University of Veterinary Medicine Budapest

Department of Zoology

Role of play behaviour in animal development

And its corelation with animal welfare

A játék szerepe az állati fejlődésben

És korrelációja az állatjóléttel

Ahmed Khaled Abdelrahman Abbas

Supervisor: Dr. Eszter Berekméri

Department of Zoology

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Abstract

This thesis explores the role of play behaviour in animal development and its intricate connection with animal welfare. Play is a crucial aspect of behavioural biology, serving functions beyond recreation, such as improving cognitive, physical, and social development. Through detailed analysis, the study highlights various forms of play, including locomotor, object, and social play, and their significance in enhancing adaptability and resilience in animals. Additionally, the thesis examines the five freedoms as a cornerstone of animal welfare, emphasizing the ability to exhibit natural behaviours, including play, as an indicator of well-being. Furthermore, it briefly examines the neurological impacts of hepatic encephalopathy (HE), a condition caused by liver failure and elevated ammonia levels, which impairs energy, cognition, and motor abilities, reducing animals' capacity for play. Empirical studies across species, such as calves, gazelles, rats, and domestic pets, reveal the adaptive and therapeutic benefits of play, not only for animals but also in fostering human-animal bonds. The findings underline the dual role of play as both a marker and enhancer of welfare, offering insights into its broader implications for conservation, animal management, and human-animal interactions.

Absztrakt

Ez a diplomamunka játék viselkedésének szerepét vizsgálja az állatok fejlődésében, valamint annak bonyolult kapcsolatát az állatjóléttel. A játék a viselkedésbiológia alapvető aspektusa, amely a rekreáción túlmutató funkciókat tölt be, például a kognitív, fizikai és szociális fejlődésben játszik szerepet. A tanulmány részletes elemzést nyújt a játék különböző formáiról, beleértve a helyváltoztatással, tárgyakkal és társas kapcsolatokkal kapcsolatos játékokat, valamint ezek alkalmazkodási és ellenállóképességet növelő jelentőségét. Emellett a dolgozat az Öt Állati Szabadságot, mint az állatjólét alapkövét is vizsgálja, hangsúlyozva a természetes viselkedés – például a játék – kifejezésének képességét a jóllét egyik mutatójaként. Továbbá, röviden tárgyalja a májelégtelenség és a megemelkedett ammóniaszint által okozott hepatikus enkefalopátia (HE) neurológiai hatásait, amelyek az energia, a kognitív képességek és a motoros készségek károsodásához vezetnek, csökkentve az állatok játékra való képességét. A borjakon, gazellákon, patkányokon és háziállatokon végzett empirikus vizsgálatok rávilágítanak a játék adaptív és terápiás előnyeire, nemcsak az állatok, hanem az ember-állat kötelékek erősítése terén is. Az eredmények aláhúzzák a játék kettős szerepét mint az állatjólét mutatója és javítója, betekintést nyújtva annak szélesebb körű alkalmazási lehetőségeibe a természetvédelem, az állatgondozás és az ember-állat interakciók terén.

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1. Introduction:

Play behaviour represents a captivating and multifaceted phenomenon observed across the animal kingdom, transcending species and ecological boundaries. Its significance extends beyond the apparent joy it brings, encompassing critical roles in physical, cognitive, and social development. This thesis delves into the intricate dynamics of play, emphasizing its role in animal growth and its profound implications for animal welfare.

Research has consistently highlighted the interplay between play and well-being, demonstrating how play enhances motor coordination, fosters problem-solving skills, and strengthens social bonds. For instance, locomotor play in calves promotes physical fitness and reduces stress, while social play in rats facilitates social hierarchy establishment and emotional resilience. Moreover, the connection between play and welfare is pivotal, as play often serves as both an indicator and a catalyst for positive welfare states.

A central framework in this exploration is the five freedoms, which underscores the importance of enabling animals to express natural behaviours, including play. By investigating how these freedoms correlate with various forms of play, the thesis aims to shed light on the adaptive and therapeutic functions of play behaviours in diverse species, from gazelles and domestic cats to humans interacting with animals.

This research not only seeks to understand the developmental and welfare implications of play but also to highlight its broader significance in promoting conservation, humane animal management, and strengthening human-animal relationships. By synthesizing empirical findings and theoretical insights, this thesis aspires to contribute meaningfully to the growing recognition of play as a vital aspect of animal life.

2. Animal play and animal welfare:

2.1 The concept of Welfare:

Animal welfare is a complex topic with significant political, economic, ethical, and scientific ramifications [1]. Therefore, this field requires an interdisciplinary approach that brings together researchers from several biological fields, including comparative psychology, physiology, veterinary medicine, and ethology [1]. The multifaceted approach must involve collaboration across the ecological and social sciences because the study of animal welfare encompasses husbandry and human-animal relations. This could increase understanding of pertinent facets of human behaviours and the social roles of animals [1].

The status of a person in respect to their surroundings is referred to as "welfare," and it is measurable. Poor welfare is indicated by both difficulties coping and failure to cope with the environment [2]. According to the American Veterinary Medical Association (AVMA), Canadian Veterinary Medical Association (CVMA), and Federation of Veterinarians of Europe (FVE), "veterinarians are, and must continually strive to be, the leading advocates for the good welfare of animals in a continually evolving society" (AVMA 2014) [3].

2.2 The history of the five freedoms:

When Franklin Roosevelt first used the phrase in his 1941 speech to the US Congress, it was known as the four freedoms, and he mentioned them in relation to humans. He distinguished these as freedom of expression, freedom of religion, freedom from fear, and freedom from want. Like the later five freedoms, it should be clear that they are ambitions [4]. All people should always enjoy these ideal freedoms, but he was not making that a legal requirement. But they are unforgettable [4].

The Brambell Committee study on the welfare of farm animals in intensive systems was the source of the phrase [4]. to summarize their findings that agricultural animals kept in captivity should have enough room to engage in the five minimal behaviours or activities listed below: standing, lying down, turning around, stretching their limbs, and grooming every part of their bodies [4]. While these factors were crucial for animals in the most intensive systems, It was argued at the UK Farm Animal Advisory Committee (the forerunner of the Farm Animal Welfare Council, or FAWC) in 1979 that they only provided a limited perspective on farm animal welfare and ignored many, if not most, welfare issues. It was first suggested a new set

of five freedoms after being asked to produce something more thorough. This is how they currently stand after FAWC worked on the initial set and released an updated version in 1993 that matched each of the five freedoms with five provisions [4].

2.3 The five freedoms:

We can consider the diverse ways that animals can be free thanks to this more complex concept of freedom [5]. There are liberations from limitations or unpleasant situations. Additionally, there are freedoms to use resources or act in certain ways. The UK's Farm Animal Welfare Council created the five freedoms framework, which embodies this [5]. This paradigm is helpful since it explicitly tries to link freedom to welfare, giving an example of the spectrum of conceivable freedoms, and these above-mentioned well known and highly established freedoms are:

1. Freedom from hunger and thirst; By having easy access to food that will keep you healthy and vigorous
2. Freedom from pain, injury and disease; Through prompt diagnosis and treatment or prevention
3. Freedom from discomfort; By offering an appropriate setting that includes a place to relax comfortably and shelter
4. Freedom from fear and distress; By giving the animal enough room, appropriate amenities, and the companionship of its own kind
5. Freedom to perform normal/natural behaviour; by creating circumstances that prevent mental distress [5].

A more sensible reading of the "5 freedoms" as stipulated by Webster (1994), is another constructive step toward a potential consensus among the previously mentioned attitudes: "Absolute attainment of all five freedoms is unrealistic, indeed they are to some extent incompatible" [6]

2.4 The relation between animal welfare and playing behaviour:

One prominent criterion for assessing animal welfare is the ability to exhibit natural behaviour. Even though numerous authors have not considered it very remarkably influencing the welfare —some natural actions may boost welfare, while some unnatural behaviours may lower it— this is nonetheless the case [7]. It was examined what this notion endures and potential consequences. A deep argument about the point the state of wellbeing entailing was contended, rather than a disagreement about whether factors influence welfare, that lies at the heart of this discussion about natural conduct [7]. While the opinions of the people against the criterion commonly adopt a "subjective" welfare notion, in which it is defined as the animal's own experience of life, proponents of natural behaviour typically adopt a "teleological" perspective of welfare, in which naturalness is key to it [7]. Others contend that the natural behaviour criterion in favour of one like behavioural preferences or enjoyment should be abandoned since natural functioning is neither required nor sufficient to comprehend welfare. This will have an impact on how we define and quantify welfare, especially on how we care for the well-being of animals kept in captivity [7].

The term "natural behaviour" refers to the actions that animals typically take in their natural environments because they are enjoyable and support biological processes. Animals have more than simply basic physiological demands, like the desire for food, water, and warmth [8]. Additionally, they must engage in some of their innate behaviours, such as scratching or dustbathing in chickens, strolling and playing in dogs, investigate the surroundings and alleviate cats' boredom, and rooting or nest-building in pigs [8]. To evaluate overall welfare, all needs must be considered. The tendency of animals to behave in preference experiments, consumer-demand research, and natural settings is referred to as positive welfare value. Stress, annoyance, aberrant conduct, hostility, and decreased fitness are all associated with negative welfare values [8].

Since play is often absent when animals face a fitness challenge and is believed to be going along with a positive emotions and experiences, it has long been recognized as a possible welfare indicator [9]. However, animal play is a perplexing behavioural phenomenon that is characterised by flexibility and variability both within and between species. Its underlying mechanisms and ultimate purposes remain largely unknown. Because of this, its connection to animal welfare is complicated and calls for a careful theoretical analysis. In the upcoming words, data were examined based on four facets of the relationship between play and welfare: First, play signals the lack of risks to fitness; second, play serves as a reward and

signals the existence of positive emotional experiences; third, play increases welfare both now and in the future by providing short-term psychological benefits as well as long-term fitness and health benefits; and, finally, play is socially contagious and can therefore promote excellent welfare in groups. Based on this, contends that play has potential as a welfare indicator and a method for enhancing it [9], the challenges were also highlighted in the analysis and interpretation of play and identifies certain open-ended issues. Play can serve as a welfare indicator that indicates both; presence of good welfare and the absence of bad welfare, hence including a large portion of the spectrum of welfare. However, play does not always represent positive environmental conditions because it might happen to arise in stressful situations, upon reacting to less parental attention, or after a time of deprivation as a recovery [9].

To completely describe the wellbeing status of an animal based on its play behaviour, as well as whether and how play could be utilized as a strategy to enhance welfare, a deeper understanding of the different end purposes and immediate mechanics of play, as well as the ways in which caged animals play according to their species., is required [9]. To correlate animal welfare with animal playing behaviour To reach our objective, we must take into account a few modifying circumstances, those factors are age, gender, and species, which next to the fact that the animal will only play when they are well fed, showing good health and not under stressful conditions [10].

3. Types of Play:

New material, such as descriptions of play in little-known species and experimental investigations using conventional laboratory animals, has greatly contributed to our current understanding of animal play [10]. A more comprehensive understanding of play in the more playful and well-studied species was made possible by integrating this knowledge with the reinterpretation of previous studies and the use of contemporary ethological techniques. This helped us comprehend significant facets of animal play [10].

Three main types of play are widely acknowledged: (1) Locomotor play: locomotor is when an isolated animal sprints, jumps, kicks, rotates its entire body, shakes its body, and makes abrupt twists. Or in another summarising words: actions that are frequently connected to anti-predator actions [11]. (2) Object play: object play is when an isolated animal plays with an inanimate object by carrying, tossing, ripping, or in any other way, we can also define it as set of behaviours that are frequently connected to predation and foraging [11]. (3) Social play: behaviour patterns related to allogrooming - the practice of providing care for another animal via physical contact, usually with the use of the hands, mouth, or other bodily part - and it is also demonstrated when two or more conspecifics wrestle, chase, or otherwise interact with one another [11]. There are several interesting examples of animals playing when two or even more of these activities are being used simultaneously. For instance, Animals can use a variety of locomotor motions when they play with objects; in social play, they can engage in locomotor-rotational movements or compete for an object [11]. Object-assisted eye-covering play, which incorporates behaviours from all three types of play in certain primate species, may have cognitive implications on pretence [11]. Combining several playing forms, demonstrated by the aforementioned instances, is in line with the widely accepted theory of play, which holds that animals integrate patterns of behaviour from multiple behaviour systems [11]. The advantages of play behaviour are typically associated with the growth of physical resistance, strength, and motor coordination, learning new environmental knowledge, and acquiring some social skills, can enhance the flexibility and adaptability of animal behaviour to better prepare them for upcoming real-life situation [12].

3.1 Locomotor Play:

3.1.1 Effect of Locomotor Play on Calves:

Calves engage in locomotor play in an open arena, which makes it quick and easy to gauge their level of playfulness [13]. And according to this fact two experiments were made urged to understand what factors influence the outcomes and tie playfulness to other welfare indicators to be able to use this as a technique of assessing the welfare. The calves' ages, the arena's novelty (how new is the arena where they will be held/kept), and the enclosure's size in relation to the calf's home pen can all have a significant impact [13]. In this study veal calves were put in a brand-new arena measuring 11m by 3.2m for 15 minutes, and timed how often they jumped and how long they ran [13]. They aimed to evaluate: vocalization, defecation, sniffing, how late they were to enter the arena, fearfulness and the impact of the exploratory behaviour on locomotor play [13]. In the first experiment two feed amounts were provided to 24 calves approximately (six weeks of age): the calves given high amount of feed diet were showing less amount of jumping and running, but no variations were observed in smelling, defecating, or entering the arena late between the two different groups [13]. Based on the results, the study concluded that their latency time to enter the arena was not connected with both running and jumping, although sniffing was positively correlated with both activities [13]. There was no correlation found between defecating and jumping or running [13]. To investigate the effects of spatial restriction, the study had gone through experiment 2: in which 48 calves were housed in either stalls (0.65 x 1.8 m) or pens (2.1 × 1.8 m) [13]. Calves in stalls performed no differences in sniffing, pooping, and mooing than those in pens when they were released into the arena, although they ran and jumped more. Which indicates that the size of the keeping place has a direct correlation with jumping and running activities of the calves [13]. These findings provide credence to the theory that the more play displayed by calves kept in smaller enclosures is a type of "rebound" brought on by a greater desire to play because of the less play options available in smaller enclosures. Monitoring the same calves became older and taking the age into consideration also made realizes that getting older was linked to more running and jumping, which in turn was linked to more sniffing [13]. The degree of exploratory behaviour displayed by the calves mediates the relationship between novelty and age on locomotor play; calves who exhibit higher levels of exploration also engage in greater play, so in simple terms (more sniffing = more playing) [13]. Also, due to fear; as stress tends to lessen playfulness in younger calves, however the effects are not very significant [13]. The rebound during arena locomotor play

is the outcome of spatial confinement in the home pen; this rebound is not related to fearfulness or exploration [13].

3.1.2 Locomotors play and hepatic encephalopathy correlation:

A consequence of liver failure known as hepatic encephalopathy (HE) is when brain ammonia (NH^{4+}) levels get dangerously high. The syndrome known as hepatic encephalopathy (HE) is linked to both acute and long-term liver damage. From mild impairments in the higher functions seen in cirrhosis to coma in severe liver failure, it presents as a broad range of neuropsychological abnormalities [14]. For 130 years, there has been no question about the crucial role ammonia plays in the development of brain oedema in acute liver failure. Later, it became clear that inflammation and infection were important factors in the development of severe hepatic encephalopathy, which was linked to the emergence of intracranial pressure and cerebral oedema [14]

A variety of neurological problems, including coma and behavioural and motor abnormalities, could result from HE. Several strategies have been developed to reduce brain and blood NH^{4+}. But there isn't a specific treatment to lessen the immediate neurological effects of NH^{4+} [15].

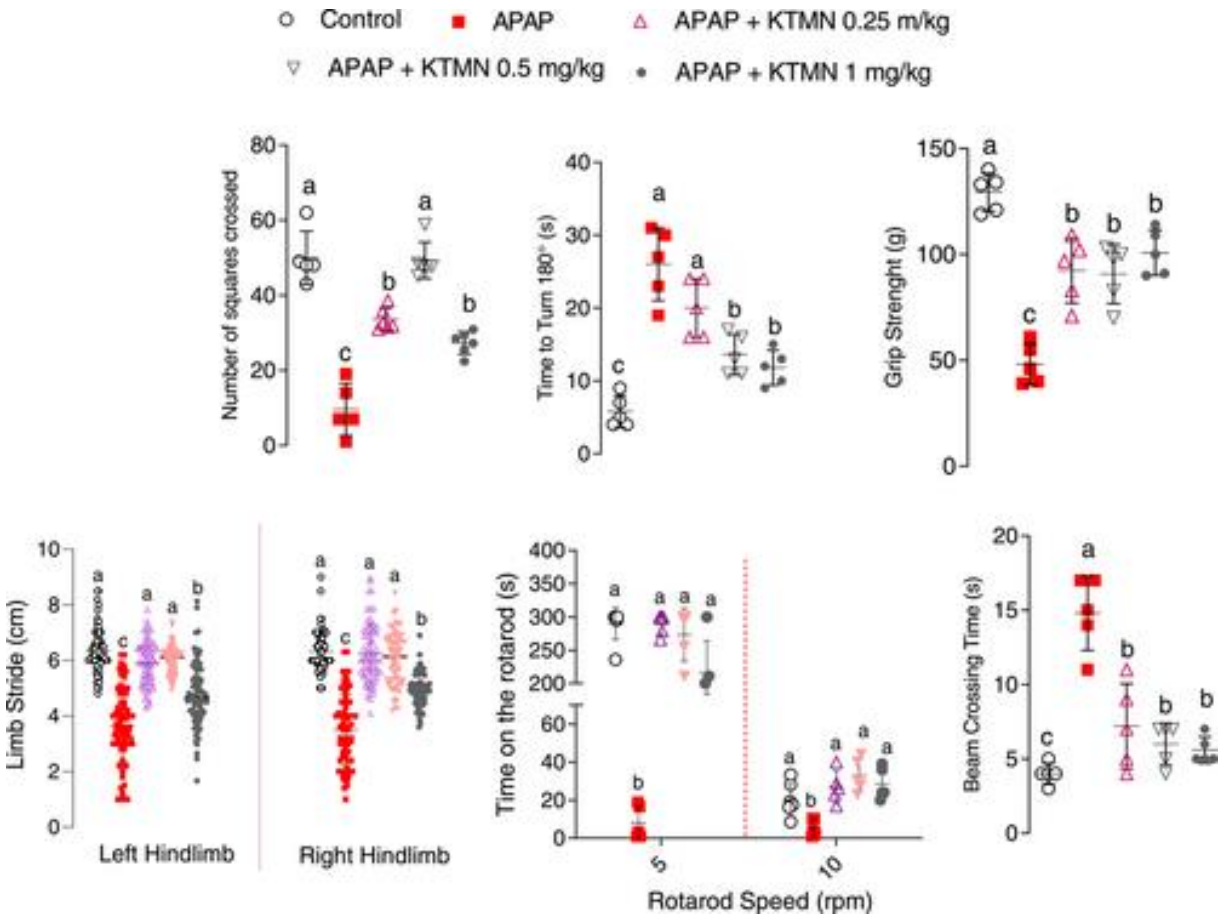
As a result of the reduced energy and motivation due to the caused fatigue that will result in a reduction in animals' vitality needed for play [16]. Furthermore, because of neurotoxin buildup in HE it will affect cognition, motor control, and decision-making, leading to disinterest or disorientation in play. And not to forget that HE disrupts social cue interpretation, diminishing interactive play behaviours in social animals and possibly leading to irritability [16].

3.1.2.1 The effect of ketamine on Locomotor play and hepatic encephalopathy:

As the primary suspected molecular cause of the neurological side effects of hepatic encephalopathy (HE) is ammonium ion (NH^{4+}) [15]. Yet, there is no particular pharmacological intervention for NH^{4+}-induced brain damage. One well-known condition in the brains of hyperammonaemia patients is excitotoxicity [15]. Excitotoxicity may result from substances such as glutamate, an NH^{4+} metabolite, hyperactivating the N-Methyl-D-aspartate (NMDA) receptors [15].

NMDA receptors, glutamate-gated ion channels, are essential for various neural processes. Widely distributed in neuronal plasma membranes, they form complexes with scaffold proteins and other receptors to regulate activity and downstream signalling [17].

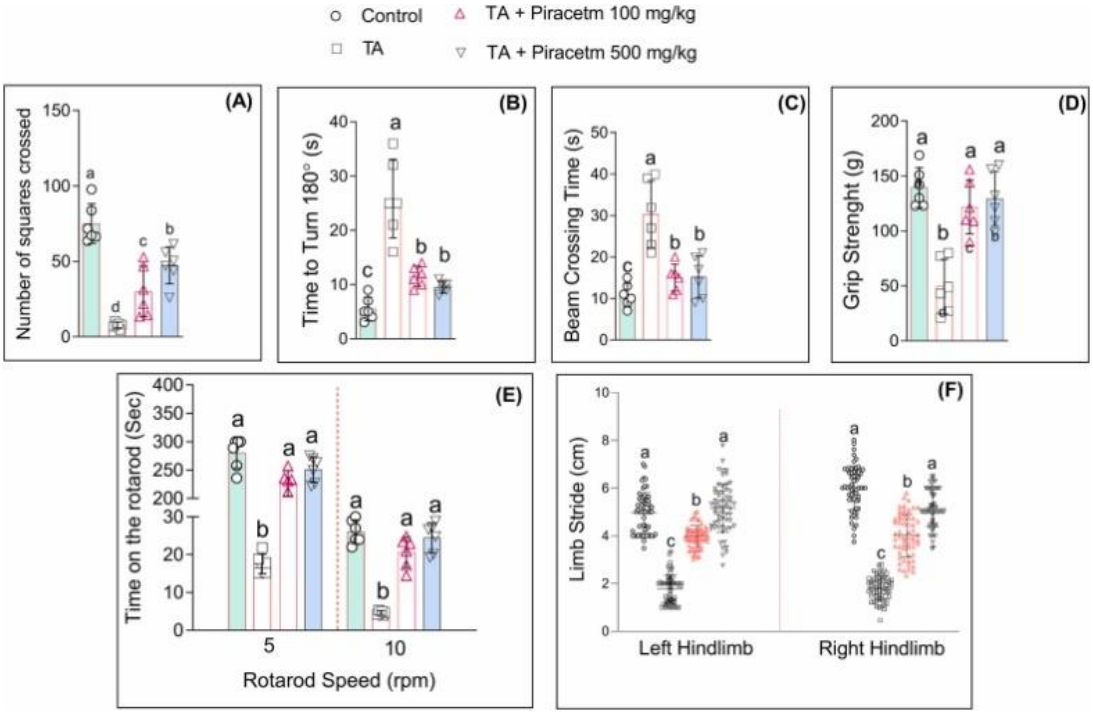
Events like neuroinflammation and oxidative stress are linked to excitotoxicity. Therefore, the use of NMDA receptor antagonists may be able to avoid the neurological effects of NH^{4+} neurotoxicity. Acetaminophen -a limited anti-inflammatory actions make it the preferred drug for treating fever. But when taken in excess, it can harm and malfunction mitochondria [18]- was administered to a mice in the current investigation in order to induce HE. Animals' plasma and brain NH^{4+} levels were abnormally elevated, and their locomotor activities were disrupted [15]. Additionally, there were a few markedly elevated oxidative stress markers in the brain. In hyperammonaemia mice, there was also a notable rise in TNF-a, IL-6, and IL-1ß levels in brain tissue [15]. As an NMDA receptor antagonist, ketamine (1 mg/kg, s.c.) was administered to hyperammonaemia rats. Ketamine was shown to dramatically reduce pro-inflammatory cytokines, enhance oxidative stress indicators, and restore animals' locomotor activity **Figure 1**. To sum up, ketamine's neuroprotective mechanises appear to be mostly dependent on its effects on inflammation and oxidative stress indicators which in turn influences the locomotor activities [15].



- ***Figure 1: Acetaminophen (APAP) treatment led to a significant reduction in locomotor activity in mice. However, ketamine (KTMN) remarkably improved locomotion in the APAP-treated groups, suggesting a potential therapeutic effect on movement deficits induced by acetaminophen***

3.1.2.2 The effect of piracetam on Locomotors play and hepatic encephalopathy:

It has been discovered that the primary causes of NH^{4+} neurotoxicity are oxidative stress, mitochondrial damage, and neuro-inflammation [19]. Medication called piracetam -a well-known nootropic thought to improve memory function via influencing neurotransmitter levels and synaptic plasticity [20] - is used therapeutically to treat neurological issues like head trauma and stroke. Piracetam may greatly reduce oxidative stress and enhance mitochondrial activity in the brain [19]. Research techniques occurred on a mouse model of HE caused by thioacetamide -A hepatocarcinogen that can cause cholangiocarcinoma or primary hepatocarcinoma [21] - (TA, 800 mg/kg, single dose, ip.) was treated with piracetam (100 and 500 mg/kg, oral). The brains of mice treated with TA showed notable abnormalities in the animals' locomotor activity as well as elevated oxidative stress biomarkers, such as the formation of reactive oxygen species, protein carbonylation, lipid peroxidation, reduced tissue glutathione, and decreased antioxidant capacity. In the meantime, the TA group's brain showed signs of mitochondrial permeabilization, depolarisation, inhibition of dehydrogenases activity, and lowered ATP levels. The brains of HE animals also contained noticeably higher levels of pro-inflammatory cytokines [19]. Upon the treatment with piracetam, it was discovered that piracetam dramatically improved mitochondrial indices in hyperammonaemia mice, attenuated oxidative stress indicators, reduced inflammatory cytokines, and increased locomotor activity in mice. These findings point to piracetam as a neuroprotective medication that may be used to treat [19].



- ***Figure 2: Piracetam significantly improved various locomotor activities in thioacetamide (TA)-treated mice, including performance in the open field (A), negative geotaxis (B), beam crossing (C), grip strength (D), rotarod (E), and limb stride (F). These results suggest that piracetam may have therapeutic potential for locomotor deficits induced by TA treatment.***

3.2 Object Play

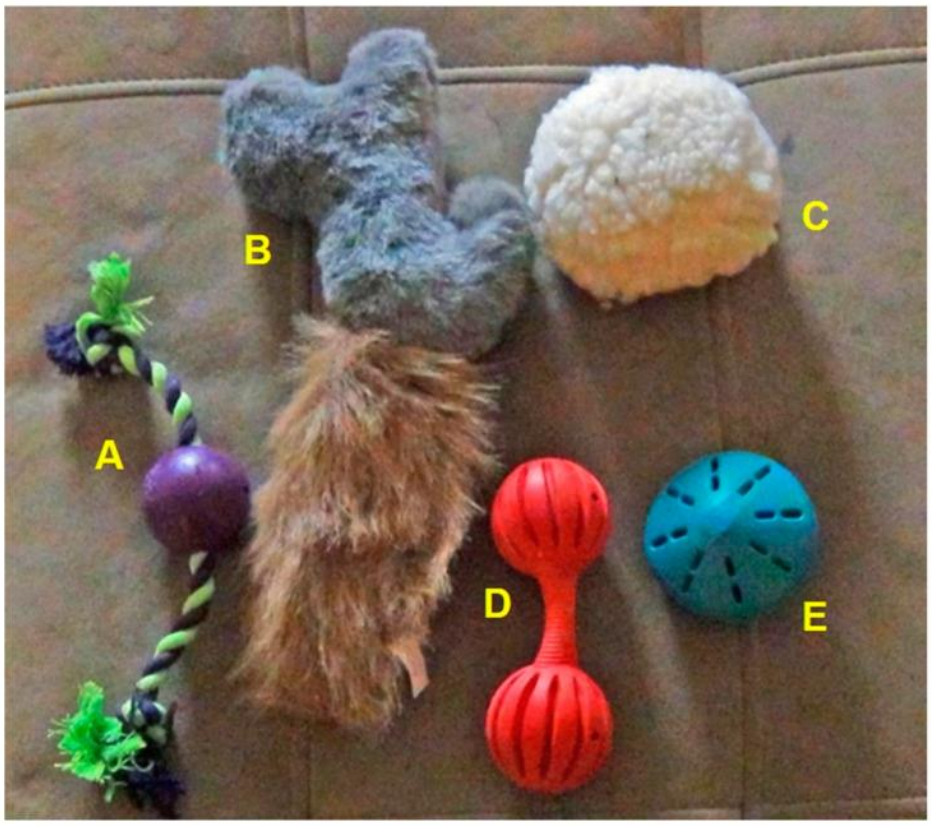
3.2.1 Object play effect on the predation of the wild animals performed on domestic cats:

Domestic cat predation is a social issue and may pose a harm to biodiversity preservation and be a big threat to it [22]. Hence many efforts were made in this special field trying to see if it's better for the animal to prevent the hunting/predation desire by decreasing it or not. It's a very controversial topic but looking at the fact that preying is the normal behaviour of the species, it made some owners not want to affect or stop what is considered to be natural behaviour of the animal, Devices installed on collars and confinement can reduce the number of animals killed during cat hunting and make it less successful, but also the owners are sometimes worried about their equipment breaking or becoming ineffective [22]. In this study a new non-invasive therapy that aim to improve cat husbandry alongside current hunting-devices that reduce/inhibit hunting in a controlled and repeatable trial were examined. A study was made on 3 groups of cats, the first one being the control, the second group were given a high meat protein with grain free diet, while the third group were introduced to 5-10 minutes object play daily [22]. The results came that the second group with the specific diet recorded a decrease of 36% of numbers of prey/animals brought home by the cats while group 3 number was 25% of less animals brought back home compared to the control group, the second group were introduced to further studies in which the numbers rose by 33% once puzzle feeders were introduced [22]. Installing Birdsbesafe collar covers (image D in **Figure 3**) had no appreciable impact on animals, but it did reduce the number of birds captured and taken home by 42% [22]. No observable effect was produced by introducing cat bells for collars (image A in **Figure 3**). Hence reaching the conclusion of this study that some non-invasive techniques - using either especial assisting equipment or via increasing the object play time- exist that aim to decrease the hunting/predation desire in the cats instead of fully inhibiting it therefore those techniques are tend more to be favoured by cat owners who are worried about the welfare effects of alternative remedies [22].

- ***Figure 3: Interventions to Reduce Wild Animals Captured and Brought Home by Domestic Cats.***

3.2.2 Object play in dog puppies versus in wolf puppies:

There aren't many studies looking into how wolf pups learn to play with objects. To help unravel the effects of domestication on any distinctions found between different dog breeds and wolves, this comparison between wolves and dogs took place [23]. Through studying the evolution of object play in two litters of Canis lupus wolf pups, aged between two and nine weeks (14–63 days), were raised by hand. Video footages of both pup litters were taken in their home cages at the beginning and middle of the week [23]. The identical five commercial dog toys **Figure 4** (Canis lupus families), each with a different sensory and functional quality, were given to each litter separately. Using a previously created ethogram of object-related behaviours, the first ten minutes of activity from each session were examined. Wolf pups were generally developmentally ahead of dog puppies, as seen by the considerable increases in behavioural counts, behavioural diversity, and the percentage of time spent playing with toys with them as they grew older [23]. Just like dogs, wolves have certain toys that they preferred. These discoveries deepen our understanding of the behaviour of baby wolves, shows the relative growth of object play in dogs vs wolves, and offer a framework for researching the effects of play behaviour on domestication [23].



- ***Figure 4: The five PetSafe research toys are labelled as follows: (A) a firm rubber ball is fastened to a braided cloth rope., (B) a squirrel, (C) a white fluffy puff, (D) a bone in the shape of a red rubber barbell, and (E) stiff rubber blue disk.***

3.3 Social play behaviour

3.3.1 Social play behaviour in mammals and rats in particular:

Among the first non-mother-directed social behaviours to emerge in mammalian species during ontogeny is social play behaviour [24]. The importance of social play activity has been hotly debated over the past century, but behavioural research suggests that social play behaviour is a distinct and important category of conduct. An extensive overview of research on the neuroscience of social play behaviour are being held more often recently. Evidence is given opioid and dopamine systems have a role in the reward portion of social play behaviour [24]. A summary is given of the roles played by the cholinergic, noradrenergic, and opioid systems in the attentional processes that underlie the development of social play behaviour in rats, as well as the function that androgens play in the sexual differentiation of social play behaviour [24]. Young rats typically play rough and tumble with one another in social situations [25]. More thorough observations, such as longitudinal studies of the developmental function from preweaning to young adult stages, have surpassed casual and informal accounts of social play [25]. 15 or 16 days of age is when social play is first observed [25]. After that, it intensifies and grows in frequency until it reaches its climax at about 36 days of age [25]. Male social play behaviours change is a situation-specific aggressive and copulating behaviours during puberty. Social play persists beyond sexual maturity in females [25].

3.3.2 Social play behaviour in other mammals:

Among juvenile mammals, social play behaviour is defined as active type of social contact [26]. It is very fulfilling and seen as critical to the social and cognitive development for instance in human children. Although the exact neurological underpinnings of social play remain unknown, there is evidence that suggests the prefrontal cortex (PFC) and striatum play a part in this behaviour [26]. The role of multiple subregions of the medial PFC and striatum in social play using pharmacological inactivation techniques was examined, i.e., infusions of GABA receptor agonists - kinds of receptors engaged in the central nervous system's inhibitory synapses [27]- the agonists were baclofen and muscimol; B&M or the AMPA/kainate receptor antagonist -Memory, learning, and experience rely on those AMPA receptors, with dysfunction linked to neuropsychiatric diseases [28] - (6,7-dinitro quinoxaline-2,3(1H,4H)-dione) (DNQX). The frequency and length of social play behaviour were significantly reduced when the prelimbic cortex, infralimbic cortex, and medial/ventral orbitofrontal cortex were activated by B&M [26]. However, B&M infusion

tended to have the same result, local delivery of DNQX into the dorsomedial striatum improved the frequency and length of social play [26]. Therefore, the expression of social play depends on the functional integrity of the medial PFC.

Furthermore regarding the Nucleus accumbens (NAcc) - this area of the brain has distinct functions in learning and memory from its well-known functions in behavior, including reward, motivation, and locomotor activity [29]: while B&M infusion into the Nucleus accumbens shell had no effect on the frequency of social play behaviour, inactivation of the NAcc's core with B&M still lengthened the social play sessions [26].

Social play is inhibited by glutamatergic inputs into the dorsomedial striatum, and the duration of playful interactions is constrained by functional activity in the NAcc core [26]. These findings emphasize the significance of prefrontal and striatal circuits linked to reward-related processes, cognitive control, decision-making, and behavioural inhibition in social play behaviour [26].

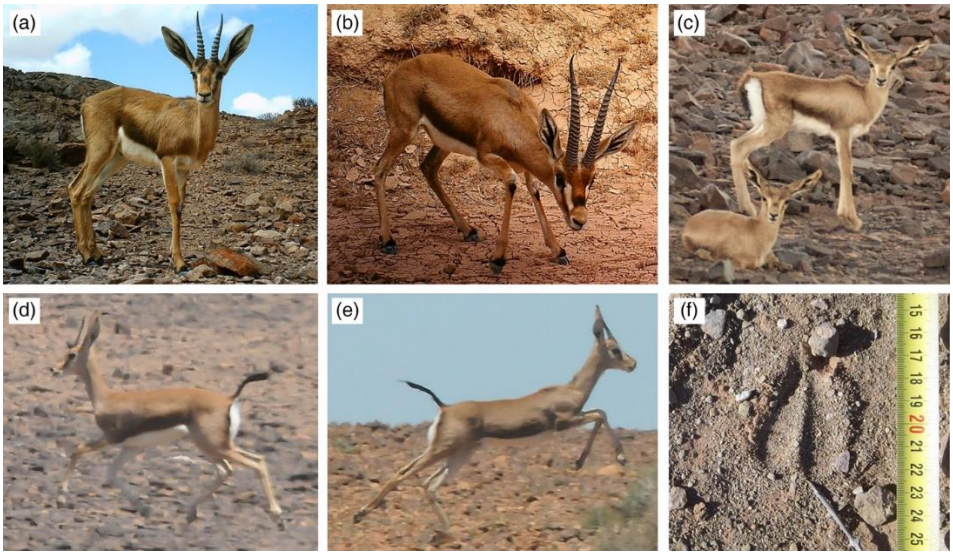
3.3.3 Charles Darwin and Pierre Huber thoughts on social play:

A mention worthy words about animal playing behaviour via intentional communication in general and social playing in particular was what Charles Darwin said about it meaning: Humans and other lower animals exhibit both pleasure and pain, as well as happiness and sadness [30]. When young animals, like our own children, puppies, kittens, lambs, and other animals play together, they never show happiness better [30].

Even insects perform this behaviour and they do play together, according to the great observer Pierre Huber, who witnessed ants acting like puppies, chasing and pretending to bite each other [30]. He wrote about this in his book, stating that it would be difficult to explain the social behaviour of ants and bees without giving them emotions if one were not used to thinking of insects as machines [30].

4. The evolution of various forms of play in gazelles: consequences for the characteristics and purposes of play:

Cuvier's gazelle (Gazella cuvieri) **Figure 5**, play behaviour development is documented and contrasted with other species. Four categories of play were distinguished: object play, play-fighting, sexual play, and locomotor play [31]. The idea that play is a diverse category was supported by the differences in developmental tendencies among the forms taken into consideration. Locomotor play accounted for a large portion of all play and started at high frequencies, but starting in the early months, both metrics decreased. In contrast, play-fighting and sexual play were uncommon in the first few months after birth, then grew and peaked between four and six months, before declining [31]. These play forms gradually gained relative prominence until they surpassed all other play forms as the most common. At all ages, object play was still rare and made up a very small percentage of all play [31]. Calves played primarily by themselves when they were young, but as they grew older, the amount of social play rose until all play was social. Calves sent out more invitations to play and engage in sexual activity before month four than they were given [31]. Calves' primary playmates were their contemporaries, then adult females. More calves approached adult females and males for sexual play and invitations than they received from both genders. These findings are examined in light of other facets of the calves' social and behavioural development, and it is suggested that play, which is thought to provide instant advantages, provides the best explanation for them [31].



- ***Figure 5: Photographs of Cuvier's gazelles across a different range of age groups and sexes captured while doing surveys in the research region include: (a) subadult male, (b) subadult male, (c) calves, (d) subadult female, (e) adult female, and (f) a typical Cuvier's gazelle track. The heart-shaped track distinguishes it from those of goats, sheep, and Barbary sheep. Photos (a) and (b) were captured using camera traps.***

5. Playing behaviour in rats and anti-depression correlation:

There is uncertainty regarding the cellular mechanism of action of antidepressants. It has been observed that brain-derived neurotrophic factor (BDNF) - is one of the most extensively studied molecules in psychiatric illnesses and a neurotrophins that regulates neuroplasticity in the brain [32]- mRNA levels are upregulated in the hippocampus because of long-term antidepressant medication, and that this effect is enhanced by voluntary running [33]. Our goal was to find out if these therapies' effects on BDNF expression could compensate for acute stress-related deficiencies and influence behaviour in an animal model. In this article, we investigated the notion that animals forced to swim in an unavoidable water tank could benefit from a reduction in neurotrophins deficiencies and an increase in swimming time if they received the antidepressant tranylcypromine along with physical activity [33]. For a week, the rats were divided into 4 groups, one control group then one group receiving tranylcypromine treatment, another participated in voluntary jogging and the last one received both the treatment with the jogging. The animals had a two-day forced swimming therapy after these treatments. When they were forced to swim for extended periods of time we could see in the control group without treatment that BDNF mRNA levels were markedly decreased due to the stressful situation of the extended forced swim [33]. The BDNF mRNA levels in the animals that had previously engaged in any kind of playing activity or received an antidepressant were back to baseline. The combined intervention-acquired animals displayed significantly higher levels of hippocampus BDNF mRNA. Compared to animals that were not treated, animals receiving the combination intervention showed a significant increase in swimming time throughout a five-minute test. But the amount of time the animal’s spent swimming was not appreciably more than when they received the antidepressant by itself [33]. Longer swimming periods were associated with higher BDNF mRNA levels in the CA4-hilus hippocampus subregion. These findings imply that antidepressant medication plus exercise or induced playing may have important neurochemical and potentially behavioural consequences. Furthermore, these findings provide credence to the idea that BDNF expression augmentation could play a significant role in the clinical response to antidepressant therapy [33].

6. Human and animal mutualism relation from playing behaviour

6.1 Playing with dogs and its effect on some bad habits among the teenagers and the health of the adolescents:

Teenagers are becoming more and more sedentary due to new technology that have been incorporated into daily life, such as the smartphones and tablets. It's turning into a major issue for society. It is critical to put up appropriate and workable initiatives to buck this tendency as soon as possible. Reducing sedentary behaviours and increasing physical activity should be part of the solution. Adopting dogs and spending time with them for walks and playtime could be a solution, and people should be made aware of this. The gathered data -which accepted a variety of study formats (randomized trials, clinical trials, and longitudinal studies) published in peer-reviewed journals in English- is a comparison of the levels of physical activity between dog owners with the regular presence of dogs in their lives and non-owners [34]. Four appropriate studies were included. A PRISMA (preferred reporting items for systematic reviews and meta-analyses [35]) flow diagram provided the specifics on the screening procedure. Participants Features: 3,747 participants were included; The age range of the participants who will be featured here was 12- to 18-year-olds. Features of Studies; The research used a range of sites and approaches [34]. Some data were concentrated on a longitudinal study in the UK, some were collected from Australian schools. Others were coming from the United States based on a cohort study while the last group of data was gathered from a group of recruited participants by phone or email for an observational study to be done on them [34]. Accelerometers such as the ACTi Graph and self-reported questionnaires were used to measure physical activity. Comparable findings were reported by the studies [34]. Teenagers who play actively with dogs increase their weekly activity by around one hour, with 26% of them walking dogs on a weekly basis. The longitudinal UK data revealed that roughly 40% of teenagers walked their dogs two to six times a week. Dog ownership and assessed physical playing were found to be positively correlated by the United States data analyses [34]. And regarding the recruited people, it was shown that dog owners among them participated in around 5 more minutes of moderate to vigorous activity each day than non-owners. The overall literature analysis found a strong correlation between owning a dog and higher levels of physical activity among teenagers [34].

Adolescents when compared to their peers without dogs, who live with dogs typically participate in more physical activities, indicating that dogs can have a good impact on their daily routines. The presence of a dog not only stimulates physical activity but also boosts

psychological well-being and social support, helping to minimize feelings of loneliness [34]. Even while some research supports these advantages, it is difficult to reach definite conclusions because of the variation in approaches and results. For example, self-reported statistics can introduce errors into the knowledge of the activities of dog owners. Furthermore, the data pointed out that owning a dog might operate as a motivating factor for exercising, which is especially crucial throughout adolescence—a period marked by major life changes [34]. It was also mentioned how crucial owning a dog is for fostering general health and wellbeing. Adolescents who have dogs are more likely to reach recommended daily activity levels, which benefits their physical and mental health [34].

Overall, the results support the need for more thorough research on how dogs affect young people's lives via the creation of successful health promotion initiatives that capitalize on the advantages of dog ownership and the need for more long-term studies that look at both the advantages and disadvantages of dog ownership during adolescence. Adolescents who have dogs in their lives experience increased levels of physical activity. The amount of physical activity each week is increased by walking and playing with the dog, meeting the recommended amount for the health [34]. The current findings should be embraced by governments to bolster existing initiatives aimed at combating the decline in physical activity levels among youth. Getting a dog during this challenging time in life encourages an individual to be more active both psychologically and socially [34].

6.2 Psychophysiological and emotional outcomes of the human-dog interactions:

Now to emphasize on the point that the animal playing behaviour is not just beneficial to the animal side but its rather a mutually beneficial interaction, an experiment was performed to show The psychological, physiological, and affective consequences of encounters between humans and dogs by interactive activity kind of study with using electroencephalogram study [36]. Studies supporting diverse health impacts are increasingly utilizing animal-assisted therapies [36]. This study looked at the psychophysiological and emotional responses to a range of activities carried out on a female standard poodle of age four took part in order to ascertain the impact of activity type [36]. The dog's readiness for this kind of job was demonstrated by its previous participation in multiple dog shows, as well as by its compatible personality and thorough training in basic obedience, etiquette, aggression, and sociability. 30 persons in their 20s to 40s took part in total (15 males and 15 women). The participants engaged in eight distinct activities lasting 3 minutes per each activity with a dog. These activities included meeting : make eye contact and observe the dog, playing: using a hand sized squeaking toys, feeding: a 5-6 small pieces of a tog treat snack, massaging: give the dog a gentle message, grooming: softly brush the dog with a hand sized slicker brush of 30gm, photographing: take a picture of the dog or together with the dog, hugging: carefully hug and feel the heartbeat of the dog, and walking: stroll the nearby park trails with the dogs [36]. These activities, which include common activities that people usually engage in with their dogs, were mainly chosen to highlight direct connections with the dogs. Brain waves in the frontal, prefrontal, parietal, and occipital lobes were captured during the workouts. The Stress Numeric Rating Scale (SNRS) was used to subjectively evaluate their emotions after each exercise: The SNRS-11 measures stress intensity by asking participants to rate their current stress level on a scale from 0 (no stress) to 10 (highest conceivable stress). It focuses on quantifying perceived stress at the moment [37], Semantic Differential Method: a psychological tool used to assess beliefs and attitudes. Respondents rate items on a series of bipolar scales (e.g., good-bad, happy-sad), typically spanning seven points. Researchers sum the scores from these scales to analyse responses [38], and Profile of Mood States: a widely utilized scale for assessing psychological distress [39]. Theta, alpha, beta, and gamma are just a few of the frequency bands that make up an EEG waveform, which is used to record changes in electrical impulses in the brain. These bands are indicative of various states, including sensory, cognitive, and motor functions. The waves thought to be most closely associated with human emotions are the alpha and beta waves [36]. This study examined

variations in EEG signals, particularly alpha waves, which indicate stability and relaxation, and beta waves, which indicate focus and attention [36]. There are two types of alpha waves: slow waves and fast waves while beta waves were divided into three subregions according to their frequency: low, middle, and high [36]. The brain's ability to relax and rest was significantly enhanced by playing with the dog and walking her, according to the alpha power spectra. During dog massage, grooming, and play, the beta power spectra considerably rose, suggesting better concentration without stress. It's noteworthy that interacting with a dog improved focus and relaxation [36]. Activities including feeding, petting, and cuddling the dog reduced the overall mood disorder score, according to the Profile of Mood States result, suggesting a favourable impact on the participants' emotions. The results of the Semantic Differential Method showed that participants felt at ease when walking their dogs and at ease when giving them massages [36]. Participants' stress levels were notably lower in each task. This study demonstrated that canine activities could promote more calm, emotional stability, focus, concentration, and creativity by facilitating increased brain activity. Additionally, spending time with dogs can make you feel happier and less stressed [36].

6.3 Horse playing behaviour with a brief psychological intervention for disengaged youth:

Since horses are huge animals that age and exercise, and because they sustain naturally occurring injuries that resemble those of humans, they are an appealing model for many human age-related degenerative illnesses of the musculoskeletal system [40]. As a result, it makes the perfect species to serve as a "proving ground" for novel treatments, particularly regenerative medicine. For more than ten years, regenerative methods utilizing cell-based therapies have been used to treat musculoskeletal disorders in horses [40]. In a pilot study looked at a brief psychological intervention that used horse-related activities to boost the self-efficacy and self-esteem of a group of disengaged teens (aged 16) [41]. Both the preintervention and postintervention versions of the General Self-Efficacy Scale -a ten item measure that evaluates how strongly a person believes in their own capacity to handle new or challenging situations and to overcome any related challenges or failures [42] - and the Rosenberg Self-Esteem Scale - Originally created for high school students, the RSE scale gauges self-esteem and has now been applied to a variety of populations, including adults. Its Guttman character, which involves blended ratings, makes scoring challenging. Responses that indicate low self-esteem include "strongly agree" on things 2, 5, 6, 8, and 10 and "disagree" or "strongly disagree" on issues 1, 3, 4, 7, 10. After reversing the scoring of negatively worded items, the scale can alternatively be scored by adding up each of the four points [43] - were used. To gauge their impression of the young people's actions and outlook on life, the case managers of the participants also answered a questionnaire. After the intervention with the horses in various types of activities some of which were playing, feeding, riding and walking with the horses, the participants' levels of self-efficacy and self-esteem significantly increased [40]. Additionally, there was proof of a general improvement in attitude toward life. The results suggested that youngsters who have not responded to other interventions and who have become disconnected from traditional institutions could find that equine-facilitated therapy is a feasible alternative [41].

7. Playing behaviour as a socializing program and its relationship with human-animal bond:

According to certain researches, dogs kept in rescue shelters only saw people for a little percentage of their observable time—between 0.3% and 2.5%—of the time [44]. Dogs kept in kennels require interaction with humans, other dogs, and a rich, stimulating inanimate environment [44]. Toys are frequently given to domestic caged animals as a means of encouraging play and reducing boredom. They are also frequently used for inanimate enrichment. A dog's age, previous toy experience (some dogs, especially younger ones, may become fearful if they are unfamiliar with these objects), mental and physical health (depressed, stressed, or sick dogs are typically less inclined to play with toys), the qualities of the toys, the presence of other dogs nearby, and habituation (most animals lose interest in a toy after a day or so) are some of the factors that determine how effective toys are as enrichment. The study, which involved 63 healthy canines carried out in a private dog shelter. The first and last assessments were completed by the same assessor in a consistent manner. Three sessions a week for the first five weeks of an eight-week intense socialization program was followed by four sessions in the final three weeks. Using toys, grooming, and massaging the dogs in addition to providing them with treats, each session lasted ten minutes. Fearful dogs were gently approached, whereas uninterested dogs were left alone. At first, 61.91% of dogs showed little interest in playing with balls, and 57.14% of them reacted poorly to back rubs, suggesting minimal prior socialization. By the end, there had been a considerable improvement in responses, with all canines accepting back rubs and 71.43% playing with balls. The percentage of dogs who responded positively to brushing rose from 42.86% to 88.89%, but 11% of them still had difficulty, mostly because of their age or fear [44]. The socialization program improved the dogs' overall friendliness and openness to human interaction, underscoring the value of these initiatives in shelters [44]. Positive interactions with people and other dogs provide them more control over their surroundings, which lowers their cortisol levels—a marker of physiological stress—in the process. It should be mentioned that regular trips outside the enclosure, play, brushing, training, and petting are some of the most effective ways for humans and animals to engage [44]. Dogs can better control their environment, lower stress levels, and increase adoption rates when they engage in significant positive interactions with people, such as playing, caressing, and training [44]. Dogs standing up during weeks of environmental enrichment increased in frequency. Research demonstrates that environmental enrichment improves the welfare of caged animals of all kinds, and there are a lot of shelter dogs in the

globe [44]. For example, providing dogs with an improved perspective of the outside world through raised platforms in kennels greatly reduces stress levels. Increased engagement from volunteers and staff is intended to raise the standard of living for the canines in the shelter. This is consistent with programs involving human-animal contact that have benefited behavioural and physiological metrics [44]. The results of the study showed that intimate human interaction and higher levels of mental and physical stimulation greatly enhanced animal welfare. Furthermore, because shelter dogs' behaviour and quality of life improve, regular application of both positive and negative reinforcement has been associated with increased adoption rates [44]. Plans for the care of animals should include environmental enrichment since it promotes the animals' mental and physical health. Important stimulation is provided by social interactions, which promote a dog's natural behaviours and interactions with people or other dogs. Although toys are a popular enrichment method, their efficacy varies depending on kennel dynamics, age, and experience [44]. Regular toy rotation is frequently better for senior dogs than introducing new ones, and dogs that exhibit fear or anxiety should be gently introduced to new toys. Which drives us to the conclusion of the study which is after an intensive socializing program was put in place, the dogs' welfare considerably improved. The first and most crucial step in improving the environment for confined dogs is to provide them with socialization chances, both with humans and other dogs [44].

8. Conclusion:

Play behaviour is a fundamental aspect of animal life, essential for development, adaptability, and welfare. This thesis highlights how various forms of play—locomotor, object, and social—enhance physical skills, cognitive growth, and social resilience, underscoring its adaptive value. Rooted in the five freedoms, play serves as both an indicator and enhancer of welfare, revealing positive states while promoting health and well-being.

The findings emphasize play's role beyond recreation, with implications for conservation, animal management, and human-animal interactions. Recognizing and fostering play is vital for improving the lives of animals and strengthening their bonds with humans, reinforcing its centrality in a holistic approach to animal welfare.

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Thesis progress report for veterinary students

Name of student: Ahmed Khaled Abbas

Neptun code of the student: HV7HQ9

Name and title of the supervisor: Bereczki Erika, tudományos munkatárs

Department: Zoológiai Tanszék

Thesis title: Role of play behavior in animal development – and its correlation with animal welfair

Consultation – 1st semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2024	febr	13	Meeting, topic choose	
2.	2024	márc	20	Topic details	
3.	2024	ápr	22	Citations	
4.	2024	jún	2	Time table	
5.	2024	júl	5	Summer plans	

Grade achieved at the end of the first semester: Jeles (5)

Consultation – 2nd semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2024	szept	17	Time table of the semester	
2.	2024	sept	23	Summer results	
3.	2024	okt	16	draft and comments	
4.	2024	nov	5	draft continuity	

5.	2024	nov	23	final draft	

Grade achieved at the end of the second semester: ....jeles (5).....

The thesis meets the requirements of the Study and Examination Rules of the University and the Guide to Thesis Writing.

I accept the thesis and found suitable to defence,

.....
signature of the supervisor

Signature of the student: ....Ahmed Khaled.....

Signature of the secretary of the department: .....

Date of handing the thesis in..... .....