awareness. These animals also tend to be more interested in and responsive to people.” They are easier to train and handle in any situation in a safe and cooperative manner (Phelps & McCartney 2007)

The main objective of the training with the four giraffes at the Vienna zoo, where this study was conducted, is easier handling and stress reduction during animal-keeper contact or veterinary visits. The giraffes shall get (and already are) used to being hand-fed, touched with hands and instruments (e.g ultrasound) and moved around on command. This training enables the keepers to carry out physical examinations, minor wound care and to draw blood without using tranquillizing drugs or force. It also makes it easier to shift the animals around without stress, as they react to their names willingly. The training is described in detail in “Material & Methods”.

A positive side effect of training sessions is the enrichment-factor, which can improve the mental well-being of animals:

2.3 Enrichment and mental well-being:

Definition: Mental well-being or psychological welfare is generally defined as the ability to adapt, which means to respond and adjust to changing situations (Petto et al. 1990). It is also described as an expression of “normal” behavior, such as performing purposeful actions that impact the animals’ life and the absence of mental disorder (Laule 1992, Hediger 1950).

In humans, mental well-being is defined by the Human Health Organisation as: “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (http://www.who.int/mediacentre/factsheets/fs220/en/).

Although this is a very anthropomorphic view, I do regard the idea behind it as appropriate for social mammals as it reaches beyond the “functioning without mental disorders” – definitions.

Reasons for poor mental well-being: In the wild, a high proportion of the day is spent foraging, exploring, hunting, avoiding predators, socializing, etc. One could say that the animals are “busy” staying alive. In contrast to this, animals in captivity usually have a structured and man-made life with hardly any choice left to them. They are provided with food, water, mating partners and a stable territory and do not have to work for anything. Thus, captivity hinders the evolution and/or

the expression of behavioral, physiological and psychological features that would be necessary for surviving in a natural environment.

This leads to a kind of “black spots” in the daily behavioral pattern of an animal, which can result in unwanted behaviors to fill these empty spots: neurotic, stereotypic (the problem of stereotypy is described in detail in chapter 2.2.4) and self-directed behavior, aggression, self-injury etc. (Winhall 1994; Laule 1992; Hedinger 1950; Laule & Desmond 1993). These actions can be regarded as signs of poor mental well-being. Especially mammals suffer from the constraint in their natural behavioral spectrum due to a lack of naturalistic habitats and stimuli (Carlstead, 1996, 1998; Miller et al., 1998).

Counter-measures: To compensate for the lack of mental stimulation resulting from captivity and to fill these behavioral gaps, it is important to offer various stimuli to the animals to induce natural behavior as it would happen in the wild. Encouragements can be the appeal to hunting instincts, foraging behavior, play instincts, problem solving abilities or simply variation in daily life. Therefore, different kinds of environmental enrichment, training and the chance to influence their environment are provided as main husbandry tools by keepers of zoos worldwide (in a growing and developing process) with the purpose of enhancing the psychological and physiological well-being of captive animals (Shepherdson 1998; Swaisgood & Shepherdson 2005).

There are no limits to creative ideas concerning enrichment strategies, as long as they are safe and do not lead to abnormal or dangerous behavior. The importance of enrichment is widely agreed, though the performance varies considerably between zoos and keepers. Concrete guidelines do not exist, yet, but there are multiple studies providing ideas and discussing strategies (Tarou & Bashaw 2006).

Further information, inspiring ideas, descriptions, publications and stories can be found in the quarterly publication “The shape of Enrichment” and their homepage http://www.enrichment.org/.

Combinations of training and enrichment or the use of training *as* enrichment are ideal. Animals, which are relaxed with people and novel objects tend to be more curious and take less time to investigate new items and toys. Thus they profit more quickly from enriched environments and can be handled more easily. This offers a broader variety of possible enrichment strategies for keepers . The training itself can be regarded as enrichment, as it is stimulating in many ways and keeps the animals busy, creative and active (Williamson & Scarpuzzi 1993; Winhall 1998; Winhall 1994). Most animals are eager to work for treats and some even prefer to take food they worked for, above food that is available without work (Laule, 1992).

Experiences in this field are exchanged and new ways are searched and found to offer enrichment to all kinds of animals. Positive effects of training and enrichment on inadequate behaviors like stereotypy, shyness, stress and aggressive behavior (Laule & Desmond, 1993) have been shown in various studies with chimpanzees (Bloomsmith et al, 1994), cetaceans, pinnipeds (Winhall 1994, Laule 1992), mice (Latham & Mason 2010) and elephants (Desmond & Laule, 1991; Maddox 1992). With giraffes, especially the use of tricky feeders has shown positive effects. These feeders demand the giraffes to use their flexible tongues to reach the food and keep them busy for a long time. This has shown positive effects on the reduction of oral stereotypies (Bashaw et al. 2008).

Above all personal experiences of keepers and trainers, scientific tests document that animals raised under enriched conditions have reduced corticosteroid outputs, which indicates a lower stress and frustration level. Furthermore these animals are less susceptible for neurological disorders, as their structure of the central nervous system is more stable and complex. This is visible in increased dendritic spine densities (Latham, Mason 2010).

Critic view: One rather critical factor to be mentioned is the effect, if enrichment activities are done only rarely and not properly elaborated, or when they are suddenly stopped for any reason. This can result in frustration, which can in turn lead to an increase of abnormal behavior, stress and stereotypy. Tendential, these behaviors are then displayed even more vigorously than in animals that never experienced enrichment. Studies in this field show rather contradictory results and it would go too far to discuss this aspect in detail. In short and simplified it seems that the loss of enrichment after growing up in enriched conditions can be more critical for some species than living without any enrichment at all. Thus, once having started with extensive enrichment strategies, keepers and trainers need to continue their activities consequently (Latham & Mason 2010).

Still the benefits of enrichment can be regarded greater than the risks, as studies have given strong evidence that they offer a quite effective chance to reduce abnormal behavior, such as stereotypy, especially compared to other methods like restraint or punishment (Tarou et al 2003; Mazur 1998).

2.4 Stereotypy – general reflection:

Basic facts: Stereotypy was generally defined by Mason in 1991 as “repetitive, invariant behavior patterns with no obvious goal or function” and is “often associated with past or present sub-optimal aspects of the environment and has been used as a welfare indicator”. Over 85 million individuals worldwide show one or more stereotypic behaviors like pacing, chewing/licking non-food items,

tongue playing or body-rocking. Especially with zoo-housed giraffes, these syndromes are almost omnipresent (Latham & Mason 2010).

Reasons: The causes for stereotypic behavior are multifarious and differ highly within species and individuals. Anyhow, these irregular behavioral patterns are mainly displayed by captive animals and can be regarded as "sustained attempts to perform highly-motivated normal behavior patterns that are frustrated by captivity" (Rushen et al 1993). This indicates the coherence of poor mental well-being and captivity, as described in chapter 2.2.3, although it is not a one-to-one relationship (Mason & Mendl, 1993; Mason & Latham, 2004; Broom 1991; Carlstead 199).

Early observations validated that stereotypies tend to be displayed more extensively in sub-optimal environments and husbandry (Hediger 1950) and the comprising study in 2004 by Mason and Latham confirmed that 68% of environments inducing stereotypy are associated with degraded welfare.

Moreover, stress seems to be a very important factor and individuals, that have difficulties with mobilizing psychological resources to cope with stress, display stereotypies as a sort of compensation (Zayan 1991).

Still, the display of stereotypy does not automatically mean that the actual condition of an animal is poor, as stereotypies, once emancipated, are hardly eradicated, even when the initial stimulus or stressor is absent. They can be remnants of former experiences and wrong early husbandry (Swaisgood & Shepardson 2005). It is also important to keep in mind that stereotypy is not the sole index of welfare! All in all, these facts show that stereotypy is a very complex topic and "its expressions are heterogeneous in source of origin, proximate causation and physical characteristics" (Mason 1991).

Critics: A critical review article (Swaisgood & Shepardson 2005) about stereotypies and enrichment shows that the latter had a positive influence on stereotypic behavior in 53% of the studied cases. But the studies mainly concentrated on outstanding and charismatic species, while the majority of zoo animals were left out. Furthermore, the article indicates that data presentation and the scientific methods used in many zoo-studies were insufficient and this limits the scientific conclusions drawn from them. Swaisgood and Shepardson propose higher sample sizes, better descriptions of experimental designs, type of stereotypy and the exact type of enrichment, plus more diligent statistical analyses. Still, the positive aspect of enrichment strategies and the good experiences by keepers and trainers worldwide outweigh the scientific criticism in my personal opinion.

Stereotypy in Giraffes: A study conducted in 2001 showed, that amongst 214 giraffes in American zoos 79,7 % executed at least one type of stereotypy. The most common ones were pacing (29,2%) and repeatedly licking none-food items like walls, doors and grids (72,4%). Correlations were found between stereotypic pacing and the following factors: sub species, birth history, size of the indoor enclosure, environmental changes and type of food.

Stereotypic licking of non food-objects (from now on simply referred to as “licking”) by contrast showed correlations with the sub species, high social density (small indoor enclosures and access to conspecifics at night), feeding frequency, method of feeding and type of food provided. This suggests that feeding motivation is related closely to oral stereotypy whereas locomotor stereotypy probably has its cause in environmental factors (Bashaw et al 2001). Pacing is furthermore a typical stereotypy of animals that normally range over large territories in the wild, like giraffes do (Eilam et al 2006).

The correlation of food-related factors and oral stereotypy seems obvious regarding knowledge about mental well-being. Giraffes are “designed” for using their flexible tongue in picking leaves of acacia trees, which is a constant challenge for concentration and maneuverability. The provision of open access food leads to an incapability of this fundamental and highly motivated feeding behavior pattern to be performed. Common enrichment strategies for giraffes, meeting their urge to use their tongues, are all sorts of complex feeders. These encourage the giraffes to display natural foraging behaviors contrary to just taking food out of open feeders. Reduction or even disappearance of oral stereotypy have been proven with various “tongue-twister” feeders (Bashaw et al. 2008; Tarou et al 2008).

There is a second theory explaining oral stereotypy: The type of food giraffes are usually provided with in captivity (long hay, pellets etc.) might produce more acid in the gut and is digested differently, requiring less ruminating or at least stimulating less ruminating. Additional tongue movements are necessary to increase saliva production. This alkaline saliva can help digesting the food via neutralizing the acid. Oral stereotypies can develop from this additional need or urge to move the tongue to produce saliva (Weeks, 2002). Thus it is important to offer a broad variety of food, which should be as natural as possible.

The definition of pacing can be confusing, as animals in the wild also tend to follow strictly fixed paths and repeat certain movements or activity sequences. These are called repetitive motor rituals and probably help an animal in organizing its territory via strict familiar paths and special spots for special behaviors. This would minimize the attention that has to be focused on the basic behaviors and enable the animal to focus on other information like the presence of danger, etc. Stereotypic

pacing, however, is defined as walking monotonously back and forth repeatedly, in circles or eights and has no obvious purpose (Eilam et al 2006).

Stereotypy can, as mentioned earlier, also be induced by stress, for example due to interruptions in social structure. A study at the Atlanta Zoo showed that the removal of the male of a herd of three giraffes induced pacing in one of the females and increased oral stereotypy in both others (Tarou et al. 2000).

2.5 Hypothesis:

To sum things up: For proper animal husbandry it is necessary for zoos to pay attention to the mental well-being of their entrusted animals. Enrichment and training, often combined, are the most effective and most common tools to improve physiological and psychological well-being. They fight symptoms like stereotypy and mental disorders. In giraffes, oral stereotypy has mostly been approached via feeding enhancement.

The objective of this master thesis is to take a closer look at the effects the daily training sessions with the four giraffes at the Vienna Zoo Schönbrunn have on their displayed stereotypies. The whole behavioral pattern one hour before and one hour after training is observed and compared with the same data taken on non-training days at the usual training time. These data sets are analysed with regards to changes in the percentages of time each behavior is displayed. Changes in the frequency of stereotypic behavior are analysed in detail.

Thus, I intend to find clues that the giraffes gain mental profits from the training, stabilising and increasing their mental well-being, which should be visible in a reduction of stereotypy after training on training days. I expect that the frequency of stereotypies shown after training on training days is lower than before training and on non-training-days. Furthermore, I anticipate that the giraffes will show willingness to join the training, which should be visible by them searching close spatial proximity to the doors of the stable before training.

3. Animals and method:

3.1 The giraffes:

The Vienna Zoo housed four Giraffes until the end of June, when the young bull was transferred to a safari park in Italy (Parco Natura Viva, Bussolengo): Two adult females (purebred *Giraffa C. rothschildii)*: **Carla** (11) and her daughter **Rita** (5), which came from Dvur Cralove, a Czech zoo in 2006 and were hardly used to human contact before, which made it harder for them in the beginning to benefit from the training.

One adult male (hybrid) **Kimbar** (17), has lived in Vienna for 15 years now. He has been used to closer human contact than the females. They lived on a large area with hardly any human contact, while he spent most of his life at the Vienna Zoo, where keepers are around every day, the giraffe house is relatively small and minor handling acts like shifting him around have been common.

Akasha (3) is the son of Carla and a Czech bull and was born in September 2007 in Vienna. With him, the best results have been visible, as he grew up with the daily training. He is less shy and nervous than the others, accepts touch on his head, body, neck, legs and genitals, and shows more willingness to interact with people. With new objects, he is curious and less scared than the others. He even lets visitors pet him regularly. This is probably due to the fact that he had problems standing up right after his birth, and had to be held upright supported by keepers for the first two hours of his life. Thus he was in closer contact with humans than other giraffes in the first hours (trainer comments, E. Dungl).

The four giraffes are easy to distinguish via looks and temperament:

- **Carla:** Fully grown, middle brownish basic colour all over the body, dark brown patches, irregular patterns on the face.
  Hardly interested in anything that happens around her in the outdoor facility; mostly relaxed and calm, neutral/friendly with the others. Had difficulties in gaining trust in the keepers and the training in the beginning. Willingly joins the training now, reacts to her name, is eager to work, and accepts most of the manipulations. Probably pregnant, accepts ultrasound investigations in irregular intervals. Shows intense pacing and occasional licking.
- **Rita**: Fully grown, pretty light brownish basic colour, dark brown patches, one conspicuous triangular patch on the upper left neck side. Four spots on the right cheek that look like two coffee beans.

Shyest individual, pays more attention to her surroundings. Tends to thoroughly investigate things in her enclosure, which have always been there. Is very sensitive and easy to scare off. Fears strangers the most. Knows her name but ignores every attempt to call her, when she is “not in the mood” to join training. Reacts very intensely to unfamiliar scents and even foods. Only takes selected treats (biscuits, no vegetables or fruits) from washed hands. Still refuses to walk in-between the opened doors of the handling area. Always looked for proximity to Akasha and refused training for two weeks after he was moved to Italy. Shows the least progress in training.

- **Kimbar**: taller than the others, darkest in colour, basic colour darker on the neck and head. Head is more massive due to the massive bony lumps. Shows least interest in his surroundings, even if the others are alarmed. Shows good spirit in training. Reacts unwilling and impatient when the others are trained before him (bangs the doors, paces restlessly, pushes against the walls). Not easy to scare off. Sometimes refuses to leave stable after training, although there is no access to food inside. Paces continuously in eights indoors, licks frequently outdoors. Willingly accepts most manipulations, even extensive manual cleaning of his face. Seems to enjoy scratching with a broom. Regularly shows sexual drive.
- **Akasha**: smallest one, light in basic colour, little light spots on most of the dark brownish patches. Delicate in comparison to the others. Lively temperament, is interested in people, cars (especially orange bin lorries) and sounds around him. Reacts to people who call him, even to visitors. Gladly attends training, accepts all kinds of manipulation so far and seems to enjoy touch with hands or broom. Always searched proximity to Rita. Showed first sexual attempts on both females, but still drank from Carla. Sometimes still showed playful juvenile behavior.

3.2 Giraffe housing in Vienna:

The giraffe house (Fig. 1) is relatively old and small, but renovation plans have already been made and should be realized within the next years. There is a closed stable with the possibility to separate the male from the females. Now that Akasha has left the group, they usually are all together in the female’s section. The gates open to a roofed shelter with feeders and access to a gravel area and a meadow. The outdoor facility is shared with three marabus (*Leptoptilos crumeniferus*) and a pair of southern ground hornbills (*Bucorvus leadbeateri*) and is open during the day. In bad weather or cold winters the gates are closed due to the danger of slipping.

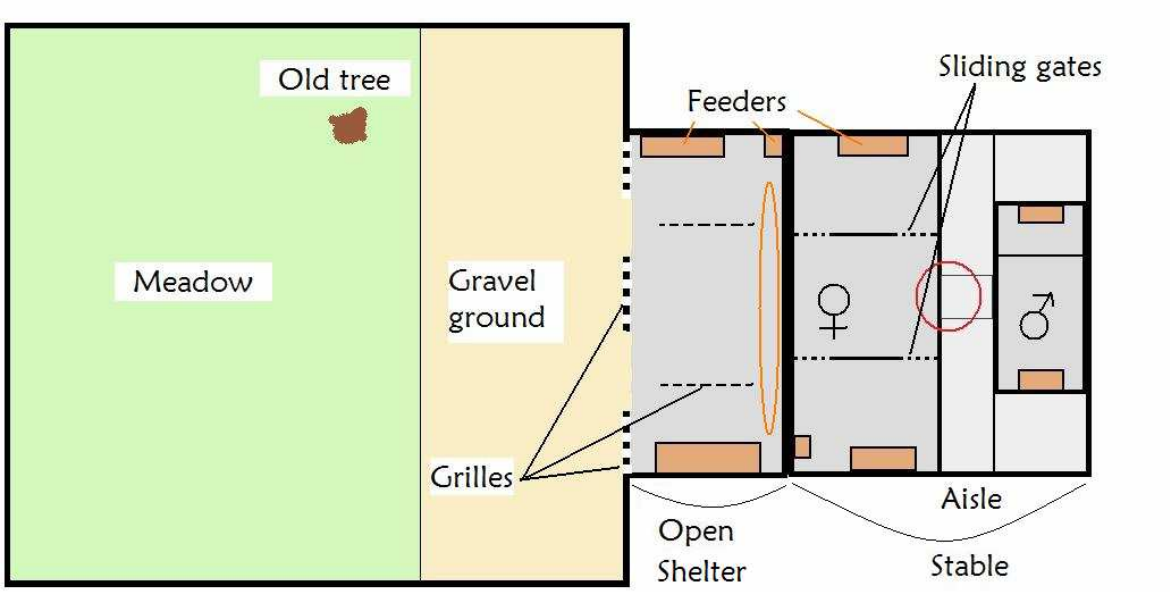

Fig. 1: Giraffe enclosure at the Vienna Zoo. Indoor and outdoor facility connected with tall gates. Orange oval: Carla's pacing route. Red circle: Training area.

Big chestnut trees surround the outdoor facility and one old tree stands in the meadow. The giraffes feed on the chestnut-leafs they can reach and gnaw on the tree trunk occasionally.

The orange oval shows the area in front of the gates, where Carla uses to pace regularly to and fro. Training takes place in the area marked with the red circle, where a gate can be opened into the aisle.

Hay is provided daily. Sometimes they are fed fresh twigs and leaves and fresh grass. Food is accessible in the feeders the whole day. A tongue twister feeder (punchbag with holes, filled with food) is available inside the female's section, but hardly ever used (not a single time during the observation period).

The giraffes are generally outside from 9.00 am to 3.00 pm and during warm weather periods also longer and over night.

3.3 The training:

The team uses positive reinforcement training only (view chapter 2.2.2). Treats are mixed fruits and vegetables, grain-pellets as extra reward and maize-rings for special occasions. Neither punishment nor force are used during training (and never had to be used during the observation period).

In the beginning, the animals were trained to mentally combine the sound of a "clicker" (metal device making fast clicking noises, also used in dog-training) with treats, therefore getting a positive association with the sound (Pavlovian conditioning). Thus, the clicker is used as a bridge,

literally bridging the gap between the animal's behavior and the moment the treat is provided (Phelps, McCartney 2007). As a second step, the giraffes were asked to take food from a keeper's hand, making first physical contact. After being familiar with this basic touch, further manipulation, novel objects and strange persons were introduced.

Keepers also started to get the animals used to closer human contact by brushing them with a broom or a long whip. As soon as the giraffes were relaxed in these situations, the distance from hand to skin was reduced until the animals accepted touch with the backside of a hand. These are very slow processes and had to be done with care and lots of patience over time. All four giraffes accept being brushed with the broom on the face, neck, shoulders and fore legs. All but Rita usually accept it on the belly, the back and the hind. With Carla it is already possible to do an ultrasound observation, when done carefully.

Intense training started in 2008. The giraffes have training sessions four to five days on week-days, generally from 1:00 pm to 2:00 pm. Training is carried out by the zoo's animal trainer, Dr. Eveline Dungl, and two of the giraffe keepers (for simplification all of them will be referred to as trainers): P. Stefan und A. Keller. Sometimes, one of the veterinarians or strangers join the sessions.

Usually, everything follows the same procedure every day: The gates to the outdoor facility are opened and the giraffes come inside. The adult male is separated from the others within the females section of the stable with the help of remote-controlled sliding doors and then, one giraffe at a time is asked into the middle part, where the training site is accessible.

As the animals react to their names being called, separation is no problem most of the time. It has got even easier after Akasha left, as the females do not have to be separated through the sliding doors. Akasha would push to the front while the others where busy training. Thus he had to be locked away. The females never really do.

The training setup is relatively constant (Fig. 2). The two middle doors of the stable are opened outwards into the aisle and a heavy wooden bar is hung between them, to stop the giraffe from going further. Thus, the trainers on the sides are protected via the doors and the one in the front via the bar, while the giraffe's body is accessible through the grids. This setup proved to work well for the trainers as well as the animals, which are familiar with the procedure.

Fig. 2: Training setup. Open doors with wooden bar, keeper with food in front of the giraffe, other keeper manipulating it. Here: Akasha being brushed with a long broom.

While calling the giraffe forward with the commando “Hier”, which means “come here”, treats are provided from the keeper in the front. The giraffe will usually move forward and take the food out of the trainer’s hand, until it touches the wooden bar with the chest. Only Rita does not walk into the open doors, but stops one meter in front of the bar. At the command “Seite”, which means “to the side”, the giraffe will take a side step towards the grid and sometimes even lean into it. This is the ideal position for the trainer on the side to touch the giraffe. A long broom is used to brush face, neck, shoulders and front legs. A small plastic brush is used for more specific cleaning or touching. The keepers use their hands on every part of the giraffe that it will accept being touched. Other tools are a long whip to stroke, an electric razor or the sensor of an ultrasound system with a cable.

Usually, the trainers use a ladder to access the neck, back and shoulders. So, various ways of touching the giraffe with different objects are acted out every training session. On special occasions, a vet will join the training with new objects, touches and smells. During all manipulations, the giraffe is fed treats to make it stand still. When it is scared off or leaves, it is asked forward again and offered food.

The time every giraffe spends with training changes from session to session and depends on cooperation, methods used and the success. When one of them is unwilling to join training, no measures are taken despite asking them forward and offering treats.
On the command “Zurück”, which means “back”, the giraffe walks backwards and stops at a “Steh”, meaning “stop”. If possible, every training session is ended with a success. After the training, the giraffes have to go outside again and the doors are locked behind them.

Every now and then, additional training tasks are practiced: A metal grid with three vertical openings can be attached to the front of the training corridor/the open doors. Through these openings, the trainers can touch the giraffe’s legs and hooves directly with their hands or other tools. This training serves as preparation for potential farrier work.

As a preparation for willing cooperation in taking blood samples, predatory bugs are positioned on the neck or back of a giraffe. This training was mainly done with Akasha, as a blood sample was necessary before his transport to Italy. The blood sample was taken successfully.

3.4 Data collection and analysis:

Data collection: Since it is hypothesized that training can have positive effects on stereotypic behavior, the giraffes were observed before, during and after training sessions. The intensity, frequency and duration of stereotypic behavior like licking the walls/doors and walking in circles or eights were recorded during one hour before and one hour after training. Together with stereotypies, all other visible behavior patterns were recorded for 60 minutes. Every full minute, the actual observation of four sets of parameters was written down in the data sheet: Movement, Attention, Behavior and Place (actual whereabouts). The following possibilities were observed and noted:

- **Movement:** Lying – l; standing – s; walking – w; galloping- g; pacing - p (alone or with other giraffes – 2-4).
- **Attention:** 1 = low, 2 = medium, 3 = high, 4 = alarmed.
- **Behavior:** Watching – wt; feeding on hay – f; ruminating – r; licking – lk; scratching – sc; interacting - i (sexual – x, neutral – g or aggressive - a); gnawing - g; necking – n; dozing – d; feeding on leaves/twigs – fl.
- **Place:** A = meadow or gravel area, B = shelter, AB = on the borderline.

For detailed information about the parameters, see Attachment 1 – a complete Ethogramm of the Giraffes. One exemplary data collection sheet is attached in Attachment 2.

Environmental factors were noted as well and coded with numbers:

- **Date, Time, before/after training (1/2), before/after Akasha was gone (1/2)**
- **Weather:** 1 = sunny, 2 = cloudy, 3 = rainy
- **Number of visitors:** 1 = very few, 2 = few, 3 = middle, 4 = many, 5 = very many
- **Temperature:** 1 = very cold, 2 = cold, 3 = warm, 4 = very warm, 5 = hot, 6 = very hot
- **Food availability:** 1 = little (feeder < 1/3 full) , 2 = middle (between 1/3 & 2/3 full), 3 = much (> 2/3 full)

As already mentioned, data was also collected on non-training-days, at the same time before and after training would have taken place (between 12.00 pm & 14.00 am) to have a comparison. Thus, I produced two sets of Data. Data collection was carried out from March until August 2010. Due to a long bad weather period in spring, where the giraffes were locked inside and data could not be taken, and several excursions from university, there are less data sets than expected for such a long period.

All in all, there is data for **25** training days and for **20** non-training-days. As Akasha was moved in the middle of the observation period, there are only **13** training-days and **8** non-training-days for him.

The behavior of the group before and after Akasha was moved has also been compared, to see if the change of the social structure had any visible influence on the herd's well-being.

Hypotheses: The two sets of data will be compared for each giraffe separately regarding the frequency of all behavioral aspects, in order to find out whether the giraffes' behavior differs and whether they draw a visible daily benefit from the training.

I hypothesize that the giraffes show less stereotypic behavior on training days after training sessions, as they are busy and challenged and this stimulation should reduce stereotypies.

On non-training days, I will also take a close look at anticipatory behavior and spatial relations to the training-place. As the training is done at the same time every day, the animals should know the time and might wait outside the stables to be let inside for training, thus also showing willingness to participate.

The details of the observations were developed during a two-week period of intense observation without taking any data, beginning with March 8th. Thus I got to know the animals and their typical behavior. The first data was taken on March 22nd.

Data preparation: The data sheets were transformed into excel-charts. The percentages of all parameters within the 60 minutes were calculated to produce files that tell how many percent of the

time the animals showed any specific movement/attention/behavior/presence in A or B. Due to the big amount of data, reductions were made. If the medians of a parameter were below 1% collectively as well as before and after training in both data sets, the parameter was taken out of the analysis. Only Pacing and licking were regarded within every set and necking was kept in the male's sets.

Analyzed parameters:

- **Carla:** *Mov*: p, s, w; *Att*: 1, 2; *Beh*: f, lk, r, wt; *Place*: a, b, ab
- **Rita:** *Mov*: p, s, w; *Att*: 1, 2, 3; *Beh*: f, lk, r, wt; *Place*: a, b, ab
- **Kimbar:** *Mov:* p, s, w; A*tt*: 1, 2; *Beh*: f, lk, r, n, wt, ix; *Place*: a, b, ab
- **Akasha:** *Mov:* p, s, w, w2; *Att*: 1, 2, 3; *Beh*: f, lk, r, n, wt, ig; *Place*: a, b, ab

Following analyses have been performed for each giraffe separately:

- Complete behavioral analysis – correlations amongst all factors
- Training days (TDs) vs. non-training-days (NDTs) overall
- Before training vs. after training on TDs
- "Before training" vs. "after training" on NTDs
- Before training on TDs vs. "before training" on NTDs
- After training on TDs vs. "after training" on NTDs

Analysis: The data sets were analyzed using SPSS 15.0 for Windows. First, a Pearson correlation test was done with the complete data set of one giraffe to find any correlations between any factors. This serves the purpose of better understanding effects that are not visible in the later, detailed analysis like correlations with external factors (weather, visitor number, food availability etc).

The second chain of analyses – the comparisons of TDs vs. NTDs and the times before and after training time – was conducted with a non-parametrical test for two dependent variables: a Wilcoxon test. Stem and leaf diagrams were produced with explorative data analysis.

4. Results:

4.1 Carla:

4.1.1 Complete behavioral analysis - correlations between behavioral and other factors:

To get a first impression of the correlations of any behavioral factors, the complete data from all days was tested with a Pearson correlation test (N=91). First attempts to test training days and non-training-days separately showed only confusing results, which is possibly due to the small Ns. Thus all data sets were analysed together, as differences between training-days and non-training-days will be visible anyway as correlations between the factor "training" and any other. Correlations ($p \leq 0,05$) or trends (little more than 0,05) were found for the following factors:

Tab. 1: Significant correlations between various parameters of the overall behavioral pattern of Carla (N=91). Blue: positive correlation; red: negative correlation. Abbreviations: r = ruminating, weath = weather, p = pacing, w = walking, s = standing, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, wt = watching, a = meadow, b = shelter, ab = borderline, before/after = before/after training session, date = date of data collection, temp = temperature, Akasha gone = before or after Akasha had left the group, food = food availability. p = significance level (≤ 5 % = significant result), corr. Coeff = Pearson correlations coefficient: positive = positive correlation / negative = negative correlation (higher number means a stronger relation between factors).

Carla	*r*	*weath.*	*p*	*w*	*s*	*Att1*	*Att2*	*f*	*lk*	
p	0,228	0,275				-0,392	0,401			**corr. Coeff.**
	3,00	0,83				0,01	0,01			**p (%)**
s	-0,264	-0,278				0,225	-0,226			**corr. Coeff.**
	1,15	0,76				3,20	3,13			**p (%)**
Att 1		-0,271								**corr. Coeff.**
		0,009								**p (%)**
Att 2		0,276								**corr. Coeff.**
		0,81								**p (%)**
f	-0,684		-0,349		0,445					**corr. Coeff.**
	0,00		0,07		0,00					**p (%)**
wt	-0,378		0,360		-0,422	-0,318	0,313	-0,216		**corr. Coeff.**
	0,02		0,04		0,00	0,21	0,25	4,00		**p (%)**
a					0,210	-0,299	0,278	-0,261		**corr. Coeff.**
					4,62	0,40	0,77	1,25		**p (%)**
b				-0,213		0,344	-0,324	0,299		**corr. Coeff.**
				4,22		0,08	0,18	0,39		**p (%)**
ab	0,214			0,324		-0,236	0,234	-0,203		**corr. Coeff.**
	4,16			0,17		2,42	2,58	5,33		**p (%)**
before/after			0,428		-0,357	-0,256	0,260		-0,180	**corr. Coeff.**
			0,00		0,05	1,43	1,27		8,73	**p (%)**
date				-0,345		-0,396	0,425		-0,219	**corr. Coeff.**
				0,08		0,01	0,00		3,73	**p (%)**
temp.			-0,198		0,192					**corr. Coeff.**
			5,94		*6,90*					**p (%)**
Akasha gone				-0,318		-0,331	0,363		-0,198	**corr. Coeff.**
				0,21		0,13	0,04		5,99	**p (%)**
food								-0,193		**corr. Coeff.**
								6,66		**p (%)**

Logical correlations between parameters, for example temperature and weather, weather and visitor number, standing and pacing, Att1 & Att2 etc. will not be discussed further.

Time spent pacing correlates positively with time spent ruminating, weather, medium attention and time spent watching. It correlates negatively with temperature, feeding and Att1 → Carla paced more on cold/rainy days, when she was mostly medium alert, ruminated and watched more, and fed less. The correlation with "after training" is highly significant, meaning that she paces more after training/later in the day.

Standing links negatively with time spent ruminating, weather, Att2, before/after and watching. It correlates positively with time spent feeding, Att1, temperature and A. Thus, she spent time standing still during good weather, when she was more relaxed, spent more time outside, fed more, plus watched and ruminated less. She stood still significantly less after training/later in the day.

The presence in A correlates negatively with low attention and feeding. It links positively with medium attention and standing. That means she spent more time in A, when her attention was higher and when she fed less. She spent more time in B on days when she walked less, fed more and displayed less attention. The presence in AB was higher when she ruminated or walked more, fed less and displayed medium attention.

The factor weather links negatively with low attention and positively with medium attention, meaning that her attention was more often medium on bad weather days.

Walking correlates negatively with date, meaning that she spent more time walking earlier in the year. This fits with the negative correlation with Akasha gone.

Attention was higher after training/later in the day and also later in the year (positive correlation with date & Akasha gone).

Licking does not significantly correlate with any factor but date (negatively) and there is a strong trend that she licked less after training and after Akasha was gone.

4.1.2 Complete comparison of training days vs. non – training – days:

The comparison of the percentages of movements, behaviors, attention and place between TDs and NTDs resulted in following table:

Tab. 2: Average, median and standard deviation of the percentages of all parameters on training days (N=50) and non-training-days (N=41) for Carla. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, r = ruminating, lk = licking, wt = watching, A = meadow, B = shelter, AB = borderline.

Carla	Movement			Attention		Behavior				Place		
Training days	**p**	**s**	**w**	**1**	**2**	**f**	**r**	**lk**	**wt**	**A**	**B**	**AB**
Average overall	**26,63%**	59,64%	8,16%	43,54%	54,96%	35,55%	45,60%	**0,80%**	13,57%	13,39%	83,04%	3,57%
Median overall	**15,00%**	66,67%	5,83%	42,50%	51,67%	36,67%	43,33%	**0,00%**	6,67%	6,67%	89,45%	1,67%
Standard deviation	**28,51%**	31,15%	8,65%	31,74%	31,47%	30,69%	32,08%	**2,26%**	16,19%	16,70%	19,16%	6,42%
Non-training-days	**p**	**s**	**w**	**1**	**2**	**f**	**r**	**lk**	**wt**	**A**	**B**	**AB**
Average overall	**27,07%**	56,87%	7,40%	38,17%	59,96%	31,14%	43,29%	**0,73%**	16,87%	15,33%	81,71%	2,97%
Median overall	**15,00%**	58,33%	5,00%	36,67%	61,67%	25,00%	40,00%	**0,00%**	6,67%	8,33%	88,33%	1,67%
Standard deviation	**29,95%**	31,97%	7,59%	33,37%	33,00%	28,11%	33,24%	**1,83%**	23,67%	21,03%	21,24%	4,21%

The Wilcoxon test gives the following results: None of the differences are significant. The overall behavioral pattern is relatively equal on TDs and NTDs. The time spent pacing is relatively equal in both data sets and makes up almost a third of her movement pattern in average. Licking hardly occurs.

4.1.3 Before training vs. after training on TDs:

A Comparison of the parameters before training (N=25) and after training (N=25) on training days gave these results:

Tab. 3: Average, median and standard deviation of the percentages of all parameters before (N=25) and after training (N=25) on TDs. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, r = ruminating, lk = licking, wt = watching, A = meadow, B = shelter, AB = borderline..

Carla	Movement			Attention		Behavior				Place		
Before training on TDs	**p**	**s**	**w**	**1**	**2**	**f**	**r**	**lk**	**wt**	**A**	**B**	**AB**
Average	**15,40%**	70,87%	6,73%	50,47%	48,20%	37,47%	47,53%	**1,40%**	9,33%	12,80%	84,53%	2,67%
Median	**8,33%**	75,00%	5,00%	56,67%	40,00%	38,33%	41,67%	**0,00%**	3,33%	6,67%	93,33%	1,67%
Standard deviation	**18,37%**	24,17%	6,81%	33,32%	32,08%	22,80%	29,37%	**3,07%**	11,92%	18,92%	20,02%	3,57%
After training on TDs	**p**	**s**	**w**	**1**	**2**	**f**	**r**	**lk**	**wt**	**A**	**B**	**AB**
Average	**37,87%**	48,40%	9,59%	36,61%	61,71%	33,63%	43,67%	**0,20%**	17,80%	13,98%	81,56%	4,47%
Median	**33,33%**	46,67%	6,67%	41,67%	58,33%	20,75%	48,33%	**0,00%**	11,67%	9,43%	86,67%	1,67%
Standard deviation	**32,55%**	33,68%	10,10%	29,09%	29,95%	37,36%	35,08%	**0,55%**	18,85%	14,52%	18,54%	8,34%

Significant differences were found with a Wilcoxon Test for the following parameters: Pacing (p = 0,001), standing (p = 0,006), licking (not significant, but a strong trend - p = 0,056), watching (p = 0,028), Att1 (p = 0,033), Att2 (p = 0,028).

The difference in time spent pacing before and after training is visible in following diagrams: It more than doubles.

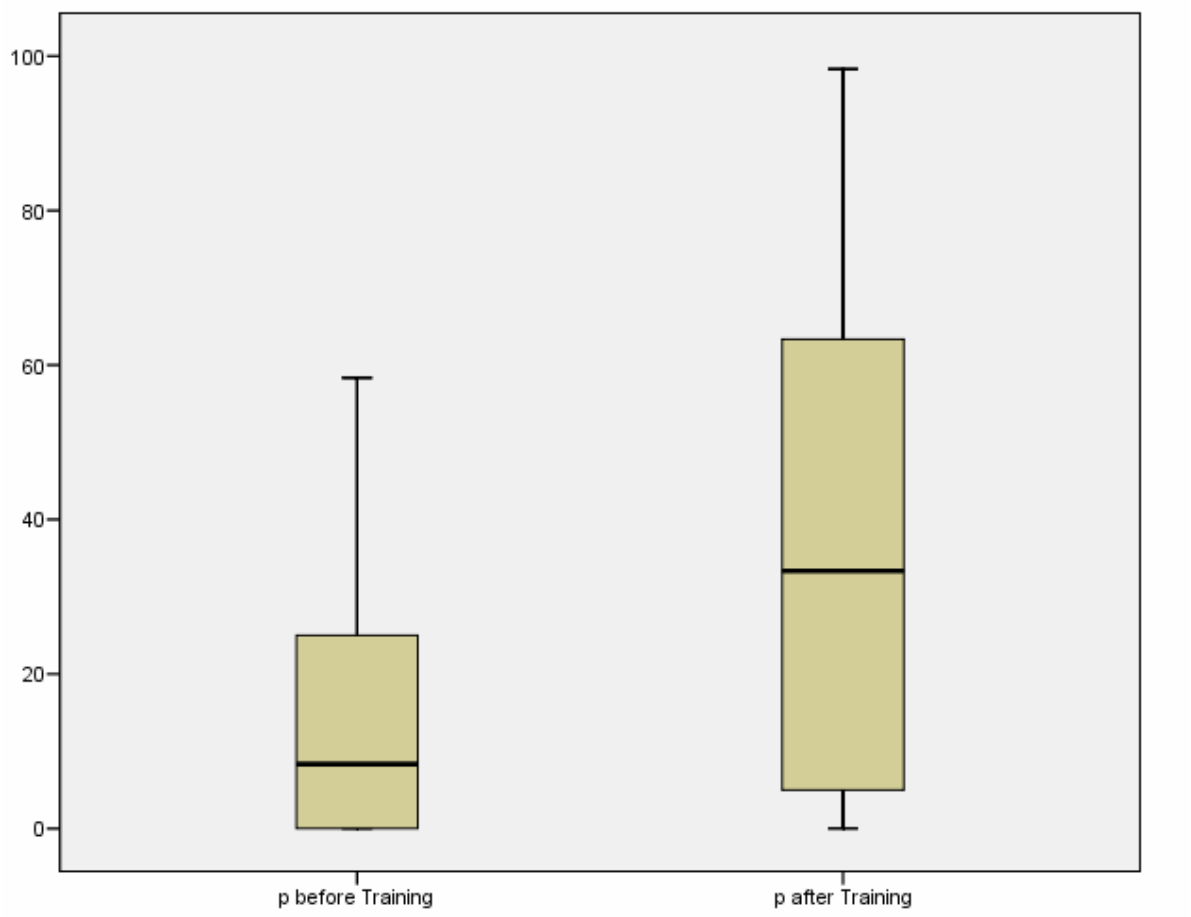

Fig. 3: Time spent pacing before and after training on training days for Carla.
Stem and leaf diagram with a confidence interval of 95%.

4.1.4 “Before training” vs. “after training” on NTDs:

To get an idea whether the differences in the parameters between the time before and after training relates to the training or the time of day, the same analysis was done for non-training-days:

Tab. 4: Average, median and standard deviation of the percentages of all parameters “before” (N=21) and “after training” (N=20) on NTD's. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Carla	Movement			Attention		Behavior				Place		
"Before training" on NTDs	p	s	w	1	2	f	lk	r	wt	A	B	AB
Average	**14,13%**	67,62%	7,54%	46,75%	51,35%	38,65%	**0,87%**	39,44%	16,03%	14,76%	83,02%	2,22%
Median	**10,00%**	75,00%	6,67%	51,67%	48,33%	45,00%	**0,00%**	31,67%	6,67%	10,00%	90,00%	1,67%
Standard deviation	**20,31%**	29,40%	7,30%	33,64%	33,10%	32,56%	**2,02%**	33,17%	23,58%	17,75%	17,80%	2,85%
"After training" on NTDs	p	s	w	1	2	f	lk	r	wt	A	B	AB
Average	**40,67%**	45,58%	7,25%	29,17%	69,00%	23,25%	**0,58%**	47,33%	17,75%	15,92%	80,33%	3,75%
Median	**40,83%**	43,33%	5,00%	23,33%	75,00%	22,50%	**0,00%**	51,67%	8,33%	5,83%	84,17%	2,50%
Standard deviation	**32,77%**	31,30%	8,08%	31,40%	31,16%	20,49%	**1,65%**	33,68%	24,35%	24,47%	24,75%	5,24%

Wilcoxon tests found significant differences for: Pacing: (p = 0,005), Standing (p = 0,059), Att1 (p = 0,033) and Att2 (p = 0,033). Again, the time spent pacing more than doubles:

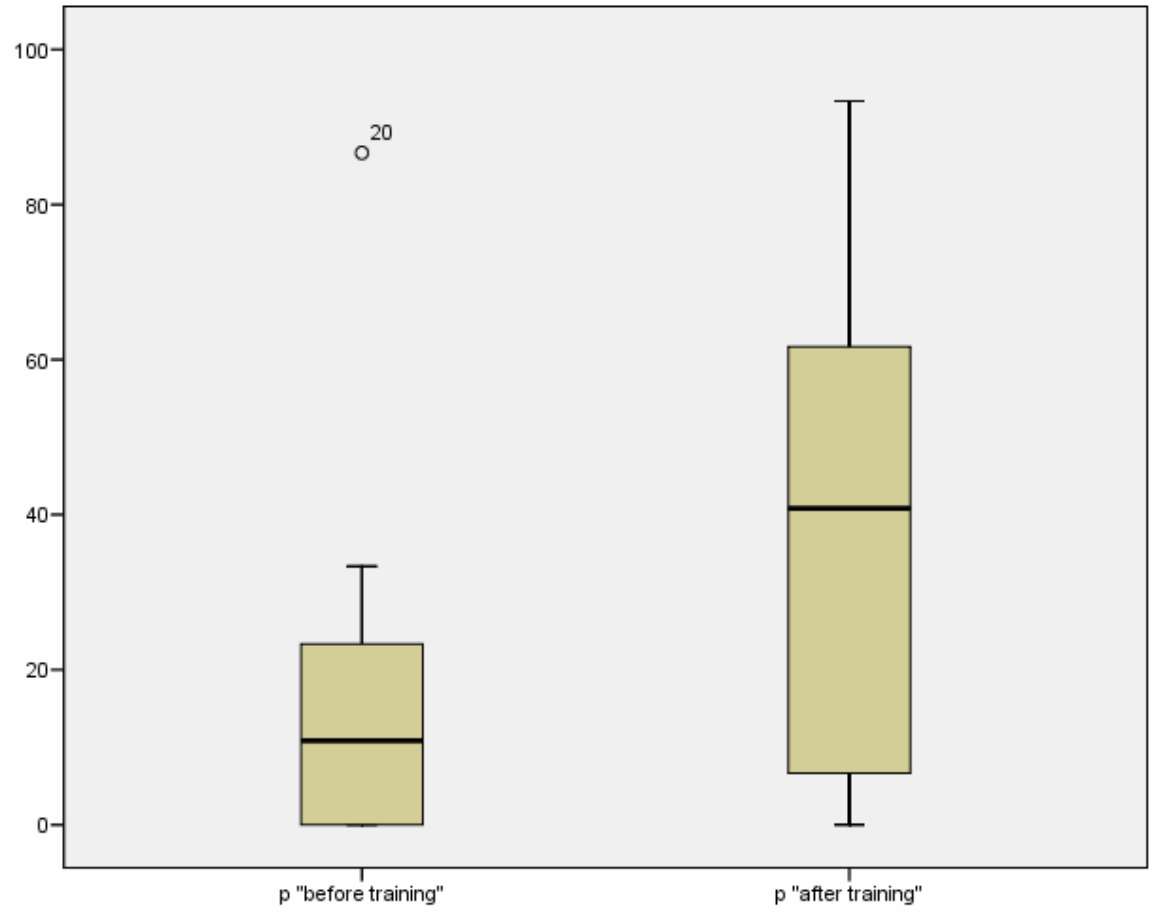

Fig 4: Comparison of time spent pacing before and after training time on non-training-days for Carla. Stem and leaf diagram with a confidence interval of 95%.

4.1.5 Before training on TDs vs. “before training” on NTDs:

In Order to clarify the question about the origin of the differences in the percentage of the parameters, the data before training time in both data sets is compared:

Tab. 5: Average, median and standard deviation of the percentages of all parameters before training on TDs (N=25) and “before training” (N=21) on NTD's. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Carla	Movement			Attention		Behavior				Place		
Before training on TDs	p	s	w	1	2	f	r	lk	wt	A	B	AB
Average	**15,40%**	70,87%	6,73%	50,47%	48,20%	37,47%	47,53%	**1,40%**	9,33%	12,80%	84,53%	2,67%
Median	**8,33%**	75,00%	5,00%	56,67%	40,00%	38,33%	41,67%	**0,00%**	3,33%	6,67%	93,33%	1,67%
Standard deviation	**18,37%**	24,17%	6,81%	33,32%	32,08%	22,80%	29,37%	**3,07%**	11,92%	18,92%	20,02%	3,57%
"Before training" on NTDs	p	s	w	1	2	f	r	lk	wt	A	B	AB
Average	**14,13%**	67,62%	7,54%	46,75%	51,35%	38,65%	39,44%	**0,87%**	16,03%	14,76%	83,02%	2,22%
Median	**10,00%**	75,00%	6,67%	51,67%	48,33%	45,00%	31,67%	**0,00%**	6,67%	10,00%	90,00%	1,67%
Standard deviation	**20,31%**	29,40%	7,30%	33,64%	33,10%	32,56%	33,17%	**2,02%**	23,58%	17,75%	17,80%	2,85%

The data sets show no significant differences.

4.1.6 After training on TDs vs. “after training” on NTDs:

To gain final certainty about the origin of any differences, the data after training on training days and “after training” on non-training-days are compared:

Tab. 6: Average, median and standard deviation of the percentages of all parameters after training on TDs (N=25) and “after training” on NTDs (N=20). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, r = ruminating, wt = watching, a = meadow, b = shelter, ab = borderline.

Carla	Movement			Attention		Behavior				Place		
After training on TDs	p	s	w	1	2	f	lk	r	wt	A	B	AB
Average	**37,87%**	48,40%	9,59%	36,61%	61,71%	33,63%	0,20%	**43,67%**	17,80%	13,98%	81,56%	4,47%
Median	**33,33%**	46,67%	6,67%	41,67%	58,33%	20,75%	0,00%	**48,33%**	11,67%	9,43%	86,67%	1,67%
Standard deviation	**32,55%**	33,68%	10,10%	29,09%	29,95%	37,36%	0,55%	**35,08%**	18,85%	14,52%	18,54%	8,34%
After training on NTDs	p	s	w	1	2	f	lk	r	wt	A	B	AB
Average	**40,67%**	45,58%	7,25%	29,17%	69,00%	23,25%	0,58%	**47,33%**	17,75%	15,92%	80,33%	3,75%
Median	**40,83%**	43,33%	5,00%	23,33%	75,00%	22,50%	0,00%	**51,67%**	8,33%	5,83%	84,17%	2,50%
Standard deviation	**32,77%**	31,30%	8,08%	31,40%	31,16%	20,49%	1,65%	**33,68%**	24,35%	24,47%	24,75%	5,24%

Again, there are no significant differences.

4.2 Kimbar:

4.2.1 Complete behavioral analysis - correlations between behavioral and other factors:

For Kimbar, the male adult, the complete behavioral analysis showed a broad range of significant correlations and trends:

Tab. 7: Significant correlations/trends between various parameters (N=91) of the overall behavioral pattern of Kimbar. Blue: positive correlation; red: negative correlation. Abbreviations: r = ruminating, p = pacing, w = walking, s = standing, Attention 1 = low, Attention 2 = medium, lk = licking, n = necking, wt = watching, a = meadow, b = shelter, ab = borderline, f = feeding, before/after = before/after training session, date = date of data collection, temp = temperature, Akasha gone = before or after Akasha had left the group, food = food availability, training: if training took place or not. p = significance level (≤ 5 % = significant result), corr. Coeff = Pearson correlations coefficient: positive = positive correlation / negative = negative correlation (higher number means a stronger relation between factors).

Kimbar	r	p	w	s	Att1	Att2	lk	n	wt	a	b	ab	
p	0,281				-0,280	0,268						0,194	corr. Coeff.
	0,69				0,72	1,03						6,54	p (%)
s					0,315	-0,283		-0,398	-0,201				corr. Coeff.
					0,24	0,65		0,01	5,64				p (%)
Att 1			-0,219									-0,380	corr. Coeff.
			3,68									0,02	p (%)
Att 2												0,376	corr. Coeff.
												0,02	p (%)
f	-0,613				0,264	-0,254	-0,244			-0,593	0,645		corr. Coeff.
	0,00				1,13	1,51	1,98			0,00	0,00		p (%)
wt			0,338									0,264	corr. Coeff.
			0,11									1,14	p (%)
lk	-0,261			0,208	-0,367	0,363						0,333	corr. Coeff.
	1,26			4,79	0,03	0,04						0,12	p (%)
A	0,437												corr. Coeff.
	0,00												p (%)
B	-0,442												corr. Coeff.
	0,00												p (%)
AB			0,252										corr. Coeff.
			1,61										p (%)
before/after		0,255	0,238	-0,199	-0,226	0,220			0,212	-0,226		0,219	corr. Coeff.
		1,46	2,34	5,82	3,15	3,58			4,35	3,12		3,68	p (%)
date			-0,263	0,393	-0,299	0,341	0,244	-0,439					corr. Coeff.
			1,17	0,01	0,40	0,10	1,98	0,00					p (%)
temp	0,383				0,215	-0,186	-0,306		-0,220	0,191			corr. Coeff.
	0,02				4,02	7,75	0,32		3,59	6,99			p (%)
Akasha gone		-0,209	-0,253	0,469	-0,201	0,235	0,269	-0,399					corr. Coeff.
		4,70	1,56	0,00	5,60	2,50	0,99	0,01					p (%)
food			-0,219						-0,192				corr. Coeff.
			3,70						6,76				p (%)

weather	-0,206				-0,357	0,354	0,315						**corr. Coeff.**
	4,98				0,05	0,06	0,24						**p (%)**
training							0,199						**corr. Coeff.**
							5,90						**p (%)**

Logical correlations between parameters, for example weather and temperature, standing & pacing etc. will again not be discussed further.

Ruminating shows positive correlations with pacing, A and temperature. It shows negative correlations with feeding, licking, B and weather. This means, Kimbar ruminated more when he spent more time in A, when it was warm and when he paced more. The more he ruminates, the less he licks.

Pacing is associated positively with before/after training, walking, Att2 and AB. It is correlated negatively with Akasha gone and Att1. Obviously, he paces more after training, when also walking more, being more at medium attention and crossing between A and B more often. He paced less after Akasha was gone.

Positive correlations were found between licking and weather, standing, date, Akasha gone, Att2 and training, as well as AB. Negative correlations were found with temp, ruminating and Att1. During bad weather, later in the year, after Akasha was gone, when he stood more, was more at medium attention and on training days he licked more and he usually conducted licking while standing in AB

Necking links negatively with standing, date and Akasha gone. So he necked less after Akasha was gone, later the year and when he spent more time standing.

Walking correlates negatively with Att1, date, Akasha gone and food availability. Positive correlations were found for watching, AB and before/after training. When walking more, his attention was higher. He walked less later the year and after Akasha was gone, as well as when much food was available. When walking more, he also watched his surroundings more and passed through AB often. After training, he walked more.

Standing links in a positive way with licking, Att1, date and Akasha gone. It correlates negatively with Att2, necking, watching and before/after. This means, later in the year/after Akasha was gone, when he licked more and when his attention was lower, he stood still more. When he necked or watched less, more time was spent standing.

Positive correlations were found between feeding and Att1 and B, while negative correlations were found with Att2, licking and A. When he spent more time in B and at low attention, he fed more. The more time he fed, the less he licked.

Att1 is associated positively with temp and negatively with weather, licking, before/after, date, Akasha gone and AB and vice versa for Att2. Thus, the attention was more often medium during higher temperatures, when licking and standing at AB more, after training, later the year and after Akasha was gone.

The time spent watching links positively with before/after and AB and negatively with temperature and food availability. After training and when spending more time in AB he spent more time watching, whereas he watched less when it was warm and when more food was available.

Before/after training correlates negatively with A and positively with AB. Temp links positively with A. Before training and on warm days he spent more time in A and less in AB, at least before training.

4.2.2 Complete comparison of training days vs. non – training – days:

Tab. 8: Average, median and standard deviation of the percentages of all parameters on TDs (N=50) and NTDs (N=41). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, n = necking, r = ruminating, wt = watching, ix = sexual interaction, A = meadow, B = shelter, AB = borderline.

Kimbar	Movement			Attention		Behavior						Place		
TDs	p	s	w	1	2	f	lk	n	r	wt	ix	A	B	AB
Average	2,67%	89,05%	5,28%	50,85%	47,78%	49,05%	6,87%	2,90%	28,66%	1,40%	3,31%	30,94%	64,02%	5,04%
Median	0,00%	95,00%	5,00%	56,67%	42,50%	49,17%	0,83%	0,00%	18,33%	0,00%	0,00%	23,33%	71,67%	1,67%
Stand. Dev.	8,09%	14,22%	4,77%	27,37%	27,03%	27,71%	13,48%	7,83%	27,75%	2,96%	6,32%	29,94%	29,52%	9,24%
NTDs	p	s	w	1	2	f	lk	n	r	wt	ix	A	B	AB
Average	0,65%	91,63%	5,24%	48,98%	48,86%	52,76%	15,16%	1,79%	16,06%	3,25%	2,97%	23,25%	71,54%	5,20%
Median	0,00%	95,00%	3,33%	56,67%	41,67%	51,67%	5,00%	0,00%	5,00%	0,00%	1,67%	15,00%	80,00%	1,67%
Stand. Dev.	4,07%	8,33%	4,83%	31,10%	31,59%	28,95%	21,98%	5,03%	22,95%	8,86%	4,61%	26,31%	26,97%	9,60%

The behavioral parameters of Kimbar differ between TDs and NTDs. He paced more on TDs and licked more on NTDs. Furthermore, he spent less time ruminating on NTDs.

The reduction of the time spent pacing ($p = 0,066$) is almost significant, differences in time spent licking ($p = 0,0020$) and ruminating ($p = 0,003$) are highly significant. The median of licking more than quadrupled on training days and ruminating reduced to a bit more than a third.

The differences in pacing are minimal due to the small amount of pacing itself. Thus they are not visible in a stem and leaf diagram and only the change in the licking proportion is depicted in following diagram:

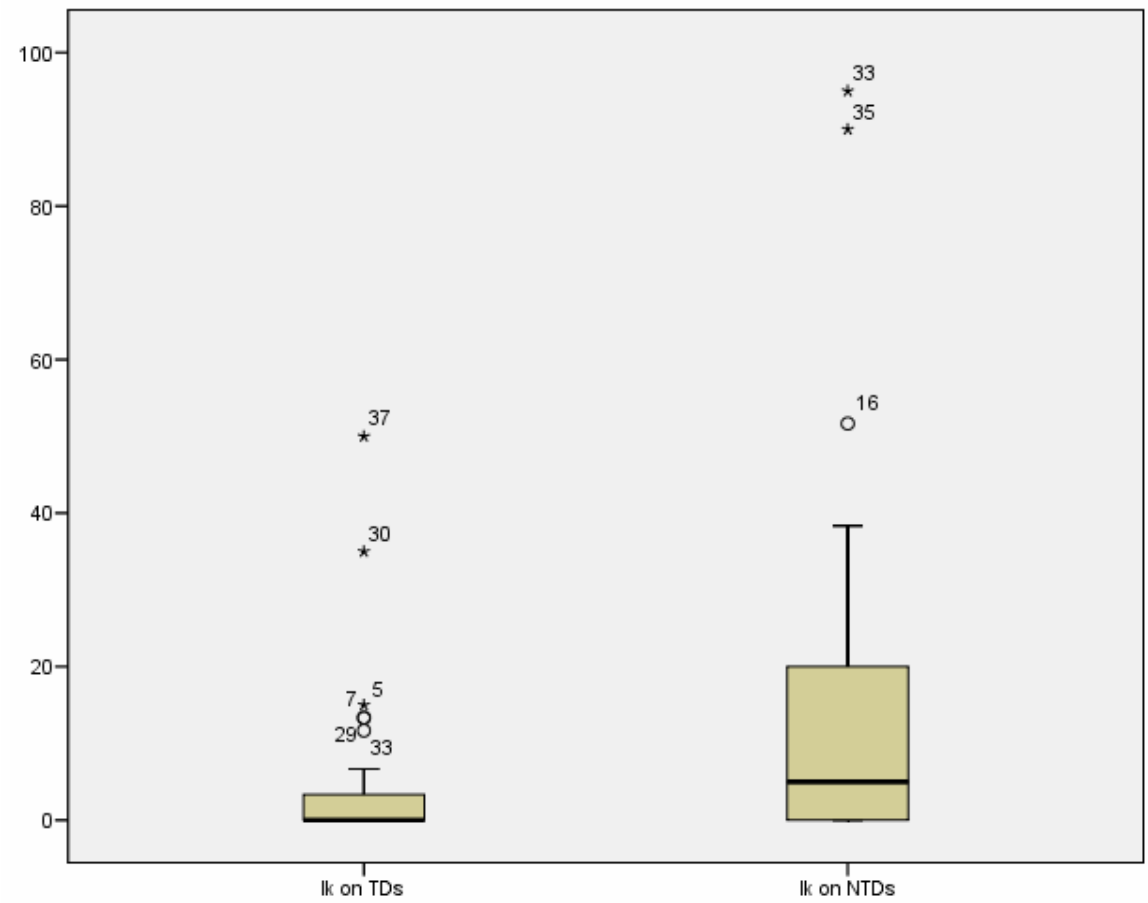

Fig. 5: Comparison of time spent licking on training days and non-training-days for Kimbar. Stem and leaf diagram with a confidence interval of 95%.

4.2.3 Before training vs. after training on TDs:

Tab. 9: Average, median and standard deviation of the percentages of all parameters before (N=25) and after training (N=25) on TDs for Kimbar. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, n = necking, r = ruminating, ix = sexual interaction, wt = watching, A = meadow, B = shelter, AB = borderline.

Kimbar	Movement			Attention		Behavior						Place		
before tr. on TD's	p	s	w	Att1	Att2	f	lk	n	r	ix	wt	A	B	AB
Average	0,20%	92,67%	3,93%	59,33%	39,93%	43,87%	6,27%	3,87%	31,87%	1,67%	1,73%	41,20%	56,00%	2,80%
Median	0,00%	95,00%	5,00%	65,00%	35,00%	43,33%	1,67%	0,00%	20,00%	0,00%	0,00%	30,00%	66,67%	0,00%
Stand. Dev.	1,00%	7,58%	3,56%	26,42%	25,93%	26,69%	11,59%	8,55%	27,24%	3,19%	4,82%	31,07%	30,20%	5,83%
after tr. on NTD's	p	s	w	Att1	Att2	f	lk	n	r	ix	wt	A	B	AB
Average	5,15%	85,43%	6,62%	42,36%	55,63%	54,24%	7,47%	1,93%	25,45%	1,13%	4,89%	20,69%	72,04%	7,28%
Median	0,00%	93,33%	5,00%	48,33%	45,00%	53,33%	0,00%	0,00%	16,67%	0,00%	1,67%	10,00%	80,00%	1,67%
Stand. Dev.	10,94%	18,11%	5,48%	26,11%	26,29%	28,28%	15,37%	7,08%	28,43%	2,75%	7,29%	25,40%	27,08%	11,40%

With a Wilcoxon test, there are significant differences between the following parameters: An increase in pacing (p = 0,025), Att2 (p = 0,049), watching (p = 0,015), time spent in B (p = 0,042) and AB (p = 0,036). A significant decrease is visible in Att 1 (p = 0,032) and time spent in A (p = 0,017).

The change in pacing frequency is depicted in detail here:

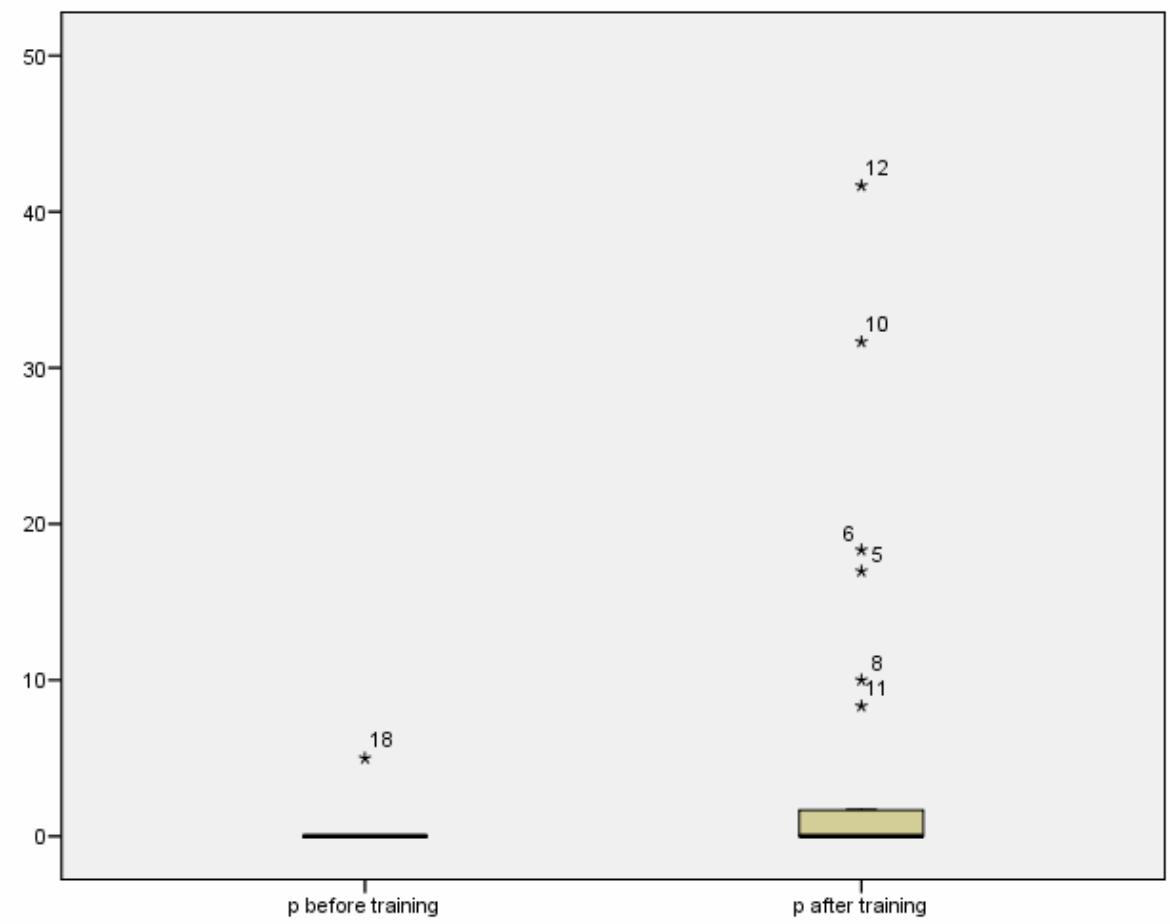

Fig. 6: Comparison of time spent pacing before training and after training on TDs for Kimbar. Stem and leaf diagram with a confidence interval of 95%.

4.2.4 “Before training” vs. “after training” on NTDs:

As with Carla, the same analysis was done on non-training-days to get an idea whether the differences in the parameters between the time before and after training are related to the training or rather the time of day:

Tab. 10: Kimbar’s average, median and standard deviation of the percentages of all parameters “before” (N=21) and “after training” (N=20) on NTDs. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, n = necking, r = ruminating, ix = sexual interaction, wt = watching, A = meadow, B = shelter, AB = borderline.

Kimbar	Movement			Attention		Behavior						Place		
before tr.on NTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	0,00%	93,33%	4,17%	51,17%	46,25%	55,58%	13,00%	1,92%	18,67%	2,42%	4,00%	25,42%	71,17%	3,42%
Median	0,00%	94,17%	3,33%	58,33%	40,83%	57,50%	9,17%	0,00%	5,00%	0,83%	0,00%	15,00%	79,17%	1,67%
Stand. Dev.	0,00%	6,86%	3,23%	30,43%	31,04%	29,12%	15,00%	6,11%	25,93%	2,91%	11,93%	26,26%	27,37%	5,63%
after tr. on NTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	1,33%	90,50%	6,33%	46,08%	52,17%	49,25%	18,08%	1,17%	13,92%	3,67%	2,00%	21,25%	71,83%	6,92%
Median	0,00%	95,00%	4,17%	54,17%	41,67%	50,83%	5,00%	0,00%	5,00%	1,67%	0,00%	10,83%	80,83%	1,67%
Stand. Dev.	5,96%	10,03%	6,16%	33,81%	34,15%	30,57%	28,44%	3,94%	20,99%	6,08%	4,48%	28,16%	28,56%	12,79%

There were no significant differences or trends between the time before and after training on non-training-days with a Wilcoxon test.

4.2.5 Before training on TDs vs. “before training” on NTDs:

To clarify the question about the origin of the differences in the percentages of the parameters of NTDs and TDs, the data before training in both data sets is compared:

Tab. 11: Kimbar’s average, median and standard deviation of the percentages of all parameters before training on TDs (N=25) and “before training” on NTDs (N=21). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, n = necking, r = ruminating, wt = watching, ix = sexual interaction, A = meadow, B = shelter, AB = borderline.

Kimbar	Movement			Attention		Behavior						Place		
before tr.onTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	0,20%	92,67%	3,93%	59,33%	39,93%	43,87%	6,27%	3,87%	31,87%	1,73%	1,67%	41,20%	56,00%	2,80%
Median	0,00%	95,00%	5,00%	65,00%	35,00%	43,33%	1,67%	0,00%	20,00%	0,00%	0,00%	30,00%	66,67%	0,00%
Stand. Dev.	1,00%	7,58%	3,56%	26,42%	25,93%	26,69%	11,59%	8,55%	27,24%	4,82%	3,19%	31,07%	30,20%	5,83%
"before tr." on NTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	0,00%	93,33%	4,17%	51,17%	46,25%	55,58%	13,00%	1,92%	18,67%	2,42%	4,00%	25,42%	71,17%	3,42%
Median	0,00%	94,17%	3,33%	58,33%	40,83%	57,50%	9,17%	0,00%	5,00%	0,83%	0,00%	15,00%	79,17%	1,67%
Stand. Dev.	0,00%	6,86%	3,23%	30,43%	31,04%	29,12%	15,00%	6,11%	25,93%	2,91%	11,93%	26,26%	27,37%	5,63%

There were no significant differences, but three mild trends: more licking “before training” on NTDs (P=0,84), less presence in A (P=0,82), and more in B (P=0,68).

Following diagram visualizes the change in the licking frequency:

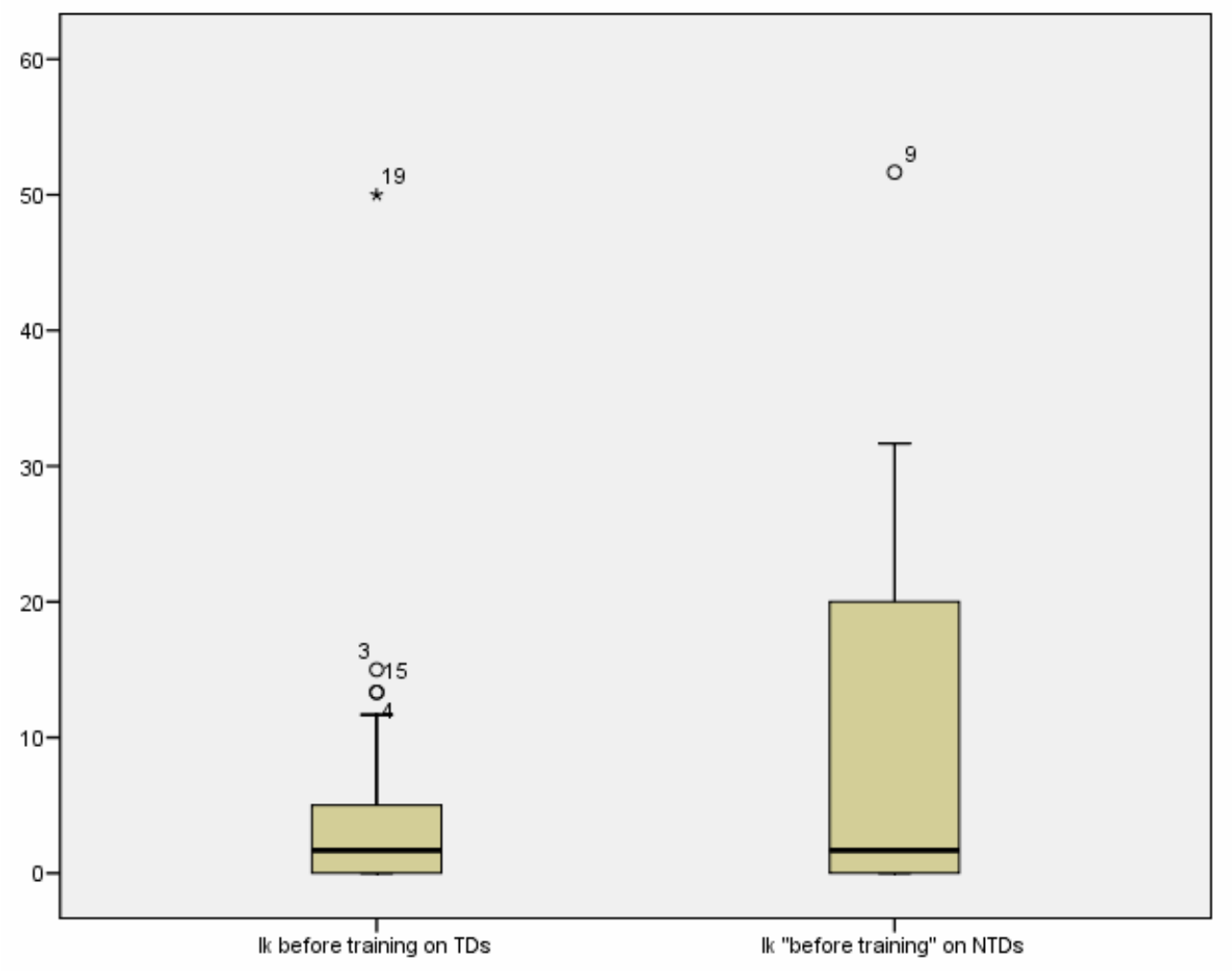

Fig. 7: Comparison of time spent licking before training on TDs and “before training” on NTDs for Kimbar. Stem and leaf diagram with a confidence interval of 95%.

4.2.6 After training on TDs vs. “after training” on NTDs:

To find further information about the origin of the differences, the data after training on training days and “after training” on non-training-days are compared:

Tab. 12: Kimbar’s average, median and standard deviation of the percentages of all parameters after training on TDs(N=25) and “after training” on NTDs (N=20). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, f = feeding, lk = licking, n = necking, r = ruminating, wt = watching, ix = sexual interaction, A = meadow, B = shelter, AB = borderline.

Kimbar	Movement			Attention		Behavior						Place		
after tr. onTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	5,15%	85,43%	6,62%	42,36%	55,63%	54,24%	7,47%	1,93%	25,45%	4,89%	1,13%	20,69%	72,04%	7,28%
Median	0,00%	93,33%	5,00%	48,33%	45,00%	53,33%	0,00%	0,00%	16,67%	1,67%	0,00%	10,00%	80,00%	1,67%
Stand. Dev.	10,94%	18,11%	5,48%	26,11%	26,29%	28,28%	15,37%	7,08%	28,43%	7,29%	2,75%	25,40%	27,08%	11,40%
"after tr." on NTD's	p	s	w	Att1	Att2	f	lk	n	r	wt	ix	A	B	AB
Average	1,33%	90,50%	6,33%	46,08%	52,17%	49,25%	18,08%	1,17%	13,92%	3,67%	2,00%	21,25%	71,83%	6,92%
Median	0,00%	95,00%	4,17%	54,17%	41,67%	50,83%	5,00%	0,00%	5,00%	1,67%	0,00%	10,83%	80,83%	1,67%
Stand. Dev.	5,96%	10,03%	6,16%	33,81%	34,15%	30,57%	28,44%	3,94%	20,99%	6,08%	4,48%	28,16%	28,56%	12,79%

The results of the Wilcoxon test show significantly more licking (P = 0,13) and less ruminating (P=0,16) “after training” on non-training-days. Furthermore, there is a mild trend (P=0,93) that Kimbar paces less “after training” on NTDs. The differences in pacing and licking frequency are visible in the following diagrams:

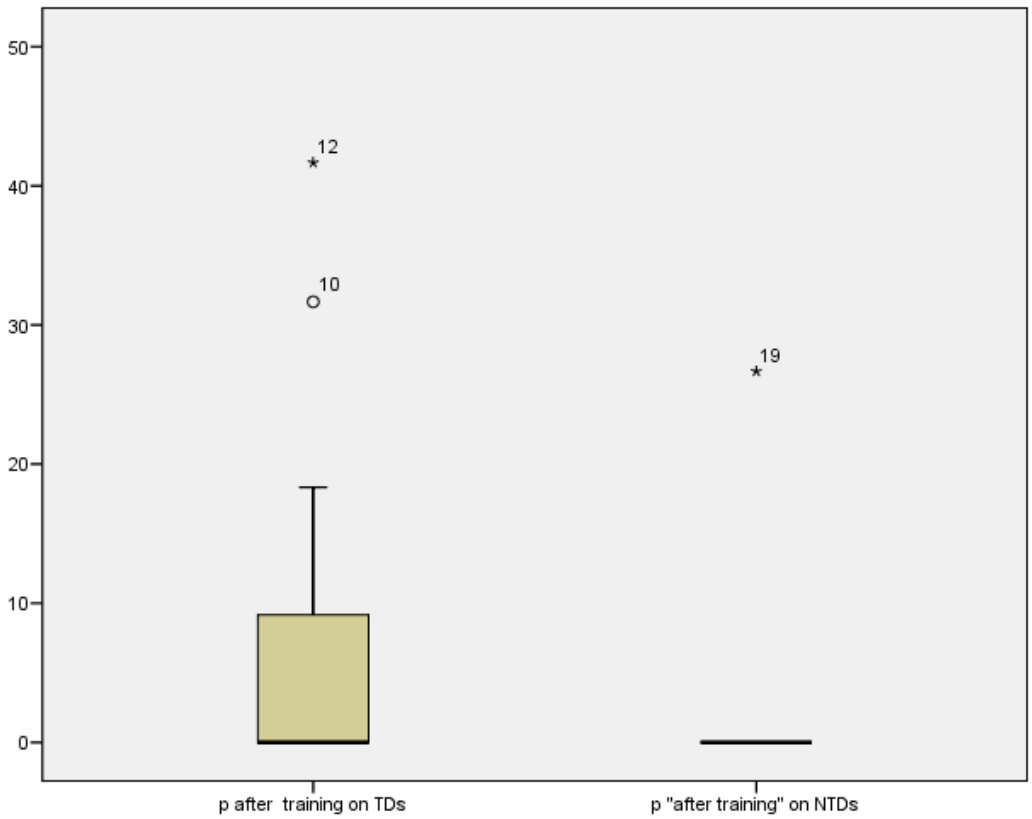

Fig. 8: Comparison of time spent pacing after training on TDs and “after training” on NTDs for Kimbar. Stem and leaf diagram with a confidence interval of 95%.

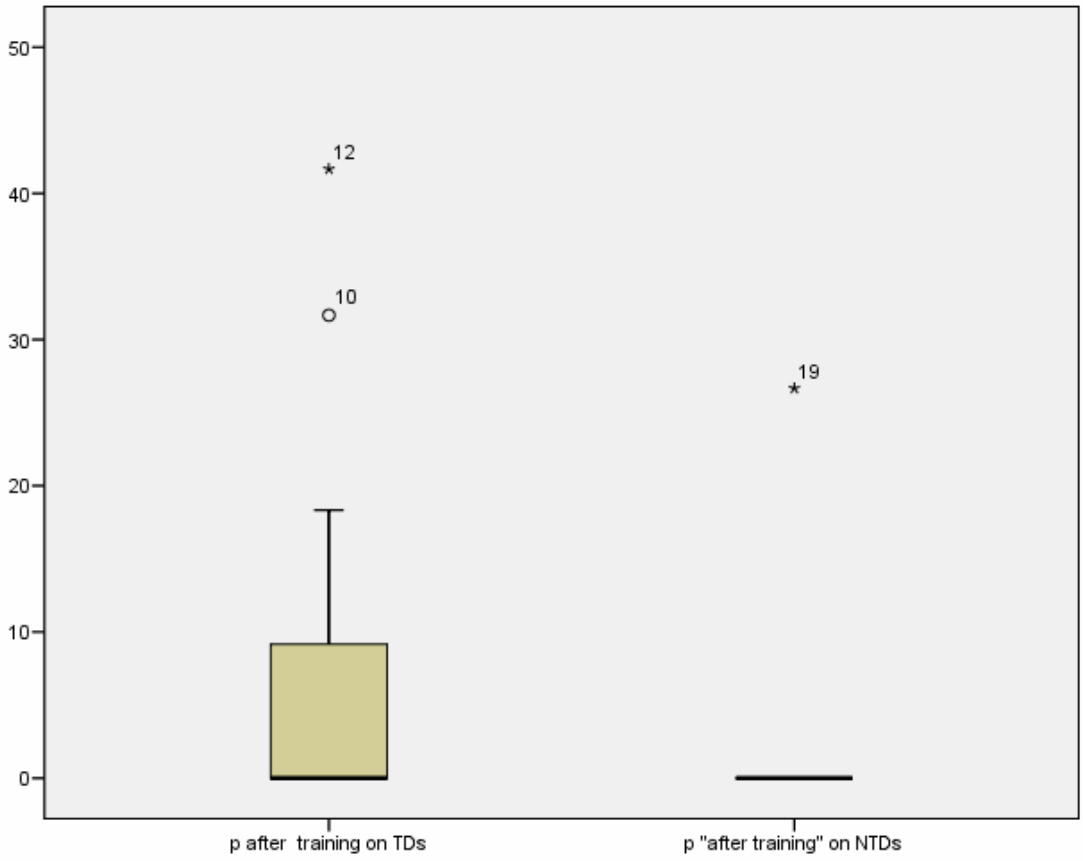

Fig. 9: Comparison of time spent licking after training on TDs and “after training” on NTDs for Kimbar. Stem and leaf diagram with a confidence interval of 95%.

4.3 Rita:

4.3.1 Complete behavioral analysis - correlations between behavioral and other factors:

Tab. 13: Significant correlations between various parameters of the overall behavioral pattern (N=91) of Rita. Blue: positive correlation; red: negative correlation. Abbreviations: weath. = weather, p = pacing, w = walking, s = standing, Attention 1 = low, Attention 2 = medium, Attention 3 = high, a = meadow, b = shelter, ab = borderline, f = feeding, lk = licking, wt = watching, r = ruminating, before/after = before/after training session, date = date of data collection, temp = temperature, Akasha gone = before or after Akasha had left the group, visitors: number of visitors present around the giraffe house. P = significance level (≤ 5 % = significant result), corr. Coeff = Pearson correlations coefficient: positive = positive correlation / negative = negative correlation (higher number means a stronger relation between factors).

Rita	weath.	p	w	s	Att 1	Att 2	Att3	a	b	ab	f	lk	wt	
p	0,2849		0,2187							0,5131			0,3815	corr. Coeff.
	0,62		3,72							0,00			0,02	p (%)
s	-0,2269							-0,3082	0,3925	-0,3950			-0,5122	corr. Coeff.
	3,06							0,30	0,01	0,01			0,00	p (%)
Att 1	-0,3901	-0,2173	-0,3978	0,4305									-0,2562	corr. Coeff.
	0,01	3,86	0,01	0,00									1,42	p (%)
Att 2	0,3934	0,2178	0,3602	-0,4062									0,2323	corr. Coeff.
	0,01	3,81	0,05	0,01									2,67	p (%)
Att 3			0,4085	-0,3070									0,2275	corr. Coeff.
			0,01	0,31									3,01	p (%)
f						0,1905	-0,1865		0,3271					corr. Coeff.
						7,05	7,68		0,15					p (%)
r					0,3365	-0,3461							-0,4622	corr. Coeff.
					0,11	0,08							0,00	p (%)
wt			0,4065						-0,2191					corr. Coeff.
			0,01						3,69					p (%)
A			0,3856		-0,4792	0,4407	0,4200				-0,3185			corr. Coeff.
			0,02		0,00	0,00	0,00				0,21			p (%)
B			-0,4381		0,5032	-0,4600	-0,4604							corr. Coeff.
			0,00		0,00	0,00	0,00							p (%)
AB			0,2936		-0,2078		0,2559					0,3554	0,1892	corr. Coeff.
			0,47		4,81		1,43					0,05	7,25	p (%)
before/ after		0,2060	0,4261	-0,3694	-0,4044	0,4065		0,2804	-0,3322	0,2651			0,2503	corr. Coeff.
		5,01	0,00	0,03	0,01	0,01		0,71	0,13	1,11			1,67	p (%)
Date			-0,3593	0,3442					0,1876	-0,2230		-0,4712	-0,2162	corr. Coeff.
			0,05	0,08					7,50	3,36		0,00	3,95	p (%)
Temp				0,2023	0,2071	-0,2093						-0,2806		corr. Coeff.
				5,45	4,88	4,65						0,71		p (%)
Akasha gone			-0,3340	0,3285			-0,2186		0,2100	-0,2655	0,2000	-0,3770	-0,2156	corr. Coeff.
			0,12	0,15			3,73		4,57	1,10	5,73	0,02	4,01	p (%)
Visitors		-0,1971												corr. Coeff.
		6,11												p (%)

Rita shows a multitude of correlations between various factors:

Pacing correlates positively with weather, walking, AB, Att2, before/after and watching. On cloudy/rainy days, after training, when she often passes AB, walks more, watches more and is at medium attention, her pacing frequency also is higher. It correlates negatively with Att1 and visitors. When more visitors were around, she paced less, as well as when her attention was generally lower.

Walking links negatively with Att1, B, Date and Akasha gone. This means, she spent less time walking later in the year, after Akasha was gone and when she spent more time in B. Walking links positively with Att2, Att3, watching, A, AB and before/after. So she walked more after training, when her attention was higher, when she spent more time watching and in A and when she passed through AB more often.

Negative correlations were found between standing and Att2, Att3, before/after, AB, weather, watching, A and AB. Positive correlations were found wit Att1, date, temp, B and Akasha gone. So she stood still more when she spent more time in B, when her attention was lower, before training, later the year/after Akasha was gone and when the temperature was higher.

Feeding frequency links positively with Akasha gone, Att2, and B while it links negatively with A and Att3. When she fed more, her attention was more often medium and she spent more time in B. After Akasha had left, she spent more time feeding.

The time spent watching shows positive correlations with Att2, Att3, AB and before/after. It correlates negatively with Att1, B, Date and Akasha gone. This means she watched more before Akasha was gone/earlier in the year and when she spent less time in B. When her attention was higher, she spent more time in AB and after training she also watched more.

The licking frequency links positively with presence in AB and negatively with date, Akasha gone and temperature, meaning that she licked more frequently before Akasha was gone/earlier in the year and when temperatures were low.

Negative correlations can be found between Att 1 and weather, A, AB, and before/after training and positive with temp, B and ruminating. So her attention was higher before training, on warm/sunny days and when she spent more time in B or ruminating.

This fits with the positive linkage between Att2/Att3 and A, as well as Att3 with AB. Still, both also correlate negatively with B. So her attention in B is relatively equally spread.

Attention was more often medium after training and on bad weather days and higher before Akasha was gone. (Positive correlation between Att2 and weather/ before/after and negative link between Att3 and Akasha gone).

A correlates positively with before/after, and AB as well. B correlates positively with date and Akasha gone, so Rita spent more time in A or AB after training, while she spent more time in B and less in AB later the year and after Akasha had left.

4.3.2 Complete comparison of training days vs. non – training – days:

Tab. 14: Average, median and standard deviation of the percentages of all parameters on TDs (N=50) and NTDs (N=41). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B= shelter, AB = borderline.

Rita	Movement			Attention			Behavior				Place		
TDs	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	2,37%	81,76%	12,00%	38,34%	59,39%	2,24%	25,98%	1,90%	47,76%	13,75%	24,00%	71,29%	4,70%
Median	0,00%	89,17%	7,50%	31,67%	61,67%	0,00%	22,50%	0,00%	51,67%	9,17%	15,83%	80,83%	1,67%
Stand. Dev.	8,02%	20,14%	12,43%	30,54%	29,90%	3,65%	23,25%	3,26%	28,25%	13,52%	25,20%	28,17%	8,41%
NTDs	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	1,22%	86,87%	8,90%	40,37%	57,24%	2,07%	36,30%	2,76%	34,55%	17,48%	22,76%	72,68%	4,55%
Median	0,00%	90,00%	6,67%	46,67%	51,67%	0,00%	33,33%	0,00%	33,33%	15,00%	13,33%	76,67%	3,33%
Stand. Dev.	6,28%	14,00%	8,67%	30,12%	29,39%	3,22%	27,42%	4,74%	30,67%	18,17%	25,49%	25,65%	5,14%

There is only one significant difference: Rita feeds more on non-training-days (P = 0,048).

4.3.3 Before training vs. after training on TDs:

Tab. 15: Average, median and standard deviation of the percentages of all parameters before (N=25) and after training (N=25) on TDs. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Rita	Movement			Attention			Behavior				Place		
before training on TD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	0,60%	90,60%	5,33%	52,60%	45,80%	1,60%	25,07%	2,13%	51,13%	9,47%	16,47%	82,33%	1,20%
Median	0,00%	95,00%	3,33%	60,00%	38,33%	0,00%	26,67%	0,00%	55,00%	3,33%	3,33%	95,00%	0,00%
Stand. Dev.	3,00%	12,16%	6,38%	31,51%	30,53%	2,83%	17,57%	3,28%	27,78%	12,37%	22,37%	22,51%	1,83%
after training on TD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	4,13%	72,93%	18,67%	24,09%	72,97%	2,88%	26,90%	1,67%	44,38%	18,03%	31,54%	60,25%	8,21%
Median	0,00%	81,67%	15,00%	20,00%	76,67%	1,67%	18,33%	0,00%	45,00%	15,00%	21,67%	73,33%	5,00%
Stand. Dev.	10,76%	22,74%	13,50%	22,09%	22,56%	4,29%	28,17%	3,30%	28,88%	13,48%	26,04%	29,32%	10,75%

The Wilcoxon test brought following results: Significant increase of the time spent pacing (P = 0,042), walking (p = 0,000), watching (p = 0,010), time spent in A (p = 0,010) and AB (p = 0,001) and at Att2 (p = 0,001) after training.

Significant decrease of the time spent standing (p = 0,001), in B (p = 0,001) and at Att1 (p = 0,001) after training.

Although Rita hardly paced at all, there is a clear difference between the time before and the time after training:

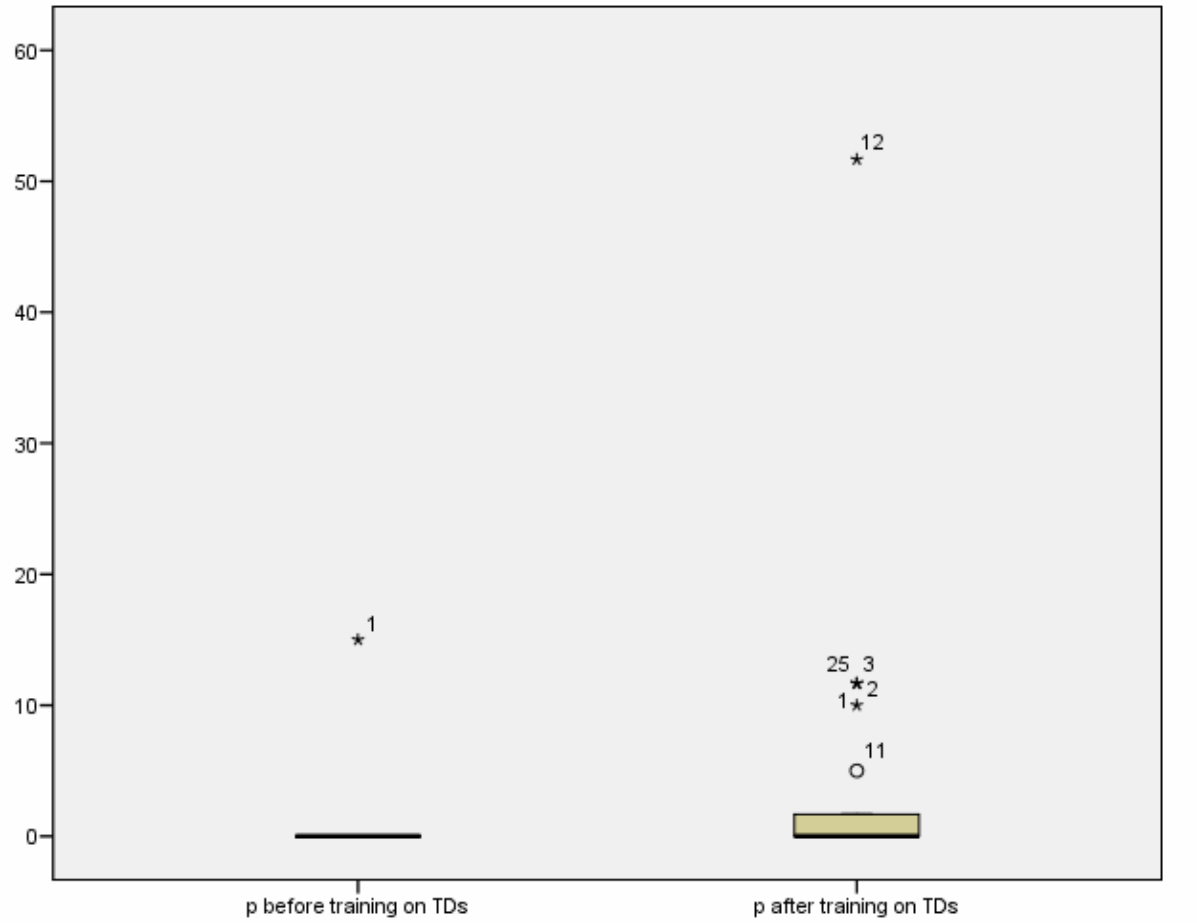

Fig. **10:** Comparison of time spent pacing before training on TDs and after training on TDs for Rita. Stem and leaf diagram with a confidence interval of 95%.

4.3.4 “Before training” vs. “after training” on NTDs:

Tab. 16: Average, median and standard deviation of the percentages of all parameters “before” (N=21) and “after training”(N=20) on NTDs. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Rita	Movement			Attention			Behavior				Place		
„before training“ on NTDs	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	0,32%	90,79%	6,43%	49,44%	47,86%	2,30%	36,83%	2,78%	38,89%	13,97%	17,06%	78,41%	4,52%
Median	0,00%	93,33%	5,00%	60,00%	38,33%	0,00%	33,33%	0,00%	38,33%	10,00%	11,67%	83,33%	1,67%
Stand. Dev.	1,13%	7,76%	4,51%	30,12%	29,04%	3,89%	27,03%	4,48%	31,96%	17,40%	23,83%	22,96%	6,10%
„after training“ on NTDs	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	2,17%	82,75%	11,50%	30,83%	67,08%	1,83%	35,75%	2,75%	30,00%	21,17%	28,75%	66,67%	4,58%
Median	0,00%	86,67%	10,00%	22,50%	72,50%	1,67%	29,17%	0,00%	20,83%	17,50%	27,50%	68,33%	3,33%
Stand. Dev.	8,94%	17,73%	11,09%	27,72%	27,06%	2,41%	28,51%	5,11%	29,35%	18,66%	26,38%	27,50%	4,04%

There are strong trends that the time spent standing (p = 0,058) and in B (p = 0,076) is decreased, while walking (p = 0,052) and Att2 (p = 0,067) are increased after training. Being in A (p = 0,030) is significantly increased after training.

4.3.5 Before training on TDs vs. “before training” on NTDs:

Tab. 17: Average, median and standard deviation of the percentages of all parameters before training on TDs (N=25) and “before training” (N=21) on NTDs. Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Rita	Movement			Attention			Behavior				Place		
before training on TD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	0,60%	90,60%	5,33%	52,60%	45,80%	1,60%	25,07%	2,13%	51,13%	9,47%	16,47%	82,33%	1,20%
Median	0,00%	95,00%	3,33%	60,00%	38,33%	0,00%	26,67%	0,00%	55,00%	3,33%	3,33%	95,00%	0,00%
Stand. Dev.	3,00%	12,16%	6,38%	31,51%	30,53%	2,83%	17,57%	3,28%	27,78%	12,37%	22,37%	22,51%	1,83%
before training on NTD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	0,32%	90,79%	6,43%	49,44%	47,86%	2,30%	36,83%	2,78%	38,89%	13,97%	17,06%	78,41%	4,52%
Median	0,00%	93,33%	5,00%	60,00%	38,33%	0,00%	33,33%	0,00%	38,33%	10,00%	11,67%	83,33%	1,67%
Stand. Dev.	1,13%	7,76%	4,51%	30,12%	29,04%	3,89%	27,03%	4,48%	31,96%	17,40%	23,83%	22,96%	6,10%

The only significant difference is the reduction of time spent in AB on training days (p = 0,040).

4.3.6 After training on TDs vs. “after training” on NTDs:

Tab. 18: Average, median and standard deviation of the percentages of all parameters after training on TDs (N=25) and “after training” on NTDs (N=20). Abbreviations: p = pacing, s = standing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, r = ruminating, wt = watching, A = meadow, B = shelter, AB = borderline.

Rita	Movement			Attention			Behavior				Place		
after training on TD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	4,13%	72,93%	18,67%	24,09%	72,97%	2,88%	26,90%	1,67%	44,38%	18,03%	31,54%	60,25%	8,21%
Median	0,00%	81,67%	15,00%	20,00%	76,67%	1,67%	18,33%	0,00%	45,00%	15,00%	21,67%	73,33%	5,00%
Stand. Dev.	10,76%	22,74%	13,50%	22,09%	22,56%	4,29%	28,17%	3,30%	28,88%	13,48%	26,04%	29,32%	10,75%
after training on NTD's	p	s	w	Att1	Att2	Att3	f	lk	r	wt	A	B	AB
Average	2,17%	82,75%	11,50%	30,83%	67,08%	1,83%	35,75%	2,75%	30,00%	21,17%	28,75%	66,67%	4,58%
Median	0,00%	86,67%	10,00%	22,50%	72,50%	1,67%	29,17%	0,00%	20,83%	17,50%	27,50%	68,33%	3,33%
Stand. Dev.	8,94%	17,73%	11,09%	27,72%	27,06%	2,41%	28,51%	5,11%	29,35%	18,66%	26,38%	27,50%	4,04%

The increase in standing (p = 0,040) and the decrease in walking (p = 0,014) are the only significant differences between data after training on TDs and NTDs.

4.4 Akasha:

The same chain of analyses like with the three other giraffes is done with Akasha. As Akasha was moved to a zoo in Italy in the middle of the observation period, there is less data from him. This results in less meaningful analysis and certain problems with the interpretation of the data. Still, the available data shows the following results.

4.4.1 Complete behavioral analysis - correlations between behavioral and other factors:

Tab. 19: Significant correlations between various parameters of the overall behavioral pattern (N=41) of Akasha. Blue: positive correlation; red: negative correlation. Abbreviations: r = ruminating, p = pacing, w = walking, Attention 1 = low, Attention 2 = medium, Attention 3 = high, w2 = walking together with one other giraffe, n = necking, wt = watching, A = meadow, B = shelter, AB = borderline, f = feeding, gn = gnawing, ig = interaction with other giraffe, s = standing, before/after = before/after training session, date = date of data collection, temp = temperature, training: if training happened or not, visitors: number of visitors present around the giraffe house. P = significance level (≤ 5 % = significant result), corr. Coeff = Pearson correlations coefficient: positive = positive correlation / negative = negative correlation (higher number means a stronger relation between factors).

Akasha	r	p	w	Att 1	Att 2	Att 3	w2	n	wt	A	B	AB	f	gn	ig	
p	0,281											0,480				corr. Coeff.
	7,55											0,15				p (%)
s		-0,332							-0,375	-0,425	0,430					corr. Coeff.
		3,38							1,56	0,56	0,50					p (%)
f	-0,579									-0,559	0,623			-0,284		corr. Coeff.
	0,01									0,01	0,00			7,15		p (%)
wt	-0,318									0,305	-0,310					corr. Coeff.
	4,31									5,29	4,83					p (%)
n							0,876									corr. Coeff.
							0,00									p (%)
gn										0,271	-0,317				0,289	corr. Coeff.
										8,61	4,34				6,69	p (%)
w2						0,366				0,290						corr. Coeff.
						1,87				6,58						p (%)
w				-0,374	0,340	0,316						0,345				corr. Coeff.
				1,60	2,98	4,43						2,74				p (%)
before/ after	0,323	0,321	0,284		0,262							0,343	-0,368			corr. Coeff.
	3,92	4,08	7,20		9,79							2,81	1,79			p (%)
Date	0,277						-0,446	-0,288						-0,451	-0,500	corr. Coeff.
	7,95						0,35	6,83						0,31	0,09	p (%)
Temp							-0,359							-0,280	-0,500	corr. Coeff.
							2,13							7,61	8,09	p (%)
Food	-0,370								0,315	0,302				0,708		corr. Coeff.
	1,73								4,51	5,48				70,78		p (%)
weather				-0,449	0,437		0,419	0,362		0,554	-0,553		-0,326	0,341		corr. Coeff.

				0,33	0,43		0,64	2,00		0,02	0,02		3,76	2,92		p (%)
training		-0,285											0,293			corr. Coeff.
		0,0710											6,32			p (%)
visitors		-0,331	-0,472	0,360	-0,313	-0,421										corr. Coeff.
		3,44	0,18	2,08	4,66	0,61										p (%)

Akasha shows the broadest range of behavioral patterns that occurred over average 1% of the time.

Positive correlations can be found between pacing and before/after, ruminating and AB. A negative trend was found with training and a significant negative correlation with visitors. Akasha tended to pace more after training, on training days, when he ruminated more and spent more time in AB. He paced less when more visitors were at the Zoo.

Standing correlates positively with B and negatively with A and wt. When he spent more time in B, less in A and watched less, he stood still more often/longer.

Feeding links positively with B and training, while it links negatively with A, gnawing, before/after and weather. He fed more on good weather days, when he gnawed less, before training, on training days and in B.

There are positive correlations between watching and A and food, whereas watching correlates negatively with ruminating and B. He watched more when he spent more time in A and less in B, when more food was available and when he ruminated less.

Necking links positively with w2-walking with another giraffe and weather. It links negatively with date. This means, he necked more when he walked more together with another giraffe, on bad weather days and earlier in the year.

Gnawing correlates positively with food availability, A, ig – interacting with another giraffe - and weather. Negative correlations are found with date, B and temperature. So he gnawed more when he spent more time in A, when more food was available, he interacted more with the others, earlier in the year and on bad weather days.

Interactions with other giraffes correlate negatively with date and temperature, so he interacted more on bad weather days and earlier in the year.

The walking frequency links positively with before/after and Att3, while it links negatively with Att1 and visitors. He walked more after training, when less people were around and when his attention was higher. The time he spent walking with another giraffe correlates positively with weather, A and Att3, while it links negatively with date and temperature. So he spent more time walking together with another giraffe during bad weather, earlier in the year and when his attention was higher and he spent more time in A.

Before/after links with ruminating, Att2 and AB in a positive way. Akasha ruminated more, spent more time in AB and his medium attention percentage was higher after training.

The positive trend between ruminating and date and the negative correlations between ruminating and food indicate that he spent more time ruminating later in the year and when less food was available. When more food was available, he spent more time in A.

The positive correlations between weather and Att2 and A and the negative correlations with Att1 and B show that his attention was higher and he spent more time in A when the weather was bad. His attention was also higher when fewer visitors were around (positive correlations between visitors and Att1/negative correlations between visitors and Att2/Att3)

4.4.2 Complete comparison of training days vs. non – training – days:

Tab. 20: Average, median and standard deviation of the percentages of all parameters on TDs (N=26) and NTDs (N=15). Abbreviations: p = pacing, s = standing, w = walking, w2 = walking with one other giraffe, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, g = gnawing, n = necking, r = ruminating, wt = watching, ig = interacting with one other giraffe, A = meadow, B = shelter, AB = borderline.

Akasha	Movement				Attention			Place		
TDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	4,55%	70,32%	12,94%	5,77%	33,07%	64,10%	2,64%	41,98%	47,42%	10,60%
Median	0,00%	74,17%	10,83%	1,67%	28,21%	64,17%	1,67%	34,17%	47,50%	5,33%
Stand. Dev.	9,45%	20,78%	8,15%	8,44%	25,39%	24,67%	3,80%	28,59%	27,00%	13,06%
NTDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,00%	64,67%	12,00%	5,56%	43,78%	53,67%	1,89%	29,00%	62,67%	8,33%
Median	0,00%	70,00%	11,67%	0,00%	45,00%	51,67%	1,67%	23,33%	66,67%	8,33%
Stand. Dev.	0,00%	26,75%	10,35%	8,92%	24,91%	25,01%	1,88%	25,05%	24,87%	6,49%

Akasha	Behavior						
TDs	f	lk	gn	n	r	wt	ig
Average	22,91%	2,90%	5,13%	5,32%	38,53%	15,92%	1,92%
Median	11,67%	1,67%	0,00%	0,00%	40,83%	12,50%	1,67%
Stand. Dev.	27,60%	3,39%	8,12%	10,32%	29,32%	14,96%	2,29%
NTDs	f	lk	gn	n	r	wt	ig
Average	39,78%	3,89%	1,78%	4,56%	25,78%	17,67%	2,11%
Median	43,33%	1,67%	0,00%	0,00%	21,67%	13,33%	1,67%
Stand. Dev.	26,51%	5,66%	3,24%	7,73%	26,58%	17,68%	2,31%

The Wilcoxon test gave significant results for the reduction of pacing ($p = 0,042$) and gnawing ($p = 0,016$) on NTDs.

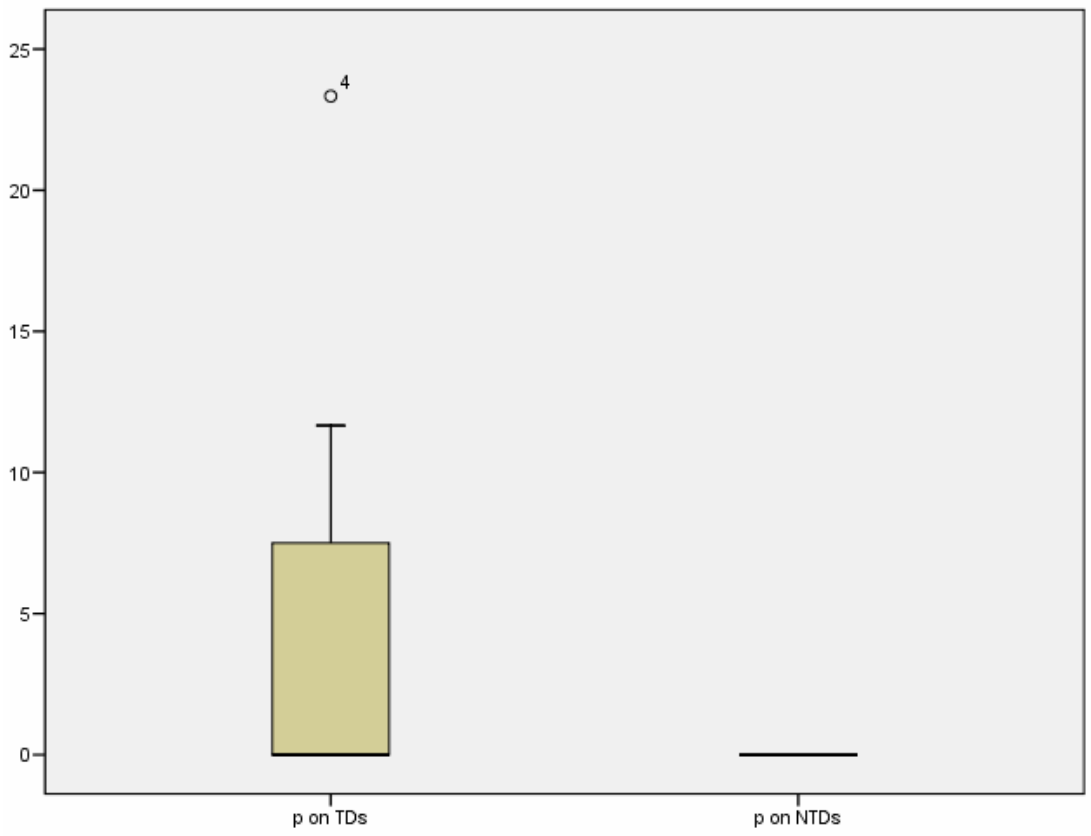

Fig. 11: Comparison of time spent pacing on training days and on non-training-days for Akasha. Stem and leaf diagram with a confidence interval of 95%.

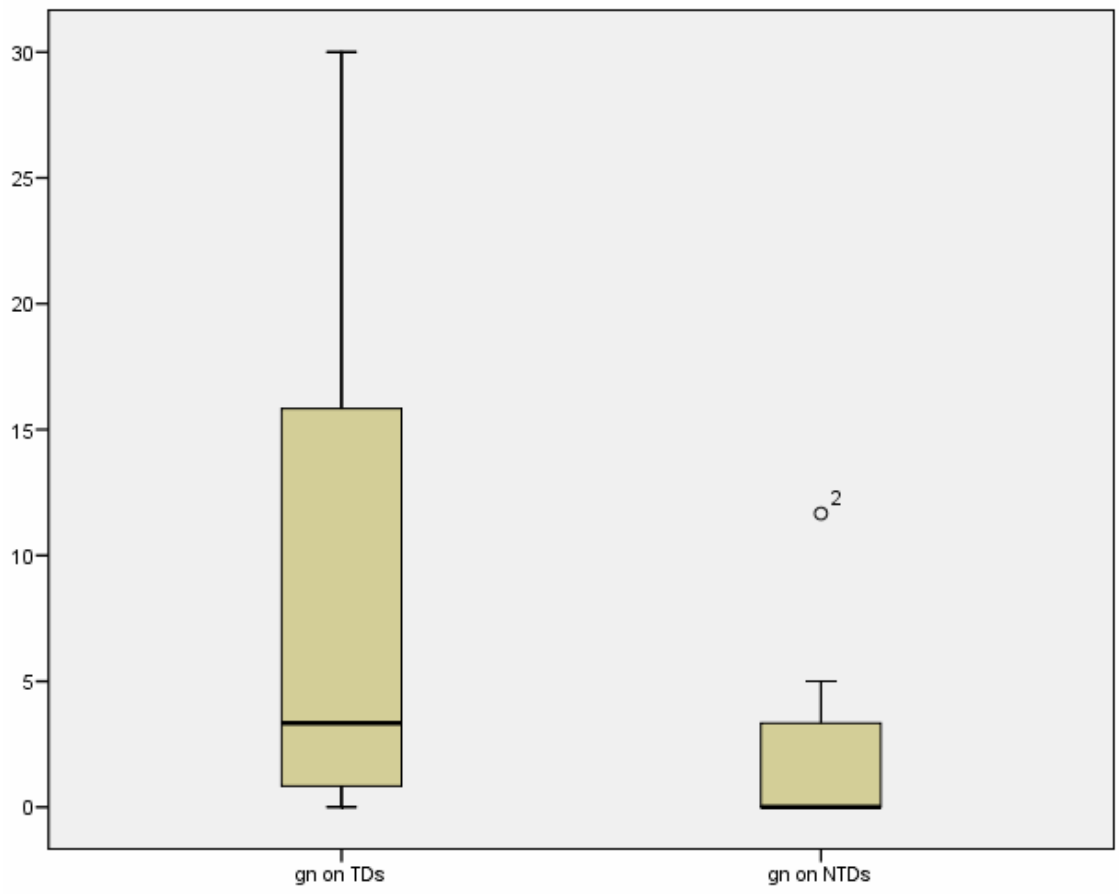

Fig. 12: Comparison of time spent gnawing on training days and on non-training-days for Akasha. Stem and leaf diagram with a confidence interval of 95%.

4.4.3 Before training vs. after training on TDs:

Tab. 21: Average, median and standard deviation of the percentages of all parameters before (N=13) and after training (N=13) on TDs. Abbreviations: p = pacing, s = standing, w = walking, w2 = walking with one other giraffe, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, g = gnawing, n = necking, r = ruminating, wt = watching, ig = interacting with one other giraffe, A = meadow, B = shelter, AB = borderline.

Akasha	Movement				Attention			Place		
before tr. on TDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,77%	73,33%	11,41%	6,41%	39,62%	57,95%	2,44%	41,03%	52,95%	6,03%
Median	0,00%	76,67%	10,00%	1,67%	40,00%	60,00%	1,67%	35,00%	58,33%	3,33%
Stand. Dev.	2,77%	20,30%	6,56%	8,33%	27,87%	25,87%	4,06%	30,80%	29,02%	7,19%
after tr. on TDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	8,33%	67,31%	14,47%	5,13%	26,52%	70,26%	2,84%	42,94%	41,88%	15,18%
Median	5,00%	71,67%	11,67%	1,67%	21,67%	76,67%	1,67%	33,33%	45,00%	6,67%
Stand. Dev.	12,13%	21,63%	9,51%	8,83%	21,75%	22,74%	3,68%	27,43%	24,71%	16,07%
Akasha	Behavior									
before tr. on TDs	f	lk	gn	n	r	wt	ig			
Average	32,82%	4,23%	4,49%	7,44%	30,90%	11,03%	2,31%			
Median	16,67%	3,33%	0,00%	0,00%	28,33%	5,00%	1,67%			
Stand. Dev.	31,90%	4,06%	9,01%	10,84%	27,74%	10,55%	2,93%			
after tr. on TDs	f	lk	gn	n	r	wt	ig			
Average	12,99%	1,57%	5,77%	3,21%	46,16%	20,82%	1,54%			
Median	8,33%	1,67%	1,67%	0,00%	45,00%	15,00%	1,67%			
Stand. Dev.	18,87%	1,90%	7,44%	9,73%	29,92%	17,41%	1,44%			

Significant differences were found in the increase of pacing ($p = 0,018$) and Att2 ($p = 0,003$) and the decrease of Att1 ($p = 0,004$) and licking ($p = 0,032$). A mild trend is visible for the reduction of feeding time ($p = 0,077$) and an increase of time spent in AB ($p = 0,070$).

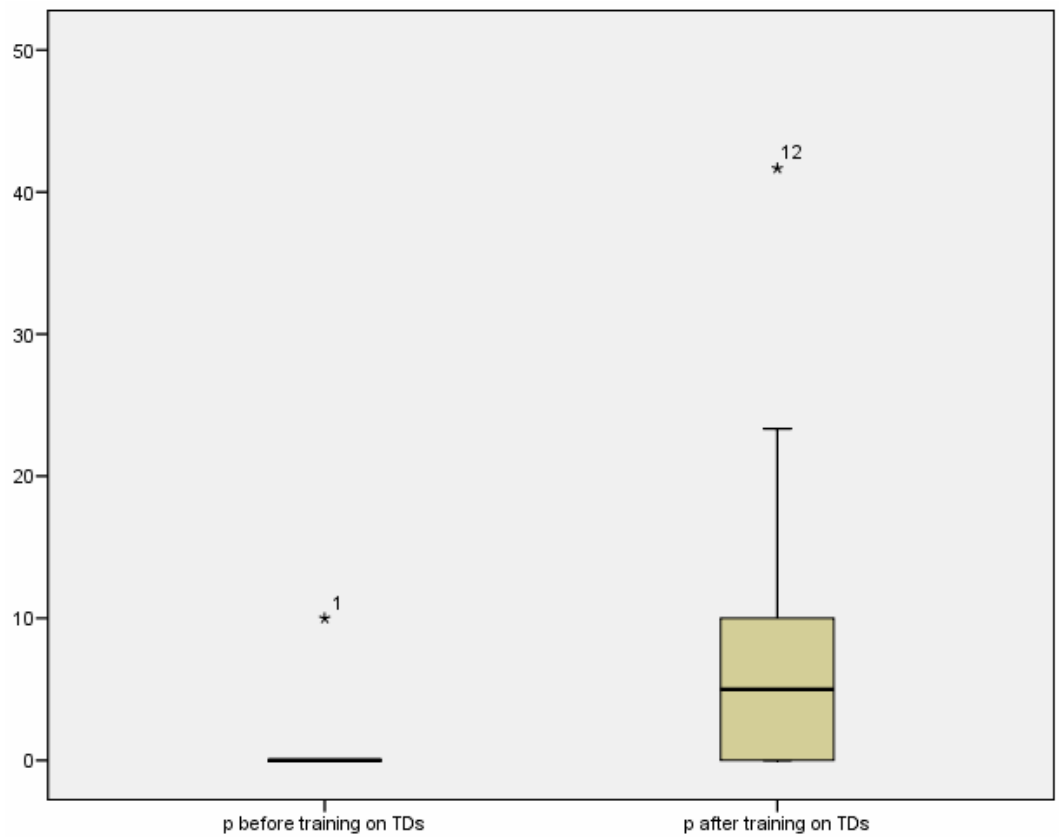

Fig. 13: Comparison of the time spent pacing before training on TDs and after training on TDs for Akasha. Stem and leaf diagram with a confidence interval of 95%.

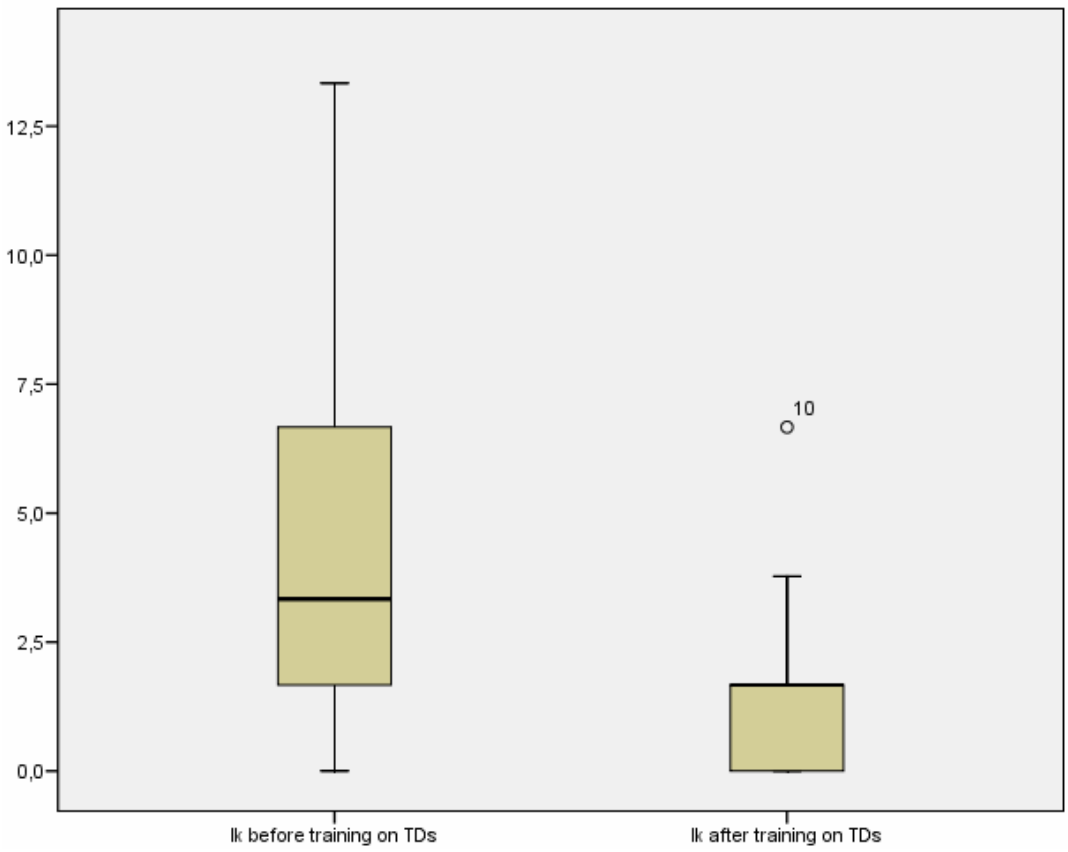

Fig. 14: Comparison of the time spent licking before training on TDs and after training on TDs for Akasha Stem and leaf diagram with a confidence interval of 95%.

4.4.4 “Before training” vs. “after training” on NTDs:

Tab. 22:Average, median and standard deviation of the percentages of all parameters “before”(N=8) and “after training” (N=7) on NTDs. Abbreviations: p = pacing, s = standing, w = walking, w2 = walking with one other giraffe, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, g = gnawing, n = necking, r = ruminating, wt = watching, ig = interacting with one other giraffe, A = meadow, B = shelter, AB = borderline.

Akasha	Movement				Attention			Place		
"before tr." on NTDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,00%	51,67%	8,33%	5,95%	50,71%	46,67%	1,90%	32,62%	60,95%	6,43%
Median	0,00%	65,00%	6,67%	0,00%	50,00%	45,00%	1,67%	18,33%	66,67%	5,00%
Stand. Dev.	0,00%	32,51%	6,93%	9,88%	29,58%	29,43%	1,99%	30,65%	28,52%	6,09%
"After tr." on NTDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,00%	75,95%	16,43%	4,29%	36,43%	60,71%	2,14%	26,19%	63,10%	10,71%
Median	0,00%	71,67%	15,00%	0,00%	43,33%	55,00%	1,67%	36,67%	55,00%	8,33%
Stand. Dev.	0,00%	12,58%	12,30%	8,27%	17,57%	18,46%	1,85%	18,75%	22,22%	6,52%
Akasha	Behavior									
"before tr." on NTDs	f	lk	gn	n	r	wt	ig			
Average	48,81%	2,14%	0,00%	5,00%	13,81%	19,76%	1,67%			
Median	48,33%	1,67%	0,00%	0,00%	8,33%	11,67%	0,00%			
Stand. Dev.	27,20%	3,45%	1,18%	9,04%	15,13%	22,61%	2,43%			
"After tr." on NTDs	f	lk	gn	n	r	wt	ig			
Average	29,05%	5,48%	3,33%	3,33%	37,86%	17,86%	2,86%			
Median	28,33%	1,67%	3,33%	0,00%	30,00%	16,67%	3,33%			
Stand. Dev.	22,91%	7,44%	4,19%	6,38%	32,60%	11,54%	2,09%			

A mild trend is visible in the increase of Att1 (p = 0,063).

4.4.5 Before training on TDs vs. “before training” on NTDs:

Tab. 23:Average, median and standard deviation of the percentages of all parameters before training on TDs (N=13) and “before training” on NTDs (N=8). Abbreviations: p = pacing, s = standing, w = walking, w2 = walking with one other giraffe, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, g = gnawing, n = necking, r = ruminating, wt = watching, ig = interacting with one other giraffe, A = meadow, B = shelter, AB = borderline.

Akasha	Movement				Attention			Place		
before tr. on TDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,77%	73,33%	11,41%	6,41%	39,62%	57,95%	2,44%	41,03%	52,95%	6,03%
Median	0,00%	76,67%	10,00%	1,67%	40,00%	60,00%	1,67%	35,00%	58,33%	3,33%
Stand. Dev.	2,77%	20,30%	6,56%	8,33%	27,87%	25,87%	4,06%	30,80%	29,02%	7,19%
"before tr." on NTDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,00%	51,67%	8,33%	5,95%	50,71%	46,67%	1,90%	32,62%	60,95%	6,43%
Median	0,00%	65,00%	6,67%	0,00%	50,00%	45,00%	1,67%	18,33%	66,67%	5,00%
Stand. Dev.	0,00%	32,51%	6,93%	9,88%	29,58%	29,43%	1,99%	30,65%	28,52%	6,09%
Akasha	Behavior									
before tr. on TDs	f	lk	gn	n	r	wt	ig			
Average	32,82%	4,23%	4,49%	7,44%	30,90%	11,03%	2,31%			
Median	16,67%	3,33%	0,00%	0,00%	28,33%	5,00%	1,67%			
Stand. Dev.	31,90%	4,06%	9,01%	10,84%	27,74%	10,55%	2,93%			
"before tr." on NTDs	f	lk	gn	n	r	wt	ig			
Average	48,81%	2,14%	0,00%	5,00%	13,81%	19,76%	1,67%			
Median	48,33%	1,67%	0,00%	0,00%	8,33%	11,67%	0,00%			
Stand. Dev.	27,20%	3,45%	1,18%	9,04%	15,13%	22,61%	2,43%			

Only the reduction in gnawing (p = 0,043) is significant between the time before training in both data sets. A trend is visible for the decrease of standing (p = 0,063).

4.4.6 After training on TDs vs. “after training” on NTDs:

Tab. 24: Average, median and standard deviation of the percentages of all parameters after training on TDs (N=13) and “after training” on NTDs (N=7). Abbreviations: p = pacing, s = standing, w = walking, w2 = walking with one other giraffe, Attention 1 = low, Attention 2 = medium, Attention 3 = high, f = feeding, lk = licking, g = gnawing, n = necking, r = ruminating, wt = watching, ig = interacting with one other giraffe, A = meadow, B = shelter, AB = borderline.

Akasha	Movement				Attention			Place		
"After tr." on TDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	8,33%	67,31%	14,47%	5,13%	26,52%	70,26%	2,84%	42,94%	41,88%	15,18%
Median	5,00%	71,67%	11,67%	1,67%	21,67%	76,67%	1,67%	33,33%	45,00%	6,67%
Stand. Dev.	12,13%	21,63%	9,51%	8,83%	21,75%	22,74%	3,68%	27,43%	24,71%	16,07%
"After tr." on NTDs	p	s	w	w2	Att1	Att2	Att3	A	B	AB
Average	0,00%	75,95%	16,43%	4,29%	36,43%	60,71%	2,14%	26,19%	63,10%	10,71%
Median	0,00%	71,67%	15,00%	0,00%	43,33%	55,00%	1,67%	36,67%	55,00%	8,33%
Stand. Dev.	0,00%	12,58%	12,30%	8,27%	17,57%	18,46%	1,85%	18,75%	22,22%	6,52%
Akasha	Behavior									
"After tr." on TDs	f	lk	gn	n	r	wt	ig			
Average	12,99%	1,57%	5,77%	3,21%	46,16%	20,82%	1,54%			
Median	8,33%	1,67%	1,67%	0,00%	45,00%	15,00%	1,67%			
Stand. Dev.	18,87%	1,90%	7,44%	9,73%	29,92%	17,41%	1,44%			
"After tr." on NTDs	f	lk	gn	n	r	wt	ig			
Average	29,05%	5,48%	3,33%	3,33%	37,86%	17,86%	2,86%			
Median	28,33%	1,67%	3,33%	0,00%	30,00%	16,67%	3,33%			
Stand. Dev.	22,91%	7,44%	4,19%	6,38%	32,60%	11,54%	2,09%			

No significant results are shown with the Wilcoxon test. Still the reduction in pacing is almost significant (p = 0,068) as well as the increase of time spent in B (p = 0,063). The difference in pacing is depicted here:

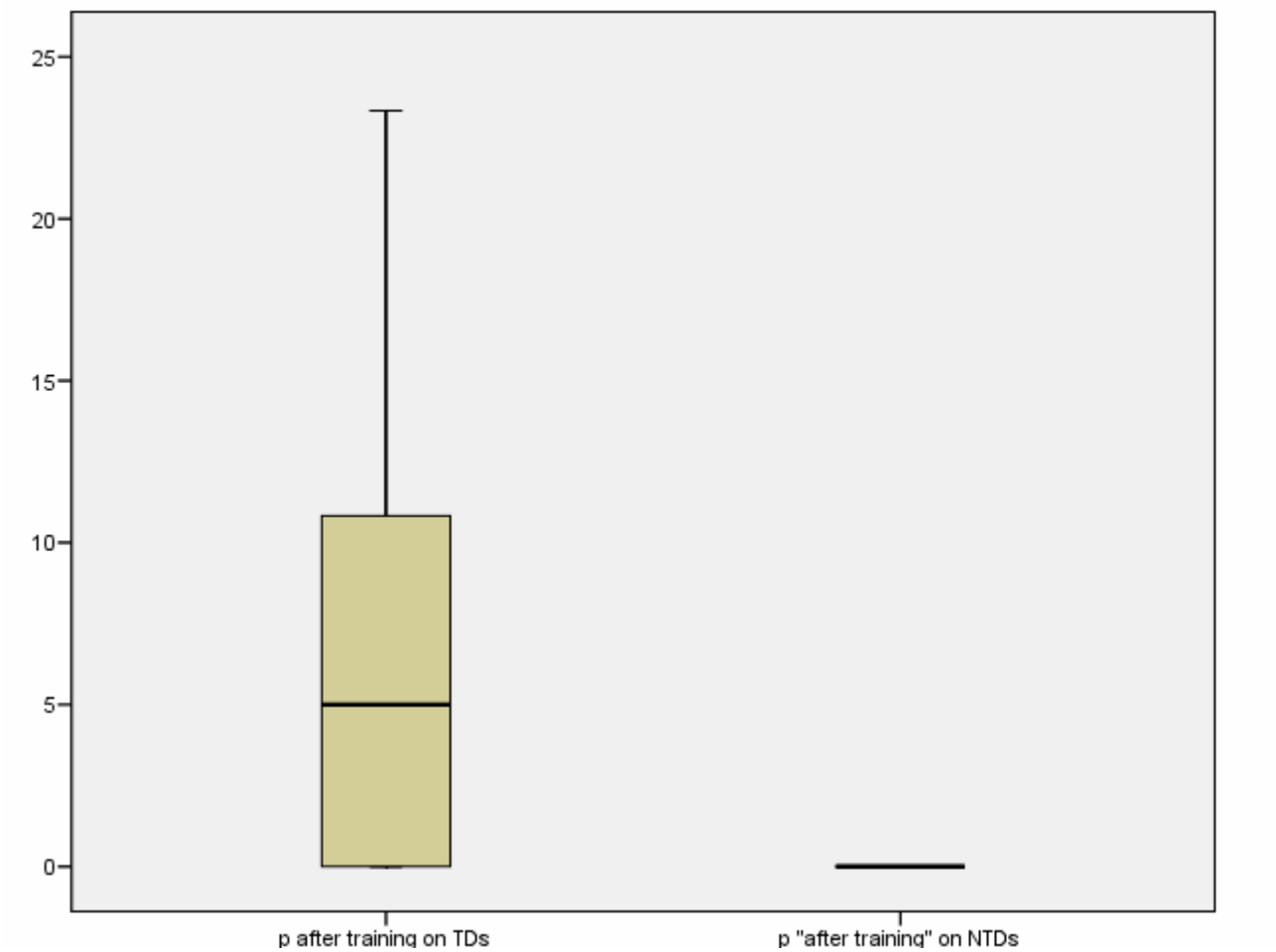

Fig. 15: Comparison of the time spent pacing after training on TDs and “after training” on NTDs for Akasha.

5. Discussion and conclusion:

As there are a lot of results for each giraffe, the discussion is done as follows: first, the change in stereotypical behavior for each giraffe is presented. Second, the rather subsidiary discussion of all other changes is done to round out the thesis, followed by an overall conclusion

5.1 Changes in stereotypic behavior:

Training affects oral as well as locomotor stereotypy in different manners:

It has a reducing effect (of various intensity) on oral stereotypy. Kimbar, Carla and Akasha show a reduction of licking/gnawing activity after training on training days.

On the other hand, training seems to trigger walking activity and locomotor stereotypy in the form of pacing. Rita, Kimbar and Akasha paced more after training on training days. This is discussed in detail in following reflections:

5.1.1 Carla – changes in stereotypic behavior:

As summary, Carla's behavioral pattern can be described as follows:

She shows the most intense form of stereotypy in the form of pacing (~ 1/3 of her movement), while licking hardly occurs. She mainly paces in B (as shown in Fig. 1 – orange oval) and usually ruminates or watches during pacing. Occasionally she would grab a bite of food and chew it during pacing, but ruminating was the most prominent behavior (personal observation), so it is logical that feeding correlates negatively with pacing as the two behaviors almost exclude. The pacing frequency is higher on cold/rainy days and after training. She paces more on days when her attention is more medium, which also meets with the positive correlation between Att1 and training/weather, meaning that her attention is higher on bad weather days anyway.

Carla seems to be hardly amenable to external influences like visitors or food availability. Training does not have any direct influence on her pacing frequency. It is equal on training days and non-training days.

The percentage of time spent pacing in the earlier data collection period (before training time) each day is lower than during the later period (after training time). This also is equal on TDs and NTDs. In Both data sets, the time spent pacing more than doubles after the training time. So this change can probably be regarded as a result of her daily rhythm. As Carla walks around relatively

little and approximately the same time in all analyzed periods, standing time is logically linked to pacing time and her standing time is reduced after training time.

This result does not find equivalents in the results of other studies about stereotypies in giraffes, which showed correlations between stereotypic pacing and the following factors: sub species, birth history, size of the indoor enclosure, environmental change and type of food (Bashaw et al 2001). It also means that it will be hard to find measures to reduce pacing in Carla's case, as it can not be told from this study, whether housing and husbandry had any positive or negative effects. As the study only covered a short period of time, no statements about the basic reasons for her pacing activity can be made. It would be interesting to analyze her movement patterns in the new giraffe house that will be built over the next years.

There is a trend that licking is reduced after training on training days. As she licks so rarely at all and the standard deviation is so much higher than the average and median, this result can not be regarded as convincing. Licking will therefore be regarded as an occasional behavior that does not give reliable information about her mental well-being and therefore does not have to be considered when thinking about methods to reduce stereotypy.

As a conclusion, it is very interesting that Carla, the female that always makes a relaxed impression, is hardly ever nervous or anxious, joins training voluntarily and has a friendly and open contact to the keepers, shows the most intense form of stereotypy. She seems most eased, when pacing and ruminating together (ruminating can also be regarded as a sign of relaxation – keepers note). Swaisgood and Shepherdson propose in their scientific approach to stereotypy (2005) that stereotypies can eventually have positive effects on an animal's mentality, as it serves as a sort of compensation to cope with suboptimal environmental conditions. So animals that are thus able to compensate a mental disbalance due to lack of stimulation or the like show less signs of poor mental well-being and seem more mentally stable as a result. Still this does not mean that the stereotypy is something positive. It serves as a tool for the animal to compensate stress, but only works symptomatic. The underlying problems that lead to the poor mental well-being are still the same.

5.1.2 Rita - changes in stereotypic behavior:

From personal observation during the whole time, I can say that Rita and Akasha had a sort of close relationship. They always searched close spatial contact, which was visible in feeding together, walking together, gnawing or exploring the exhibit together and standing together most of the time. There were also more interactions between the two of them than with any of the others. I

furthermore observed more half-hearted mating attempts from Akasha with her than with Carla. All in all, he was a fix point in her daily life and so it is not surprising that a lot of parameters of her daily behavioral parameters changed after Akasha was gone.

The explanation of the reduction in licking frequency after his transport to Italy is a bit complicated. On the one hand, one could regard this reduction as a sign of better mental well-being and thus less stress. The reason for this improvement could be the following: Social density can induce stress and this can induce oral stereotypies or make them worse (Bashaw et al 2001). The presence of four (more or less) fully grown giraffes in the facility (especially inside the stable and at night) was definitely too much and the situation has been more relaxed since Akasha left. So the loss of this social pressure could have relieved her long term stress level and thus reduced the stereotypy. Stress hormone measurements were not conducted in this study due to logistical problems in taking samples, so this cannot be proven.

On the other hand, as a second factor, increased feeding duration has led to a decrease of licking frequency in giraffes and various other species (Redbo and Norblad, 1997; Terlouw et al., 1991; Savory and Maros, 1993; Bashaw et al 2001). So, as she spent more time feeding after he was gone, this longer feeding duration can also have had an effect on her licking frequency. Probably the combination of these two circumstances led to the reduced licking activity.

There are no clear differences between the times spent licking on TDs or NTDs, so training probably has no direct influence on this rather rare behavior. The link between AB and licking can be explained by the fact that she usually licked the grids or walls right at the borderline. Furthermore, Rita licked more on colder days. Still it is important to remember that licking made up only less than an average of five percent of her overall behavioral pattern (the median is always zero) and that the standard deviation is mostly twice as high as the average. So this behavior can be regarded as unproblematic and sporadic, anyway.

The pacing frequency also depends on weather, which is similar to the results found with Carla. Rita also paces more on bad weather days (and vice versa stood more on good weather days). Her pacing path is longer than Carla’s and stretches over the borderline AB to the sides of the outdoor facility. This explains why AB and pacing correlate, as her appearance in AB increases during pacing. The positive correlations with walking, watching and Att2 can also be explained from observations: When Rita was relatively relaxed and walked around much while watching, at a certain point the walking sometimes shifted to pacing and she kept to her fixed paths for a short while. She hardly ruminates during pacing or walking like Carla, but usually watches her surroundings with medium or high attention.

Her walking frequency seems to be lower when many visitors are at the zoo. As Rita is generally rather wary, she spent more time standing still and watching her environment closely or under the shelter, facing the wall when the zoo was crowded. So the ritual of walking a while and than starting to pace hardly occurred during these times.

The influence of training on pacing is hard to specify. After training on training days, she paces significantly more than before training, while the pacing intensity does not increase after training on NTDs. The first impression would be that she paces more after training on training days and thus training has a negative effect, but the time after training on NTDs does not significantly differ from the time after training on TDs, so this conclusion would be too easy. I suspect that the data is contradictory due to the inhomogeneous pacing behavior. On many days, she did not pace at all. Standard deviation is many times higher than the average in all cases and the median is mostly zero. So it is hard to find reliable statistic evidence. Possibly training works as a short time inducer for pacing, but with the current data there is no clear evidence or indication.

Overall, she paced rather seldom and never as persistent as Carla, so this behavior can be regarded as unproblematic, when it does not get more severe. Regular observations would be advisable for the future. As walking often merged into pacing and was sometimes hard to distinguish, the increased walking activity after training on training days is definitely interesting and would have to be considered in further observations.

5.1.3 Kimbar – changes in stereotypic behavior:

It is important here to look at the distribution of pacing: It hardly ever adds up to more than five percent of the movement pattern in any of the data sets and standard deviation is ways higher than the average itself. He never paced persistently and almost never paced alone, when none of the others were pacing. It rather occurred occasionally when Carla and Rita were pacing a lot, that he fell into line with them when he was walking around more (usually at medium attention and while passing through AB more often). As Carla paces more later in the day, and there are no differences in her pacing frequency on TDs and NTDs, the fact that there is a trend that he paces more after training on TDs does well indicate that training triggers his pacing behavior a bit. Still this is not critical as the behavior occurs so seldom and even less after Akasha was gone, which is probably due to the same reasons as Rita's reductions of licking: a reduction of social stress.

Licking is more of a problem than pacing, as it occurs about four times as much. The intensity was higher during bad weather, later in the year, after Akasha was gone, when he stood more, was more at medium attention and according to the correlations on non-training-days. He usually conducted

licking while standing in AB. The increase of licking stands in contrast to the decrease of pacing after Akasha's departure. But as locomotor and oral stereotypies probably have different underlying reasons (Bashaw et al 2001), this is no logical problem.

Again there is a connection between the stereotypy and bad weather. The connections with standing, Att2 and AB can be explained with the observations that he mainly licked the walls and grids between A and B and normally stood still during licking and was at medium attention. As he mainly licked in A lately, I come to the conclusion that this is sort of a compensation as he usually spent his time when being in A with necking with Akasha. His loss might have left a behavioral gap that is now filled with licking.

In the correlations analysis, licking correlates positively with training. In the analysis of the single data sets, it definitely shows that he licks more on non-training-days. So the later results will be regarded and the ones from the correlation will be ignored, as they are not so expressive.

Kimbar licks significantly more on non-training-days (about twice as much). The interesting thing is that he licks more "before" *and* "after training" on the NTDs. Still he licks even more "after training". The reason for the reduced licking frequency can be that the training works as a mental stimulus and thus reduces the suppressed intention to perform action in the form of licking as it was hypothesized in the introduction. If Kimbar is able to sense that training will take place and thus licks less even before training, can only stay an assumption.

In addition, he spent less time licking when he fed more. Feeding logically mainly occurred in B and at low attention, as he was totally relaxed when feeding and he hardly reacted to anything around him. He would even hardly move his head or ears (personal observation) during feeding. This relaxed state of mind probably also prevented him from licking. Former studies have furthermore shown that increased feeding time reduced oral stereotypies (Redbo & Norblad, 1997). The comparisons also confirm that he spent significantly more time in B or AB and at medium attention after training on training days.

5.1.4 Akasha - changes in stereotypic behavior

All results from the analysis of Akasha have to be regarded with care, as the small N makes the statistic analysis very vague.

As gnawing makes up to six percent of the behavioral pattern, a reflection is necessary: There is one old, dead tree trunk in the middle of the outdoor facility. An old metal feeder is attached to it, but was never filled. Akasha was the only one to regularly explore it thoroughly and gnaw on the old wood (Rita would also do that, but very seldom). As this probably does not serve any feeding

purpose and oral stereotypy does not only refer to licking non food objects but also to chewing non food objects (Latham & Mason 2010), the gnawing will be regarded here as a stereotypy. From personal observation I can say that his state of mind, visible from ear/head posture, reaction to environment and look of the eyes, was the same as during licking, and comparable to the way Kimbar and Rita looked during licking.

Akasha gnawed more, when he spent more time in A. This is logical as the tree trunk is located in A. He also gnawed more when more food was available, he interacted more with the others earlier in the year and on bad weather days. Again, weather has a negative influence on the frequency of a stereotypy. Interactions between him and others often took place in A, as Kimbar often tended to interrupt any interactions with the females in B. Gnawing also took place in A, so this could be a reason for the correlation.

As only two feeding places were available for the four giraffes in B, and Kimbar would usually not let Akasha feed next to him, a full feeder could be a stronger visual feeding stimulus than an empty one, this triggering a feeding motivation in Akasha, that can not be followed as he would probably want to. This could induce increased gnawing. He also gnawed less when he fed more.

The reduction later in the year can have its reason in the worse weather earlier in the year. As data collection started in March, it was still cold then and he gnawed more when weather was bad.

Additionally he gnawed more on training days, especially before training. Possibly training reduced his gnawing activity. There is no statistical evidence for a reduction of gnawing after training and on NTDs he hardly gnaws at all. Again, this result is not significant due to the little N and a clear statement would be unrealistic. I propose that, on days, when his intention to gnaw is generally higher, training can reduce it again.

For licking, no correlations were found at all. Still, on training days, there is a significant reduction of licking after training. So, like gnawing, the oral stereotypy was reduced due to training. As there are no significant differences to the non-training-days, this is again relatively vague. The small N of the non-training-days on the other hand makes is hard to find reasonable results.

Akasha paced significantly more after training on training days. These results are pretty vague as there are only data from seven NTDs and he did not pace on any of them. Still it seems as if training triggered pacing. He paced more when he also ruminated more. This is similar to Kimbar’s pacing behavior. Akasha also seldom paced alone but would fall in line with another giraffe every now and then. His pacing line was also longer than Carla’s so he also spent more time in AB when pacing as he had to cross this line.

Pacing was reduced when many visitors were at the zoo. Akasha was the only giraffe to obviously react to visitors, as he had a closer relationship to humans and was less afraid of them. He would often watch people and stand in A attentively. He also reacted to cars and would run after them. So external stimuli did reach his mind and he showed less signs of boredom.

5.2: Changes in other behavioral aspects:

5.2.1: Carla – changes in other behavioral aspects:

Carla spends more time standing still when her total attention is low or when she spends more time in A or feeding (which excludes ruminating and watching). During good weather and before training, her presence in A is higher. This seems logical, as she spends overall less time standing and more time pacing (in B) after training or when weather is bad. Furthermore, she seems to avoid rain. Thus, bad weather keeps her under the shelter, where she usually spends her time with pacing. As a logical consequence of the presence of the feeders in B, she hardly feeds in A.

When her overall attention is medium, she spends more time in A. Together with the positive correlation of standing and A plus standing and Att1, this can be confusing at first sight. This can be explained by the fact that she also walks a lot in A, although there is no significant correlation as walking serves mostly for a change of place and occurs equally in every place. Her attention is mostly medium when she walks much. From personal observation it can be confirmed that her attention is mostly medium during walking.

Carla usually spends most of her time in B, and this even more on days when she walks less (thus changes place less often) feeds more and is at lower attention, only during pacing in B, her attention is medium.

A trend is visible over the whole observation period of five months: Time spent walking increased with the date but reduced again after Akasha was gone. As she seems to react to weather, this might also be due to the weather changes from winter to summer. Her overall attention was higher later in the year and after Akasha was gone. Although licking is hardly performed by Carla, there is a trend that she licked less later in the year/after Akasha was gone and after training. Licking does not show any correlation with any other factor.

A distinct change is the increase of time spent watching on training days after training. As feeding, ruminating and licking hardly change, this must be due to a reduction of the other behavior parameters, which were neglected in the analysis due to their little percentage-number. This could

possibly have its reason in following thought: Training could calm activity down, not only by reducing the percentages of the most prominent activities, but rather in reducing the number of the different activities conducted over a period of time. Further data collection would be necessary to clarify this point.

5.2.2: Rita – changes in other behavioral aspects:

After Akasha's departure, further changes were measurable: The correlations indicate an increase of time spent standing, feeding and spent in B (B also correlates positively with Date), while there was a decrease of time spent walking, licking, watching and time spent in AB. High level of attention was displayed less after he was gone. During feeding she mostly stood still and due to the presence of the feeders in B logically in B. So this can be attributed to an increase of time spent feeding.

This and the reduction of walking and watching can be explained as Akasha generally spent a lot of time in the outdoor facility and she would often interrupt feeding, walk out of the shelter to him, walk around slowly near or with him and watch her surroundings. She reduced this to a minimum after he was gone and spent more time standing and feeding in B without these breaks under the shelter. This also explains the set of correlations found with standing.

Walking intensity changed significantly after training: on TDs as well as NTDs, she walks more after training time (and vice versa stands less after training time and spends less time in B and more in A). There are no differences between the times before training in both sets, but there is a significant difference after training: she walks even more after TDs than after NTDs. This indicates that the training triggers walking activity additionally to an increase due to a daily rhythm. If this is positive or negative is hard to tell, as the borderline from walking to pacing is very narrow and as increased walking can also lead to increased pacing. On the other hand, it is good when the giraffe moves and is active. As the differences in walking are bigger than the differences in pacing, I regard this result as a positive result from training.

The presence in A and AB also correlates positively with before/after. This is logical as she (as already mentioned) hardly walked in B but mostly walked in A and thus also passed through AB when walking outside. Before training on TDs, her presence in AB was even higher than before training on NTDs, this can also be regarded as a sign of increased movement but the origin can not be clarified. She spent more time walking earlier in the year, which corresponds to the correlation of walking and Akasha gone and probably has the same explanation.

To finish the reflection on the correlations, the rest is discussed here: The explanations of the correlations between standing and other factors are the counter effects of changes in walking or pacing frequencies, as these behaviors are mutually exclusive: she stood more when her attention was lower, after Akasha left, before training and when temperature was higher. When standing more, she spent less time in B or AB and watched less.

The time Rita spent watching was higher when she spent more time in AB, after training and earlier in the year (which is aligned with the negative correlation with Akasha gone). During watching, she usually either lingers in A or at the borderline AB with a good view of the surroundings. As she mostly watched during walking, and she walked more after training and earlier in the year, she also watched more then. As watching and ruminating are mutually exclusive behaviors, it makes sense that she ruminated less when she watched more, and vice versa. Her attention was higher, the more she watched. When her attention was higher, especially when it was at Att3, she usually only watched as she did not ruminate or feed (which she rather did when she was relaxed, thus at Att1) or anything else when being attentive.

Rita's attention was mostly medium after training time, during good weather and when she fed more. As the difference in attention is relatively equal on TDs and NTDs, this is probably due to a daily rhythm, comparable to the differences in walking. She usually fed in a relaxed mood, but not as relaxed as Att1. In contrary, she ruminated more when being in a relaxed mood, meaning Att1. The colder the weather, the more time she was at low or medium attention. Maybe this is due to their natural habitat and giraffes get more vigilant when the temperatures are higher.

Her attention was higher when she spent more time in A or AB, while it was lower in B. This is logical as the external stimuli are buffered when she is under the shelter.

A further difference with regards to the distinction of TDs and NTDs is: More time spent feeding on non-training-days: As there are no significant differences in the times before and after training in both sets, but the percentage is constantly higher in the non-training-day's data sets, this is hard to explain. A theoretical explanation could be the following: as training triggers walking and movement, the time spent still relaxed and feeding is reduced on training days. Maybe the treats the giraffe gets during training stills their hunger additionally, or at least the appetite. Still, this is very vague as it does not explain the differences in the data before training time.

5.2.3: Kimbar – changes in other behavioral aspects

Kimbar shows a broad range of behavioral differences. Most of them can be explained from personal observations during the data sampling period.

Kimbar ruminated mainly when standing in A. Furthermore his ruminating frequency was increased when it was warm, when he paced more and when he spent less time licking. Like the other giraffes, he avoided rain or cold weather and spent more time outside when it was sunny and warm. Mainly when he spent some time outside, he would stand still and ruminate for a while. It is interesting that he shows more ruminating, which is a sign of a relaxed state of mind, when he also paced more. Probably there is no direct connection between these data, but the factors that induce more ruminating also induce more pacing: for example changing place more often (correlation between AB and pacing and A and ruminating).

Furthermore he ruminated more on training days, especially after training (which also meets with increased attendance in A on training days). The increase of ruminating is ways higher (average 13,92/median 5,00 → average 25,45/median 16,67) than the increase of pacing (average 1,33/median 0,00 → average 5,15/median 0,00), so training might have a calming effect on Kimbar, as ruminating is mainly performed at a relaxed state of mind.

Differences in standing and walking are also found: He walked less and stood more after Akasha was gone. As he would often walk out to Akasha and either walk around near him, neck with him or chase him, this change is obvious. This also explains the correlation of walking and AB as he had to pass the borderline more often. He mainly walked when his attention was medium (thus also watching more), and stood mostly when his attention was low. Vice versa, he stood more when watching or necking less. When much food was available, he would mainly stay in B and feed and thus walk and watch less. After training, he tends to walk more and watch more, as both behaviors mainly occurred together. This is not confirmed significantly in the detailed analysis but will be regarded as a trend that is also visible in the numbers themselves.

Walking only makes up between three and six % of his movement pattern and standard deviation is again pretty high, so a definite interpretation is as hard as with pacing.

Another change after Akasha's departure is a reduction of necking. This is logical as mainly the two males necked and thus, after Akasha was gone, no partner/stimulus was present. Later the year, he necked with Rita every now and then for a few moments. When necking with Akasha, both usually walked slowly, this explains the negative correlation with standing.

Another factor that depends on temperature is attention. It was more often medium during higher temperatures. It was also higher when he spent much time in AB, as he often stood there, watching and observing his surroundings. It is interesting that the frequency of Att2 was higher after Akasha had been gone and after training. Maybe training stimulated Kimbar to react more to his environment. Social stress could have been acting as a suppressive force on his attention while Akasha was still there. This is a vague guess, as no stress hormone measurements have been done.

Furthermore, he watched less when it was warm, as he then often conducted other behaviors. He also spent more time in A and less time in AB (at least before training) when it was warm, which meets with the reactions of the other giraffes on good weather. One interesting personal observation was the following: Kimbar got more active with warm weather, but reduced his activity to a minimum when it was really hot and sunny. This shift was more obvious for him than for the others.

5.2.4: Akasha – changes in other behavioral aspects

Standing depended on his whereabouts: the more time he spent in B, the more he stood still. During standing he mainly ruminated or fed, thus watching less. When he was in A, he mostly walked and watched. He also watched more when more food was available, this could have the same reason as the increased gnawing frequency and time spent in A when more food was available: a stimulus that can not be followed and thus increasing time spent in A, attentive behavior like watching and finally gnawing.

Feeding frequency depended on weather, he fed more when weather was good: Maybe because the other giraffes – especially Kimbar – would leave B more often then. He furthermore fed more before training on training days. After training his attention was higher and he spent more time in AB, which indicates increased movement. As he also walked more after training, training probably had a stimulating effect to his movement patterns and he did rather walk around than feed relaxed. Maybe he also was satisfied with the treats he got from training, which might have lowered his hunger or appetite. Walking frequency was increased when less people were around and when his attention was higher. Att2/Att3 also correlate negatively with visitors. It is hard to tell which is the cause and which is the result when talking about attention and walking etc. It probably changes together.

Interactions, specifically necking, occurred more when he walked more together with another giraffe, on bad weather days and earlier in the year. As necking was mainly conducted while walking with Kimbar in A, this is obvious. He also generally walked more together with another giraffe on bad weather days and earlier in the year (and logically in A). His attention was mainly

medium while doing so. The correlations between bad weather, A and Att2 also strengthen the assumption that environmental factors, especially weather and temperature, do have a strong influence on movement parameters.
After training, he furthermore licked less and ruminated more. This goes well with the results that he gnawed less after training and thus training can well have a positive effect on oral stereotypies. As he ruminated more afterwards, his state of mind seems to be relaxed and calmed.

5.3: Conclusion:

The effects of training are two sided: Training has a positive effect (of various intensity) on oral stereotypy by reducing their frequency. Kimbar, Carla and Akasha show a reduction of licking/gnawing activity after training on training days.

On the other hand, training seems to trigger walking activity and locomotor stereotypy in the form of pacing. Rita, Kimbar and Akasha paced more after training on training days.

A possible explanation could be following: During the training, the giraffes get the treats out of a keeper's hand. They use their tongues to wind the bits of fruit and vegetable out of the hand and often the keepers would even close their hands a little, so the giraffe had to strengthen its attempt to grab the treat with its tongue. This is only a little challenge, but it seems to be enough for the giraffes to satisfy the urge to use their tongues in a more complex manner than when feeding on openly provided hay. This seems to have a high potential to reduce oral stereotypies as a short time effect. This result meets with results from other studies, where devices that demanded giraffes to user their tongues in more complex manners proved to reduce oral stereotypies (Bashaw et al. 2008; Tarou et al 2008).

The locomotor stereotypy in contrary is triggered: the giraffes are firstly separated and the grid walls between them are closed. So they are, in a way, locked up in a small enclosure for a while. Furthermore they are asked to stand still and not move during training. This restriction of movement can result in an increased urge to walk and/or pace afterwards. The study of Bashaw et al in 2001 also came to the result that a small size of the indoor enclosure affected locomotor stereotypic behavior negatively.

It is interesting, that weather has a measurable effect: Bad weather triggered pacing in Carla, pacing and licking in Rita, licking in Kimbar and gnawing in Akasha. This might have its reason in giraffes being ungulates of African savannah, and European cold weather days are somehow stressful for them.

The departure of Akasha visibly affected the group: There was a decrease of licking frequency for Rita and a decrease of pacing for Kimbar. This is probably due to a reduction of social stress. On the other hand, Kimbar licked more after Akasha was gone. As already explained, this behavior might fill the gap that opened in his normal behavior in A when Akasha left.

As Akasha was the youngest giraffe, still curious and used to close human contact, it is not surprising that a high visitor number reduced his pacing activity as he would often watch people then.

The results here only give information about short time effects. Long time observation data is unfortunately not available so there is no possibility to compare stereotypic behavior in the time before training was introduced in Vienna with the behavior nowadays. It would furthermore be interesting to observe the behavior in the new giraffe house that is planned to be built over the next years. All in all, the mental well-being of the giraffe group is regarded as unproblematic, as only one of them (Carla) shows a really extensive form of pacing. Regarding the other three, stereotypies are rather side effects and occur relatively seldom and not as persistent (maximum 15% -Kimbar licking -, mainly below five percent). This good overall shape could also be regarded as a positive long term effect of the training, but there is no way of proving it.

For future training, the team could try to increase the effort the giraffes have to make to wind the treats out of the keeper's hands. One could also think of games for the giraffes where they have to use their tongues even more to get food out of complicated devices. As they did not accept the tongue twister in their enclosure, something like that should be integrated into training.

As there is no other way to conduct training with regards to separation and standing still etc, it will be hard to change the setup in a way that could reduce pacing activity afterwards. Maybe this can be taken into consideration when the new giraffe house is built. Single enclosures should be significantly bigger. It might also be interesting to think about an outdoor training to get the giraffes moving in a purposeful way.

Reflection of the study itself:

Only few problems were faced in the study: Data could only be taken when weather was good, as the doors to the indoor enclosure were closed. Due to the size and shape of the giraffe house and the often high movement activity, all four giraffes could not be observed at a time in bad weather, when the doors were open and the giraffes were able to walk inside. Due to a long bad weather period in spring, the overall number of observed days is much lower than expected in the beginning.

Akasha’s departure date was only fixed one week before he left. In the beginning of the study it was already clear that he would leave, but the date was open. Unfortunately his departure came relatively early after the bad weather period and thus little data is available for him.

One further objective of this study was to find clues that the giraffes expect training also on non-training-days and might wait outside the doors to be let inside. As the giraffes mainly spent their time in B anyway, no obvious differences were seen or recorded.

6. Literature:

6.1 Scientific articles:

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7. Attachments:

7.1: Ethogramm Giraffe (*Giraffa camelopardalis*):

7.1.1: Movement:

W - Walking: Both feet on one side move forward almost in union. The head moves in synchrony with the feet and helps the giraffe to maintain its balance. Slow and controlled movement.

W - Walking alone
W2 – Walking with other giraffe

G - Gallop: Hind legs are almost simultaneously brought forward and spread, thus overreaching the forelegs. Neck is elongated and moving rhythmically. The tail is twisted over the back and switched regularly. Fast movement, up to 50 hm/hrs.

(GP – galloping playful – jolting, bolting, swinging head
GF – galloping fearsome – when scared, head/neck straight up, ears flinched back)

G – galloping alone
G2 – galloping with other giraffe

P - Pacing: Walking back and forth or in circles or eights monotonously and repeatedly.

L - Lying: Lying down on their withdrawn legs, neck most of the time upright. Deep sleep with head and neck down is rare during day.

S - Standing still: Standing still, legs not moving. Head erect or lowered to feed.

7.1.2: Attention:

1 – Low/relaxed: Low body tension, body relaxed, head and neck between 30° & 60°. Ears relaxed and sideways, eyes not fixing anything particular.

2 - Medium interest: Head turned towards object/situation of interest. Ears directed forward in same direction. Eyes fixing object/situation of interest. Neck erected. Still chewing, if feeding/ruminating.

3 – High interest: Neck and head straight up, eyes wide open and fixing object/situation of interest. Ears erected and facing forward, high body tension. Chewing movements stopped.

4 – Alarmed: Head and neck +90°, highest body tension, ears flicking backward and forward. Maybe mini-flights, then turning around and facing potential threatening object again. Eyes wide open. No chewing movements.

7.1.3: Behavior:

L – Licking: Licking non food items repeatedly, wrapping the tongue around iron bars or licking the walls or doors.

F – Feeding: Wrapping tongue around food item (hay) or taking it up with the lips to bring it into the mouth. Chewing & swallowing food.

R – Ruminating: Food is brought up to the mouth again from the stomach and re-chewed repeatedly.

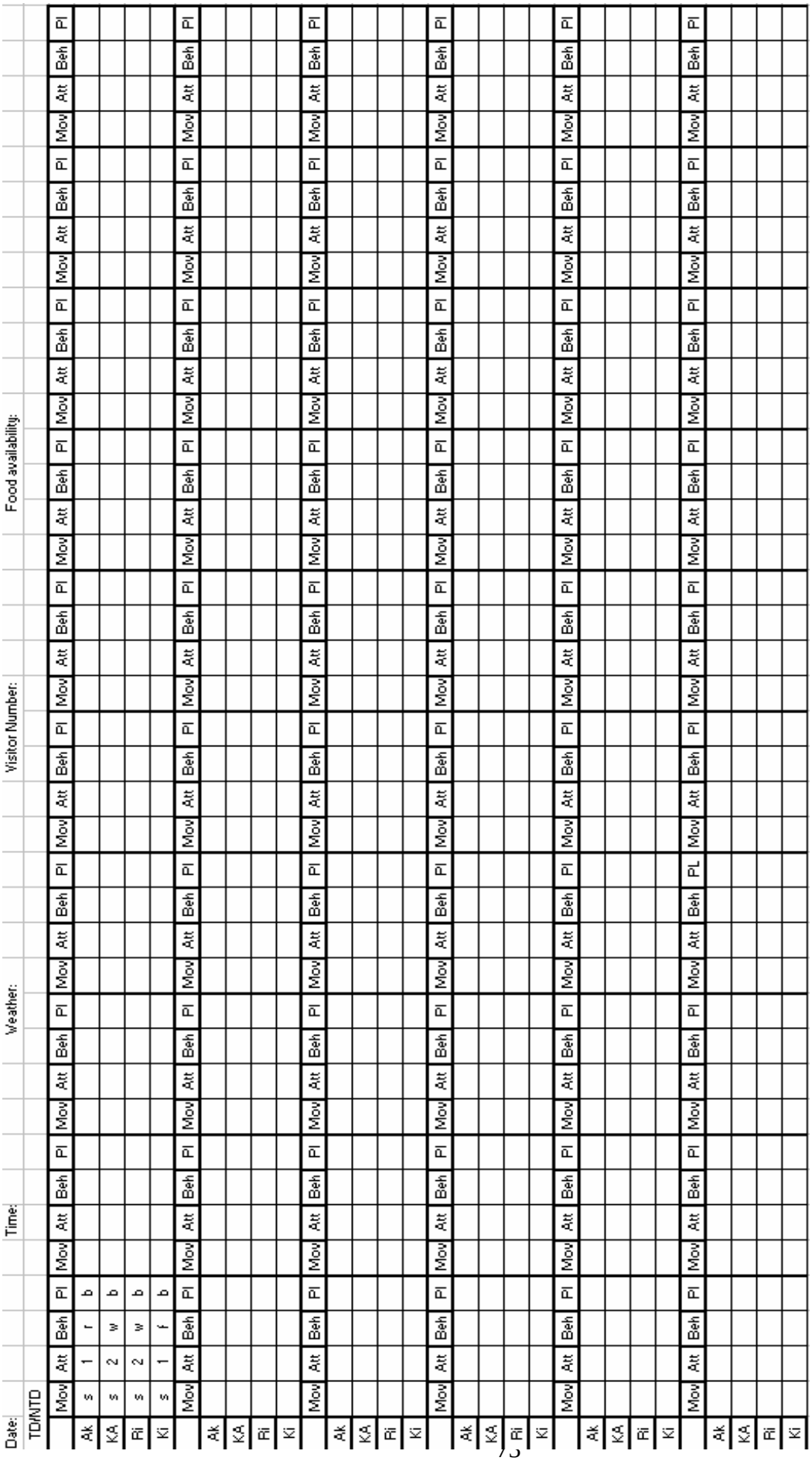
W – Watching: Giraffe is neither chewing anything, nor moving much, but only watching its surrounding.

I – Interaction: Active approach to other individual (human or giraffe) with clear interest. Not just passing by by incident or touch when walking around/feeding together. Usually approaching head first, watching individual of interest intensely and sniffing it first (humans) before (when at all) touching. Contact to humans usually just short with lips/nose and tongue. Giraffe in active role, not passively being touched.
Contact to other giraffes: rubbing/pushing parts of head/neck against other giraffe, swinging head against other giraffe or sniffing it.

IG – Interaction with other giraffe

IX – Sexual interaction with other giraffe – Urine tasting, following, sniffing/licking, nudging, mounting.

7.2: Data sheet for the data collection:



10. Erklärung

8: German abstract:

Stereotypien sind ein typisches Zeichen für ein schlechtes mentales Wohlbefinden bei Tieren, die in Gefangenschaft gehalten werden. Sie variieren stark in ihrer Intensität und Ausprägung. Suboptimale Haltung und schlechte Umweltbedingungen können als Grund für schlechtes mentales Wohlbefinden solches Verhalten auslösen, oder – soweit schon vorhanden – verstärken.

Tieren in Gefangenschaft fehlt im Normalfall die Möglichkeit die ganze Bandbreite an Verhaltensaspekten ihrer Art auszuleben. Sie müssen zum Beispiel nicht aktiv nach Nahrung oder Geschlechtspartnern suchen oder Fressfeinde vermeiden. Bei den meisten Arten werden arttypische Verhaltensweisen, der Drang ein Territorium zu etablieren oder sich Nahrungsquellen oder bestimmte Gebiete gegen Andere abzusichern von Tierpflegern oder der Anlagenbeschaffenheit eingeschränkt. Diese Einschränkung des normalen Verhaltensspektrums hat oft negative Auswirkungen auf das Verhalten eines Tieres: Probleme im Sozialverhalten, repetitives Verhalten, Langeweile, selbstdestruktives Verhalten etc. können daraus resultieren. Stereotypien sind verkümmerte Ausdrücke von Verhaltensweisen, die aufgrund der Lebensumstände in Gefangenschaft nicht in ihrer vollen Bandbreite ausgelebt werden können.

Um dieses Fehlen von adäquaten mentalen Stimuli – die für einen stabilen mentalen Zustand notwendig wären – auszugleichen, werden verschiedenste Arten von Enrichment und Training angeboten. Zusätzlich dazu sollten Tiere von ihren Tierpflegern die Möglichkeit erhalten, ihre Umwelt aktiv zu beeinflussen. Dadurch können stereotypes Verhalten, Stress, Angst und aggressives Verhalten reduziert werden (Laule & Desmond, 1993).

Diese Studie befasste sich im Detail mit den Effekten von Training mit positiver Verstärkung auf die vier Giraffen im Zoo Schönbrunn, Wien im Jahr 2010. Verschiedene Verhaltensaspekte, hauptsächlich Stereotypien, wurden an Trainingstagen und Nichttrainingstage analysiert. Ich erwartete dass Stereotypien an Nichttrainingstagen und vor Training intensiver ausgelebt werden. Eine Reduzierung von stereotypem Verhalten wurde als Verbesserung des geistigen Wohlbefindens betrachtet.

Die Ergebnisse zeigen, dass das Training zwar als Kurzzeiteffekt orale Stereotypien verringert, dafür aber lokomotorische Stereotypien verstärkt. Das Ablecken futterfremder Objekte (Licking) hat sich bei drei der vier Giraffen verringert, während stereotypes Hin- und Herlaufen (Pacing) sich bei drei von vieren verstärkt hat.

Vermutlich hat die Art der Durchführung des Trainings einen Stimulus für vermehrte Zungenaktivität geboten, aber im gleichen Moment die Bewegungsfreiheit innerhalb des Stalles so eingeschränkt, dass diese Verschiebung zustande kam.

Wetter beeinflusste stereotypes Verhalten zusätzlich: Pacing verstärkte sich an Tagen mit schlechtem Wetter. Der Umzug des jungen Männchens nach Italien führte auch zu Veränderungen des Verhaltens bei der Gruppe: Pacing und Licking reduzierten sich bei zwei Giraffen, während sich bei einer das Licking verstärkte. Veränderungen im Tagesablauf und Reduzierung von Langzeitstress könnten hierfür die Ursache sein. Insgesamt haben Stereotypien nur einen kleinen Prozentsatz des täglichen Verhaltensspektrums der vier Giraffen ausgemacht.

9. Declaration

Here, I declare truthfully that this Master thesis was composed by me …… independently, without any help apart from the people named below. No other than the cited literature was used and quotations are marked clearly.

Bad Reichenhall, 13.12.2010:

10. Acknowledgement

Special thanks goes to the Staff of the Tiergarten Schönbrunn, Zoo Vienna, especially Dr. Eveline Dungl, P. Stefan und A. Keller who helped me understand the four giraffes and the basics of animal training and handling, and who were patient enough to answer all my never ending questions. It was a great experience working with you and the four sweethearts!

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I also want to thank my brother, who tried to make the best out of my English and offered honest critic, when I needed it.

Sincere thanks goes to my mother: You gave me the opportunity and the power to study and live without any restriction. Without your help, I could never have made it like this, you set me free!

11. Curriculum vitae

Reiter Sylvia
Bad Reichenhall
Deutschland

E-mail: reiter.sylvia@yahoo.de

Geboren am: 23.09.1985

In: Bad Reichenhall

Familienstand: ledig

Eltern: Mutter: Therapeutin,
Vater: Bauingenieur

S C H U L B I L D U N G

1992 bis 1996	Grundschule Karlstein
1996 bis 2003 *2003 bis 2005*	Christophorusgymnasium Berchtesgaden, Karlsgymnasium Bad Reichenhall Abschluss: Abitur

H O C H S C H U L S T U D I U M

Okt. 2005 bis Okt. 2007: Biologiestudium an der Ludwig Maximilian Universität München, Schwerpunkte: Zoologie und Ökologie

Okt. 2007 bis Okt.2009: Bachelorstudium Biologie an der Universität Wien – Abschluss erfolgreich
Abschlussarbeitsthema: "individual and social factors affecting neophobia in greylag geese, *Anser anser"*

Okt. 2008 bis aktuell : Masterstudium Naturschutz und Biodiversitätsmanagement an der Universität Wien

Okt. 2009 bis July2010: Zweitstudiengang: Master in Wildbiologie

B E S O N D E R E K E N N T N I S S E

Fremdsprachen Englisch (fließend), Französisch

B E R U F L I C H E E R F A H R U N G E N und P R A K T I K A

Juli 1999	Zweiwöchiges Schnupperpraktikum in der Tierarztpraxis Dr. Euler
2000 - 2009	Regelmäßige Studentenarbeit. → Ausbildung von Koordinationsfähigkeit, Zuverlässigkeit sowie effektiver Arbeitsmoral
1999 bis 2006	Aktive Mitarbeit im Schulungsbereich eines Tauchcenters in Bad Reichenhall sowie Ausbildung zum Divemaster. Koordination von Kursen und Betreuung von Schülern → Ausbildung von Verantwortungsbewusstsein und sicherem Umgang mit Menschen in ungewohnten Situationen und Stress
2006 bis aktuell:	Arbeit als Divemaster in einer Tauchschule in Bad Reichenhall
Oktober 08 – Jan 09:	Projekt-Praktikum an der Uni Wien: " Soziale Präferenz bei Ratten in Abhängigkeit vom ovariellen Zyklus
Juni/Juli 2008	Einmonatiges tropenbiologisches Praktikum in den Bergen von Tansania → Verbesserung der Problemerkennung und aktiven selbständigen Arbeit, Praktische Erfahrungen im Bereich Umweltschutz und Einbindung der local communities. Abschluss mit einer wissenschaftlichen Arbeit über *Phrynobatrachus kreffti.*
Juni – Oktober 2009	Vier Wochen Umweltbildungs-Praktikum + 2 Monate Steinadlerpraktikum im Nationalpark Berchtesgaden
März – August 2010	Datenaufnahme im Zoo für meine Masterarbeit: „Effects of positive reinforcement training on behavioural well-being in Giraffes (Giraffa camelopardalis)" – fast tägliches Beiwohnen beim Handling-Training der Giraffen im Wiener Zoo. → wertvolle Erfahrungen im Bereich Tiertraining und Handling von sensiblen Tieren
Juli 2010	Dreiwöchiges Tierpflegerpratikum im Zoo Wien → Einblicke in die Arbeit als Tierpfleger, praktische Erfahrungen im Umgang mit Exoten
Dezember 2010- aktuell:	Praktikum in der Tierarztpraxis Dr. Facharani, Bayrisch Gmain.

MITGLIEDSCHAFTEN / SONSTIGE TÄTIGKEITEN

Aktive Mitgliedschaften:	Tauchclub Thumsee Reichenhall;

HOBBIES / FREIZEIT

Sport:	Kampfsport (Aikido, Karate), Tauchen, Schwimmen, Klettern, Ballsportarten, Tanzen, Berggehen, Laufen
Sonstiges:	Engagement für Natur & Umweltschutz, Lesen, Schreiben („Flammenstreit" – Fantasy Roman, erscheint im Berger - Verlag) Campen, Basteln/Handwerken, Reisen…