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Bc. Natália Marčanová

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WHERE TO WALK YOUR DOG: ARE DOGS DIFFERENTLY IMPULSIVE IN GREEN AND BUILT ENVIRONMENTS?

Abstract

by Bc. Natália Marčanová
University of Vienna
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Mathew White BSc MSc PhD

As urbanisation continues to progress, both humans and their dogs are increasingly confronted with potentially stressful environments. Furthermore, not only is human success largely dependent on the capacity to suppress spontaneous yet counterproductive actions, but our canine companions also spend much of their time in settings that call for restraint unfamiliar to non-domesticated animals. Since nature has been found to improve human decision-making, this study compared the impulse control of dogs in both green and built environments. Impulsivity is commonly experimentally tested for by the delay of gratification task, where participants need to decide between two alternatives, one of which is immediately rewarding but ultimately less desirable than the other. The Spatial discounting task (SDT) is a simplified version of the delay of gratification task, that became the most well-established paradigm for measuring canine impulsivity. In the current study, the performance of 30 dogs was evaluated in the SDT, which tested them in two environments: green and built, using a within-subject design. The majority of subjects performed better in the green than the built test setting. On the other hand, we detected no significant relationship between the hypothesised mediating factor: distractedness (measured as the latency to complete simple obedience tasks). In addition to this, dogs performed better in their second test if they were first exposed to the green condition. Our findings highlight the need to investigate how exposure to various stimuli in the canine environment affects the animal's impulsivity and suggest that taking dogs for more "green" walks could help improve their self-regulation abilities.

Zusammenfassung

Mit der zunehmenden Verstädterung sind sowohl die Menschen als auch ihre Hunde zunehmend diesen potenziell stressigen Umgebungen ausgesetzt. Darüber hinaus hängt nicht nur der Erfolg des Menschen weitgehend von seiner Fähigkeit ab, spontane, aber kontraproduktive Handlungen zugunsten von vorteilhafteren zu unterdrücken. Hunde verbringen einen Großteil ihrer Zeit in Umgebungen, die eine Beherrschung erfordern, die nicht domestizierten Tieren fremd ist. Da sich gezeigt hat, dass die Natur die menschliche Entscheidungsfindung verbessert, wurde in dieser Studie die Impulskontrolle von Hunden in grüner und bebauter Umgebung verglichen. Impulsivität wird üblicherweise experimentell mit der Aufgabe "Verzögerung der Belohnung" getestet. Bei diesem Experiment müssen sich die Teilnehmer zwischen zwei Alternativen entscheiden. Eine der Alternativen ist unmittelbar belohnend, aber letztlich weniger erstrebenswert ist als die andere. Die Spatial-Discounting-Task (SDT) ist eine vereinfachte Version der Belohnungsverzögerungsaufgabe. Diese Methode wurde zum gängigsten Paradigma für die Messung der Impulsivität von Hunden. Die Leistung von 30 Hunden wurde in der SDT bewertet. Sie wurden in zwei Umgebungen getestet: in einer grünen und in einer bebauten Umgebung, wobei ein Within-Subject-Design verwendet wurde. Die Mehrheit der Probanden schnitt in der grünen Umgebung besser ab als in der bebauten Umgebung. Andererseits wurde kein signifikanter Zusammenhang zwischen dem hypothetischen vermittelnden Faktor Ablenkbarkeit (gemessen als Latenzzeit für die Ausführung einfacher Gehorsamsaufgaben) festgestellt. Des Weiteren schnitten die Hunde in ihrem zweiten Test besser ab, wenn sie zuerst der grünen Umgebung ausgesetzt waren. Unsere Ergebnisse unterstreichen die Notwendigkeit, zu untersuchen, wie sich die Exposition gegenüber verschiedenen Reizen in der Hundeumgebung auf die Impulsivität des Tieres auswirkt. Es deuten darauf hin, dass es zur Verbesserung der Selbstregulierungsfähigkeiten von Hunden beitragen könnte, wenn sie mehr "grüne" Spaziergänge unternehmen.

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Chapter One

Introduction

1.1 Progressing urbanisation

Cities created a new, unique ecological niche for plenty of species—not only humans but also animals, among them dogs (Johnson and Mushi-South 2017. A half of the world's human population today lives in metropolitan settings. Projections show that by 2050, this percentage will have risen beyond 70% (OECD 2001). This remarkable change from rural to urban life reduces exposure to nature. Therefore, various health problems seem to be on the rise in tandem with urbanisation around the globe (Bratman *et al.* 2015).

Capaldi and colleagues (2015) pointed out in their review that both the body and the mind have become gradually detached from nature especially in economically developed, industrialised countries. Less than 10 percent of the typical day is spent outdoors, while children are less likely to be playing outside and devote more time in front of screens. At the same time, not enough people are changing their habits to help with environmental problems like climate change. Yet, the robustness of natural ecosystems keeps declining as a direct result of human activity (Intergovernmental Panel on Climate Change 2014).

The constant hustle of city life, along with the continuous stream of sudden noises, contribute to the stereotype of the urban environment as an overwhelming place to live. The stress of facing busyness on a daily basis could lead to distractedness and sub-optimal decision-making. The ability to exercise self-control is fundamental for accepting responsibility for one's habitual responses, thus allowing for the deliberate selection of constructive behavioural responses (Bensky *et al.* 2013).

Hofmann and colleagues (2012) revealed that, people generally spend roughly three hours per day exercising self-control. That's intriguing since prior research has confirmed that self-control is a finite resource that may be drained with time, a phenomenon known as ego depletion (Mead *et al.* 2010). In a study on restorative effects of nature, Beute and Kort (2014) investigated the processes following the induction of stress and subsequent resource depletion. They discovered a positive impact of natural exposure lowering self-regulation (e.g., impulse control). Similar effect was seen by Sun and colleagues (2022), after athletes managed to counteract their exhaustion with green exposure resulting in better performance and decision-making ability. Taken together, these studies give useful insights into the nature of ego depletion and suggest that getting closer to nature may be a realistic and effective technique for regaining self-control.

1.2 Impulsivity

In human literature, the term “impulsivity” refers to a broad range of behaviours, including unwillingness to wait, inclination to risk-taking, limitation in thinking things through, indifference to the potential repercussions, and an inability to resist temptation (Stevens *et al.* 2022). The capacity for inhibitory control spans from the cognitively difficult processes of self-control to perhaps less demanding mechanisms like motoric self-regulation (Kelly *et al.* 2019).

Although high impulsivity is often viewed as detrimental, this behavioural feature can in fact be adaptive in diverse ecological contexts. That means, in certain contexts it is advantageous to respond rapidly (Fawcett *et al.* 2012). Nevertheless, impulsivity became a crucial notion of cognition, largely dealing with failures in a decision-making framework under the delayed reward paradigm (Nigg 2016).

A significant amount of evidence suggests that it is not a singular attribute but rather one that is influenced by a variety of unique psychological and neurological factors. Impulsive behaviour may be linked to either increased or decreased motivation. Furthermore, it can either indicate a failure to absorb information adequately or to regulate reaction intensity (Dalley and Robbins 2017). This means that individuals who exhibit impulsive behaviour may do so for different reasons and in different ways.

Even though there several facets of impulsivity, it can be broken down into two different types: motor (behavioural) impulsivity and cognitive impulsivity. Motor impulsivity is equivalent to action without thinking. Those who exhibit cognitive impulsivity, on the other hand, have difficulty delaying gratification. Decision-making tasks usually assess this category. While these components are coupled and overlap in multiple ways, they frequently fail to intercorrelate or even decouple in specific situations (Bakhsani 2014). By and large, both types affect our behaviour, our decisions, and our emotions. But how does a lack of self-regulation manifest in real life?

Dysfunctional traits of impulsivity have been associated with a number of behavioural issues, such as suicide attempts, substance misuse, criminal activity, and academic underachievement. It has also been connected to various neuropsychiatric disorders, including substance abuse, ADHD, borderline personality disorder, and binge eating disorder (Pan *et al.* 2021). Recently, higher levels were manifested in participants with traumatic childhood experiences (Richard-Lepouriel 2019). Accordingly, these paradigms stay consistent also across most non-human animal research.

Impulsive choice happens when an individual selects a little benefit that is readily available over a greater reward that requires a delay. Typically, such decisions may be mathematically defined as hyperbolic discounting, which occurs when individuals favour smaller, more immediate rewards over larger ones, despite the fact that the latter present objectively greater benefits. The hyperbolic shape of the discounting function refers to the tendency of people to devalue delayed rewards at a higher rate than they do immediate ones. Furthermore, the shape of the curve in a graph indicates that the present value of the reward drops with longer delay, and the rate of discounting is steeper for smaller delays (Thome *et al.* 2022). This trend was reflected in empirical experiments with pigeons and their "preference reversal" (a preference switch from the higher option to the lower option after the value of the higher reward falls over time (Ainslie, 1975)). In this regard, animals and humans may be fairly comparable (Dalley *et al.* 2011).

1.3 Human-canine connection

Despite the fact that people are becoming less and less in tune with the natural world, they nonetheless feel a strong subconscious need to reconnect with it. Wilson (1994) argues that humans have a hardwired affinity for nature. And that our strong ties to other living species originate, at least in part, from our evolutionary past and shared ancestry. In this context, "man's best friend," has recently been a focal point for social cognition researchers. Dogs and humans do not only have common traits of social competence, but these components may also operate in a manner similar to that seen in humans (Miklósi and Topál 2013). As a result, canine companions and their owners grew to have a special link of love and devotion.

Pet ownership is a widespread and accepted trend in western cultures. In fact, the probability of obtaining a four-legged friend is so high that pups outnumber children in several U.S. communities (Hendrix 2019). According to Bedford (2021), the number of dogs in Europe exceeds 89 million. Having a companion dog may have a profound impact on the lives of its owners. In addition to giving company, comfort, and amusement, there is growing evidence that such animals may be able to improve their owners' health (e.g., Wells 2009).

Yet, in some countries, the proportion of dogs with documented behavioural disorders tends to reach up to 80% (Martnez *et al.* 2011). Which means, that not all dogs are equally suited to provide these benefits and canines with healthy behaviour are better equipped to support human health. Therefore, it is crucial to invest time and effort to ensure that they are well-behaved and able to provide the improvements we seek.

1.4 Returning to nature can help human cognition and impulsivity

Immersion in nature has been recently used to improve human mental and physical health or even advance health-promoting behaviours (e.g., Ochiai *et al.* 2015, Kobayashi *et al.* 2017, Bang *et al.* 2017, Bang *et al.* 2018). In particular, working memory improved consistently after exposure to a range of natural stimuli (as opposed to urban stimuli) (Schertz *et al.* 2019). That was the case for children who lived near parks and other green areas. These surroundings helped them do better in school (Dadvand *et al.* 2015). Likewise, people who lived in close proximity to nature had better self-control. It was discovered that people who were allotted housing units with more green space had higher attentional functioning capabilities than those whose units had less access to nature (Kuo and Sullivan 2001). A variety of experimental studies have used visual and auditory stimuli (e.g., Berry *et al.* 2015, Van Hedger *et al.* 2019) as well as real-world exposure (e.g., Bratman *et al.* 2015) to show that time spent in nature improves working memory, cognitive flexibility, and attentional control, whereas time spent in metropolitan areas was linked to attention deficiencies.

A number of theories have been proposed to explain these results. Biophilia, stress reduction and attention restoration are the three main ideas that attempt to explain why spending time in nature is good for our health. According to the biophilia theory, our predecessors relied on their relationships with the natural world for their health and survival (to locate sources of food and water, to navigate, to forecast time and weather, etc.). Capaldi and colleagues (2015) explained that while urbanisation among humans is a relatively recent phenomenon, a fundamental human need—the need to feel in touch with nature and animals—likely persists. Affinity for nature is evident across cultures and at very young ages, providing encouraging support for evolutionary concepts like biophilia despite the difficulty of testing them.

The second idea summarized in the paper is stress-reduction theory, which argues that being exposed to certain (safe) natural conditions triggers a wide range of stress-reducing psychophysiological reactions (Ulrich, 1983). Lastly, the attention restoration hypothesis states that restorative functions are provided by a change of scenery or varied stimuli that may easily capture our involuntary attention, and the freedom to behave without having to continually check our actions (Kaplan & Kaplan, 1989).

While discussing attention restoration theory, Lee and colleagues (2015) compared the differences between built and green settings within this paradigm. They ran an experiment in which participants were required to perform an attention-demanding activity. Individuals who took a 40-second break to stare out over a blossoming green roof produced considerably fewer errors than those who took a break to gaze at a concrete rooftop. The authors mentioned that nature views may improve concentration and mood for minutes to hours. Yet they believe that this might happen after just a few short glimpses of wilderness. However, additional research is needed to confirm the potential benefits of nature views on concentration and mood.

The first inspiration for our study came from a similarly themed paper by Berry *et al.* (2015), which too examined visual exposure to built and green pictures in the delay of gratification task. The study explored impulsivity in relation to negative coping mechanisms such as binge eating and substance abuse. To which the authors stated that delay discounting may be the strongest predictor of human health-related activities (like exercise) at the present time. People who were impulsive in a delay discounting test with actual or hypothetical incentives in the lab were also likely to be impulsive in everyday life, suggesting that it might have been a generally stable feature influenced by genetics, neuroscience, and upbringing.

The authors further encouraged learning techniques about how to reduce impulsivity based on delay discounting tests. Such experiments could reveal the most effective ways to combat our impulses. It might lead to better decisions on a global scale, since raising self-regulation abilities in one area may have an effect in other areas as well (Daniel *et al.* 2013). While it is true that demonstrating "spill-over" effects in practice is especially challenging.

Accordingly, decreased impulsivity in delay discounting may be indicative of a more general decrease in impulsivity across a wide range of activities. Berry's *et al.* (2015) experiments also demonstrated that exposing people to more images of nature could reduce impulsive decision-making in a delay discounting test, albeit the mechanisms behind this effect remain unclear.

As more individuals become aware of the health advantages of spending time in natural settings, practices such as forest bathing (Wen *et al.* 2019) and open-air factor (Hobday and Collignon 2022) are gaining popularity. These activities are leading to a discussion across disciplines, allowing us the opportunity to acquire new perspectives on how we might successfully lower our levels of stress. According to a number of studies, spending time in green spaces might have a beneficial impact on one's mental health (Hansen *et al.* 2017). As a result, engaging in these activities might be the key to unlocking the healing powers of nature and achieving greater well-being.

1.5 Potential challenges of urbanisation for dogs

From a comparative perspective, it is vital to explore whether the shared, built environments pose similar challenges to dogs as well as humans. Is it possible that canine self-regulation is compromised by insufficient exposure to nature? Undoubtedly, dogs' impulsivity substantially shapes their interactions with humans. Salonen *et al.* (2020) questioned 13,715 owners regarding the highly problematic behaviour of their pets. According to their data, a high degree of impulsivity occurred in 15% and aggression in 14% of dogs. Given the convergent social evolution during domestication and identical environmental conditions, the same biophysical, behavioural, and genetic elements indeed mediate both human and canine impulsivity (Sulkama *et al.* 2021). Therefore, it is reasonable to suggest that they both face similar challenges in built environments.

While there has been extensive research done on human impulsivity, the opposite is true for dogs. Whereas eliminating problem behaviours would help in various practical situations. For instance, pathological levels of impulsivity in dogs appear in a form of biting, growling, pulling on the leash, running into the street, jumping on strangers, sprinting out the front door, et cetera. (Olsen 2018, Piotti *et al.* 2018). Moreover, ensuring our pets are well-behaved decreases the probability of relinquishment and helps re-homing. The exact numbers of dogs relinquished in urban versus rural environments may depend on the specific location, cultural factors that affect pet ownership, and available data. However, a survey conducted in

Mexico revealed that urban households (49.0%) tend to give up their dogs more frequently than village households (12.2%) (Cavalli and Heard 2019). Additionally, based on data from The Best Friends 2020 national dataset in the United States, shelters in counties with more rural populations reported fewer owner-requested euthanasia incidents (Best Friends Animal Society 2022).

1.6 Can nature help control impulsivity also in dogs?

It has been established that dogs are, in fact, affected by the environment in which they were raised (Harvey *et al.* 2016). However, it would also be helpful to examine real-time information about the cognitive processes of our pets. This can be achieved through the use of advanced technologies such as wearable devices or in situ tests. Alternatively, on-the-spot feedback from caretakers can help us examine how dogs interact with their environment and process information. Westgarth and colleagues (2020) conducted thorough interviews with a reasonably large sample of participants on the topic of physical environment for dog walking. By using an anthropological approach, they were able to witness individual interactions and collect data through their observation. The authors concluded that taking a dog for a stroll in an urban area would only provide a minimally useful walk because it would be dull for the dog. The responders felt very strongly that their dogs should be allowed to run free without a leash whenever possible. The enjoyment of the walk for their pet was conditioned by the availability of safe green spaces. Additionally, sites that were deemed ideal for dog walking offered beautiful scenery and provided opportunities for exercise and playful exploration. Although it should be noted that such locations also bring a potential disturbance by livestock and wildlife e.g., ground-nesting birds.

Another essential piece of evidence found that self-control is more difficult to maintain in urban environments than in rural ones. After Jenkin and colleagues (2018) tested children's delay discounting, they discovered that the built environment depleted their self-regulation, which was manifested is poorer test performance. Thus, I reason that, like people, dogs living in metropolitan areas would experience sensory overload due to the abundance of man-made stimuli. On the other hand, they may find the stimulation of nature to be more intense and overpowering than that of a city street. Although I am unaware of any studies, either recent or past, that link canine impulsivity with the presence of natural environments.

In any case, understanding how dogs perceive and respond to different environments is critical in order to provide them with the best possible living conditions and to improve their overall well-being and behaviour. More research is needed to fully understand the impact of urban and natural environments on dog self-control.

1.7 Current research

Over the years, several studies have focused on evaluating impulsivity in dogs. Previous investigations were done via owner surveys (Wright *et al.*, 2011) and diverse cognitive test batteries, including the delayed reward task, detour-fence task, box task, reversal task, and middle cup task (Olsen 2018, Wright *et al.*, 2012; Bray *et al.*, 2014; Riemer *et al.* 2014, Fagnani *et al.* 2016, Brucks *et al.* 2017a). Easy and convenient general assessment is often done via the Dog Impulsivity Assessment Scale (DIAS) (Wright *et al.* 2012). DIAS provides the calculation of the impulsivity index on three levels. Namely: behavioural regulation, aggression and response to novelty, and responsiveness (Wright *et al.* 2011). Several studies demonstrated that owners are capable to judge the behaviour of their pets adequately, reliably, and consistently (Kubinyi *et al.* 2009, Gosling 2001, Jones and Gosling 2005, Riemer *et al.* 2014). Ratings reported by the owners have matched the dog's performance in temporal/spatial delayed reward tasks (Brady *et al.* 2018, Wright *et al.* 2012, Riemer *et al.* 2013). However, one line of recent research failed to prove a clear correlation between owner perception and the actual performance (Mongillo *et al.* 2019, Stevens *et al.* 2022). In other words, these contradictory results highlight the need for advancement in experimental methods in scientific research. It should be mentioned, that Brady *et al.* (2017) argue that impulsivity is a practically relevant feature of dogs. They underline that the questionnaire-based approaches might aid in determining impulsivity in practice, such as when choosing the future work type for a dog.

The delayed reward task (DRT) is employed from a development of the so-called "marshmallow test," where children around 3-5 years are asked to sit in a room alone in front of a single marshmallow and told they can eat it, but if they wait until the adult returns they will be rewarded with two instead (Mischel & Mischel 1983). In the dog-adapted version, they are also presented a choice dilemma between a small, immediate reward and a larger, delayed reward. Their self-regulation ability is assessed after they opt for the higher or lower prize.

Barela *et al.* (2023) composed a systematic review assessing impulsivity as a behavioural trait and found a lack of connection between owner's perception of their dog's impulsivity in 10/15 studies. However, out of these 5 significant correlations between DIAS and dog performance, 4 studies tested the delay of gratification paradigm instead of different self-regulation tests. This trend suggests that DRT provides a fairly well-rounded picture of the decision-making process in dogs (Reimer *et al.* 2013, Wright *et al.* 2012). But this task is time-consuming in terms of preparations and training, resulting in high drop-out rates. As part of an effort to create a simplified evaluation of impulsivity, Brady *et al.* (2018) developed a spatial discounting task (SDT), where the dog had to choose between a smaller reward that was closer and a larger reward that was farther away.

Their procedure has been reproduced with certain modifications several times since (Mongillo *et al.* 2019, Stevens *et al.* 2022). Although neither found a correlation to the impulsivity index like Brady and colleagues (2018) did. Nevertheless, thanks to its test-retest reliability, SDT is suitable to assess impulsivity, having strong advantages under field conditions. For example, checking the instant effects of the environment calls for a quick and easy setup that is robust enough to withstand outdoor conditions. The apparatus for the classical DRT is not easily transportable and is generally set up inside a closed-off laboratory. That is why Brady *et al.* (2018) demonstrated several modifications to their STD, precisely for the purpose of simplifying outdoor procedures.

1.8 Spatial discounting test for assessing environmental impact

In order to investigate whether the momentary environment substantially shaped the impulsivity of man's best friend (as found in humans; e.g., Berry *et al.* 2015), the SDT was employed outdoors in the present study. More specifically, it was based on a gradual increase of the distance that an animal has to travel for a high quantity (HQ) reward (e.g.,3 pieces of sausage) while having the choice of taking a closer but lower quantity (LQ) reward (e.g.,1 piece of sausage). Dogs were tested in 11 trials where the distance to the HQ reward was increased by 50 cm after each choice. As a measure of impulsivity, the number of times the dog opted for the HQ reward was counted. Given that the primary objective was to compare the impact of the environment on self-regulation, subjects were primed by conducting the experiment outdoors in two contrasting conditions – green or built areas. Priming was additionally enhanced via a 5-minute walk in the area surrounding the apparatus, before the STD started. Another test took place during the walk, to determine the level of distraction. The score was calculated as an average response time to four different commands given by the caretakers.

Due to the contrasting results in the recent studies, we also checked whether the SDT and the DIAS are reliable methods for determining impulsivity in dogs (Barela *et al.* 2023).

Dogs able to regulate themselves can prevent undesirable behaviours and better meet their owners' expectations (Olsen 2018). For the establishment of thriving dog-human cohabitation in public spaces, the satisfaction of all actors (i.e. the general public, owners, and dogs) is incremental (Mongillo *et al.* 2015). Therefore, I endeavoured to evaluate the impact of the environment. Considering that dogs living in cities tended to be more fearful than dogs living in agricultural areas (Puurunen *et al.* 2020), I analysed whether distractedness was a potential mediating factor playing a role in this context. This was supported by human research where rural dwellers had a superior ability to tune out irrelevant stimuli and ignore distractions compared to their urban counterparts (Linell *et al.* 2014, White and Shah 2019).

To my best knowledge, no prior research specifically examines the possible effects of natural/man-made environments on canine impulsivity via delay discounting. In order to fill this gap, I hypothesise that exposure to built settings will result in higher impulsivity relative to green environments, as suggested by Berry *et al.* (2014). On the other hand, a counterargument also needs to be recognized that nature could be more engaging for dogs than a built environment, and so they may perform worse there. Acknowledging the limitations of the selected mediator, I further postulate that the effect of environment on dog impulsivity (manifested via SDT performance) might be explained by the distraction score. In sum, if exposure to green environments enhances canine self-regulation, it can support scientific guidance to the most rewarding routes where to walk your dog.

Chapter Two

Methodology

2.1 Subjects

We recruited 46 dogs altogether. 27 adult family dogs living in Vienna, 14 family and 5 certified rescue dogs (IRO Level B) in Slovakia were tested in both priming conditions. Later, we have excluded the 5 highly trained rescue dogs in order to keep the sample less diverse. Nevertheless, the performance of these dogs is reported in a freely accessible database file (the digital pathway is provided in an Appendix A). Additionally, dogs that did not complete the training phase or dropped out of the experiment were excluded from the analysis (n = 11, Appendix A). The average age of the remaining 30 subjects was 5.3 years (2–12). Dogs of both sexes (18 males and 12 females) and diverse breeds (including mongrels) were recruited, mostly from a different household (Table 2.1.). All steps were video recorded. The criteria for participation were that the dogs should be motivated to work for food outdoors, should be ready to be approached and pay attention to an unfamiliar experimenter who offers them food. The participating dogs were accompanied by their caretakers, who continuously kept them either on leash or by their side. The list of all analysed dogs, their age, breed, sex, testing location, and order of conditions are provided in Table 2.1.

N	Name	Breed	Age	Sex	First env	Country	High reward pieces
1	Rita	Berger Blanc Swisse	2	F	park	Austria	3
2	Striezi	mix	4	M	park	Austria	2
3	Kono	Laekenois	2	F	park	Austria	2
4	Camillo 3	German shepard dog	8	M	park	Austria	2
5	Kiba	Old german shepard dog	8	F	park	Austria	3
6	Henry 5	Golden retriever	7	M	park	Austria	2
7	Rusty 2	Mix	8	M	park	Austria	3
8	Bishuji	Akita Inu	6	F	street	Austria	3
9	Kyle	Mix	8	M	park	Austria	3
10	Chilli 5	Mix	8	M	street	Austria	3
11	Dunni	Miniature Pinscher	2	F	street	Austria	3
12	Flamme	Pyrenean Sheep dog - smooth faced	12	M	street	Austria	3
13	Manni 2	Pyrenean Sheep dog - smooth faced	8	M	street	Austria	3
14	Ludwig	Mix	4	M	street	Austria	3
15	Sammy 11	Parson Russel Terrier	5	M	street	Austria	3
16	Skylos	Labrador	10	M	street	Austria	3
17	Yuukibo	Japanese Spitz	3	F	street	Austria	3
18	Gimli	Deutscher Spitz	3	M	park	Austria	3
19	Nox	Border Collie	2	M	park	Austria	3
20	Aquila	Border Collie	9	F	park	Austria	3
21	Bruno	Welsh Springer Spaniel	7	M	street	Slovakia	3
22	Jolie	Central Asian Shepherd	6	F	street	Slovakia	3
23	Sunny	Australian Sheperd	4	F	street	Slovakia	3
24	Arvin	Pointer	2	M	street	Slovakia	3
25	Beri	Small Münsterländer	2	F	street	Slovakia	3
26	Sky	Husky	4	M	street	Slovakia	3
27	Zafa	Boseron	2	F	park	Slovakia	3
28	Jasna	Boseron	2	F	park	Slovakia	3
29	Teddy	Border Collie	6	M	park	Slovakia	3
30	Kony	Foxterrier	5	M	park	Slovakia	3

Table 2.1. List of analysed subjects. First env = the type of priming green/built upon the first experiment date, High reward pieces = the number of treats positioned on HQ tray.

2.2 Questionnaire

The caretaker of each participating dog was asked to fill out the Dog Impulsivity Assessment Scale (DIAS) questionnaire (Wright *et al.* 2011, Appendix B) before taking part in the experiment. This was done only once, at the first environment type tested. The DIAS questionnaire contains 18 short items, and was evaluated after the experiment in order to use its Behavioural Regulation score as a single measure of each dog's general impulsivity as perceived by the caretaker. I reasoned that this personality-level impulsivity of the dogs may influence whether and how they differentially respond to the two environments. To take such a possible variation into account, I included this measure as a control variable in our statistical model (see Chapter 2.11. Model description). The answers were noted down, and the scores were calculated based on the guide by Wright and colleagues (2011).

2.3 Location

The dogs were tested at three different locations (one in Austria, two in Slovakia). For each of the three locations, both built and green environments were chosen beforehand, resulting in 6 observation sites. The space was always large enough to allow a free 5-minute walk. Green observation sites were exhibiting as little human influence as possible. Abundance of plants was the main factor for selecting natural sites. The meadow paths and park trails were circa 1 km from the built properties. In both countries, no outside traffic or heavy machine activity could be heard. As everything took place in a public space, pedestrians entering our experimental area could not be completely avoided. There were signs stating that we requested bypassers to choose another path within the park, however, they were not always respected. On occasion of people approaching, the experimenter tried to verbally prevent any disturbance during the experiment. In case of refusal to leave the experiment area, the experiment was paused and the owner was asked to call his/her dog back to him/her or the starting mark and remain passive until the bypasser leaves the field of vision. Once all intrusive sights and sounds were gone, the experimenter counted 3 seconds and gave the cue to continue with the testing. Built observation sites were chosen so that the whole experiment would be conducted with the minimum amount of greenery visible and at least 95% man-made enclosure (including the ground). There was not a lot of heavy traffic, but occasional cars and pedestrians passing by were present. The proximity to road transportation was 5–20 m, and in all sites, cars (although mostly parked) were visible to the subject. Overall, the noise level was at a medium level, but the owner never had to raise his/her voice in order to communicate with the experimenter or the subject. All Viennese experiments were conducted in one of the side trails of Theresa-Tauscher Park (Figure 2.1a.) and within a concrete-heavy areal of the STUWO apartment complex on Nippongasse (Figure 2.1b). The natural environment in Slovakia was represented by the meadow trail in Nesluša (Figure 2.2a.) and Vrútky (Figure 2.3a.). Urban priming was established via a roofed area in the industrial complex of Myotis company, Kysucké Nové Mesto (Figure 2.2b.), and towering panel apartment blocks, Vrútky (Figure 2.3b.). Both Slovak urban sites were industrial areas.

Figure 2.1a. Teresa-Tauscher-Park, 1210 Wien, 48.258745, 16.429229

Figure 2.1b. STUWO area, Nippongasse, 1220 Wien, 48.251127, 16.428504. n=20

Figure 2.2a. Nesluša, Slovakia, 49.303051, 18.752572

Figure 2.2b. Kukučínova 2540, Kysucké Nové Mesto, 49.305709, 18.778071. n=1

Figure 2.3a. Vrútky, Slovakia, 49.110053, 18.919951

Figure 2.3b. Kyjevská street, Martin, Slovakia, 49.109536, 18.932094. n=14

2.4 Apparatus and setup

The experimental setup consisted of the 2 trays and 2 barriers. The two trays were placed on the ground in front of the dog, 50 cm apart from each other and in a slanted manner so that the dogs could see their contents even when one tray was further away from them. We baited the trays with either higher quantity (HQ) tray or lower quantity (LQ) tray (Figures 2.4. and 2.5.). At first, the quantity difference between rewards was 2:1 (4 subjects out of 30); which means, that the HQ tray was baited with 2 sausage pieces and the LQ tray was baited with 1. This difference was not sufficient to keep several subjects interested in the better reward, so we increased the HQ piece count to 3 (for the remaining 26 subjects). Nevertheless, all subjects who passed the preference test, regardless of the HQ piece number, were included in the analyses. Between the trays, a low partition panel (5m long, ca. 40cm high) was placed in order to prevent the dogs from switching from the more distant to the close tray while on the way to the more distant one. Parallel to the partition panel, there was a measure tape (5m long) lying on the ground to help position the distant tray. The side of the larger amount was fixed for each dog and same for both environments, side counterbalanced across dogs. The owners were asked to stand facing the trays, holding their dog on a leash. The dog could either stand or sit on the marked spot on the ground (ca. 1m in front of the trays). The owners were instructed to remain passive until they were given a cue to release their dog. Furthermore, an opaque screen (1 x 1 m) was placed between the dogs and the 2 trays at the beginning of each trial to prevent the dogs from seeing the experimenter positioning the trays and the treats on them. The experiments were recorded with a video camera placed on a tripod nearby, and the rest was captured with a phone camera. There were 6 videos in total that were partially or completely lost. The reasons were a faulty camera and an unsuccessful backup. The concrete ones are listed in the database file (or Appendix A).

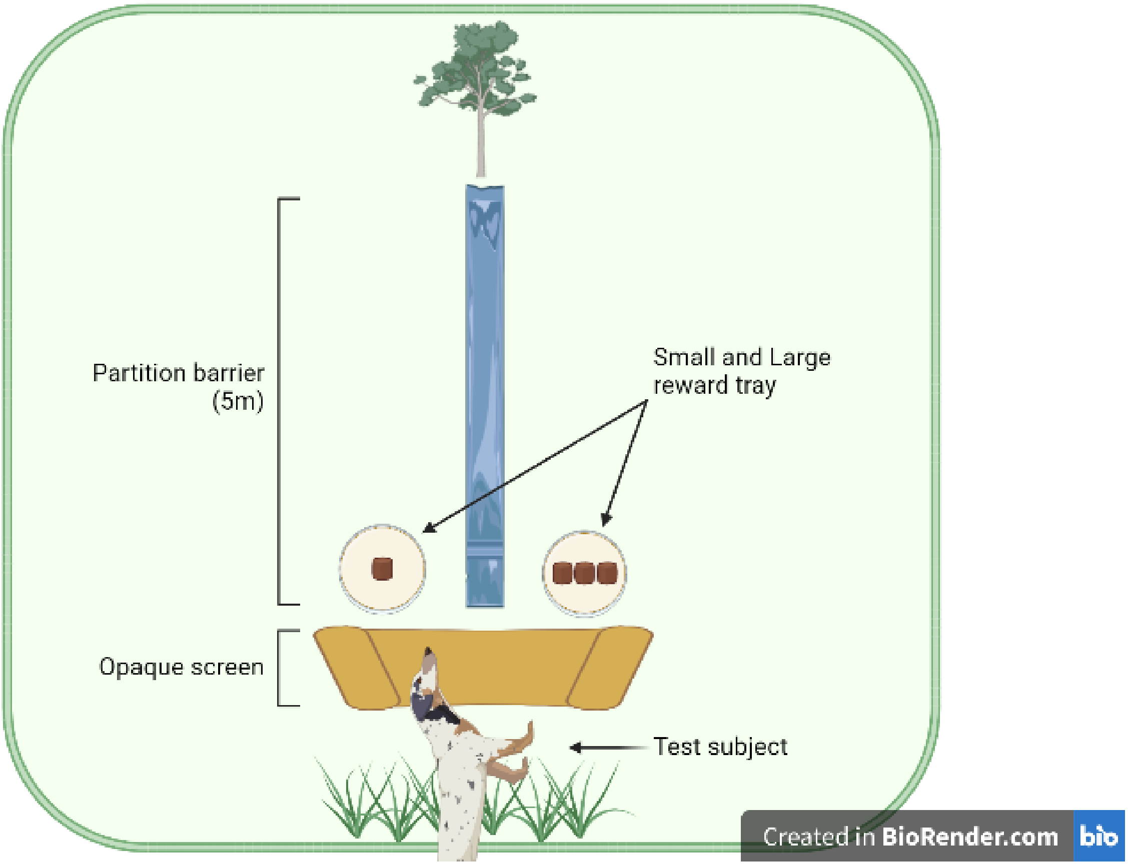

Figure 2.4. STD testing procedure, the default zero-meter distance, credits: Biorender.com

Figure 2.5. STD testing procedure, 0m/2.5m/5m distance

2.5 Procedure

The meeting on the day of the experiment always had the same sequence of steps. At the beginning, priming was achieved via a short walk. There were 4 obedience tasks performed by the subject during the walk to assess the distractedness of the subject. Impulsivity was measured afterwards during SDT. This task consisted of familiarization with the apparatus, establishing the difference between the two rewards, and fulfilling the SDT. The owners were given a choice among a 10 m standard leash, an 8 m flexi leash, and no leash for the whole experiment, including the walk. Their choice was supposed to reflect the particular dog's everyday walking habits. For the whole conversation with the owners, we developed a script, which was followed throughout the meetings (Appendix C).

2.6 Treatment

The owner took the subject for a 5-minute walk in the respective environment. The walk took place in a silent and undisturbed environment, and the owner was asked to act as if it were any other day to take a walk. The experimenter followed them with a camera during the walk.

2.7 Obedience tasks

Roughly in the middle of the walk, the owner was asked to perform 4 obedience tasks with their dog (e.g., sit, lay down, stand up, give a paw, bark, turn around, etc.). The identical tasks were done in the same order during the second meeting. The aim was to recruit dogs that are well trained to accomplish these 4 tasks, however if that was a challenge, the owner could use two tasks repeatedly.

2.8 Preference test

In order to familiarize the subjects with the setup and make sure that the dogs show a preference towards the tray with the more and better reward, the dogs participated in 3–6 warm-up trials and then 12–36 Identical Distance Trials (see below). During the warm-up, the experimenter presented the trays while holding them in her two hands in front of the dog. When the dog had looked at both, she simultaneously placed the trays on the ground 1 m in front of them, took a step back, and asked the owner to encourage the dog to make a choice. The dog could take the food from the tray they chose, while the experimenter immediately picked up the other tray. Trial phase was successful when the subject chose 2 HQ rewards in a row and showed no signs of fear towards the apparatus. Directly after the warm-up, the Identical Distance Trials followed. Here, the experimenter placed the screen at the end of the long barrier in order to block the dog's visual access to her placing the 2 trays on the ground at a distance of 1m from the dog and baiting them. When finished with the baiting, the experimenter moved the screen to the side, and the dog could make a choice between the trays. Subjects were released only after verbal permission was given by the experimenter to the owner, who subsequently used his/her preferred way how to encourage the dog to make a choice. These were either a verbal release word, upward movement by the hand, or releasing the leash. The experimenter's release cue was not identical for each dog, as we wanted to exclude words familiar to the dog. The word choice depended on the concrete training, and after an agreement, only the owner commanded the release word familiar to the dog. Since multiple dogs tested in Slovakia had either gone or were going through rigorous training to work in a rescue team, the experimenter had to give the cue silently via touch while standing behind the owner. If given a chance, we would omit the verbal cue completely and use only a touch on the owner's shoulder. It could prevent confusion of the dog while hearing two sets of release cues, as we saw an anticipation after the experimenter said out the instruction always before the owner gave the actual release cue. The dogs were tested in min. 10 and max. 36 identical distance trials. Following the criteria Bray *et al.* (2018) set up, the dogs would have completed the preference test and would move over to the experimental task when they had chosen the tray with more food in at least 10 of the last 12 trials and in the last 5 trials. There was reoccurring feedback suggesting that the training duration was too long and that, in combination with subsequent tasks, it could potentially overwhelm the subjects. We kept the time and amount of food to a minimum because the decisive part occurred during the final phase. The same idea was expressed by Brucks *et al.* (2017b), who also argued for the reduced pre-test training regime. Therefore, the training phase of the Identical Distance Trials ended with the 10^{th} choice for dogs, which chose only the better tray from the very beginning. All other subjects which chose the LQ reward during the preference test had to meet the 10/12 standard. Testing was terminated if the dogs did not reach this criterion within 36 trials or if they lost motivation during the warm-up trials or during the preference test (in 3 consecutive trials, they approached none of the trays within 1 minute).

2.9 Spatial Discounting Task (SDT)

After the Preference trials, 11 SDT trials followed. The procedure of these trials was consistent with the Identical Distance Trials, with the only exception that in every trial, the experimenter placed the HQ tray 50 cm further from the dog than in the previous trial. Every time before the opaque screen was taken away, the experimenter touched the LQ tray. This way, even though the baiting was not visible to the dog, both trays were touched each time. No criterion is applied in this case; every dog was tested in a fixed number of 11 SDT trials. We recorded in each trial whether the dog chose the HQ or the LQ tray. The entire experimental procedure was repeated in the second environment six days to 3 weeks later.

2.10 Coding

Videos were coded in the Loopy software (© loopbio gmbh.). The obedience tasks were timed from the moment the owner verbalised the first syllable of his/her command to the first frame in which the subject completed the concrete command (e.g., the dog’s belly touching the ground for the task “lie down”). The ethogram describing the exact rules can be viewed in Appendix D. The times measured in Loopy software were subjected to a reliability check by an external coder. There was 99 percent agreement between the two sides. The output was a collection of latencies across 4 consecutive obedience tasks; the mean of these latencies was then used as a control variable in the model (the individual times are recorded in Appendix A).

2.11 Model description

To determine whether walking in a green vs. an urban environment influences dogs’ impulsivity differently, we fitted a generalized linear mixed model with a binomial error structure and a logit link using the “glmer” function of the lme4 package (Bates *et al.* 2015), using the optimizer “bobyqa” with 100.000 iterations.

As a binary response, we used the choice of tray (small reward tray = 0, high reward tray = 1). As test predictors, we included environment as a factor with levels street and park; tray distance and the interaction between the two because we anticipated that dogs in the street would be more likely to choose the lower reward at shorter tray distances. As control predictors, we included the dog’s DIAS-score “Behavioural regulation” (as a three-way interaction with environment and tray distance); median latency in the 4 obedience tasks; the environment where dogs were first tested (as a factor with levels street or park); and the country where dogs were tested (as a factor with levels Austria and Slovakia). To account for repeated observations of the same individual as well as to avoid pseudo-replication, we included the random intercept effects of the identity of the dog (dogID). To avoid overconfident models and to keep the Type I error rate at the nominal level of 0.05 (Barr *et al.* 2013; Schielzeth & Forstmeier 2009), we included all possible identifiable random slopes of the interaction between tray distance and environment as well as the random slope of latency in dogID. Prior to fitting the model, we z-transformed median_latency and DIAS-score to ease model convergence and achieve more easily interpretable model coefficients (Schielzeth 2010).

After fitting the full model, we confirmed that none of the model assumptions were violated and assessed model stability. We verified the absence of collinearity by calculating the Variance Inflation Factor (VIF) (max. vif = 1.17) using the R package "car" version 3.0-12 (Fox & Weisberg, 2019). We visually inspected the best linear unbiased predictors (BLUPs) per level of the random effects to determine if they were approximately normally distributed (Harrison *et al.* 2018), which they were.

We assessed model stability with regard to the model estimates by comparing the estimates from the model including all data with estimates obtained from models in which the levels of random effects were excluded one at a time (e.g., dropping each dogID once) (Nieuwenhuis *et al.* 2012). This revealed the estimates to be of good stability.

We compared the full model with all terms included to a null model lacking the key terms of interest (environment and tray_distance and their interaction) to avoid 'cryptic multiple testing' (Forstmeier & Schielzeth 2011). After this, we determined the significance of individual fixed effects by means of likelihood ratio tests, comparing the full model with models lacking them one at a time (R function drop1).

We calculated confidence intervals for the model estimates by applying the function 'bootMer' of the package 'lme4', using 1,000 parametric bootstraps.

The data analysed included a total of 638 observations of 30 dogs.

Chapter Three

3.1 Results

Of the 46 dogs recruited in Austria and Slovakia, 35 (76%) passed the 4 obedience task test, the preference test, and completed the SDT in both urban and green observation sites. Accordingly, 30 out of the 46 dogs (omitting 5 certified subjects along with unsuccessful completions) supplied data for analysis and convergent validity with Behavioural regulation (BR) score of DIAS. The mean of tray distance was 2.5 m +/- 1.58 m, the mean BR was 0.48 +/-0.14, and the mean of median latency was 2.09 s +/- 1.61 s.

In a full-null model (Table 3.3. Full-null model, supplementary material), we found a clear effect of the test predictors: environment, tray distance, and their interaction ($\chi 2 = 34.267$, $df = 6$, $P < 0.0001$). However, the two-way interaction between environment, tray distance and DIAS score was not significant (Table 3.2. Reduced model, supplementary material). After removing this and other non-significant two-way interactions the main effects model showed that there was a clear effect of tray distance and environment, irrespective of tray distance (Table 3.1. Main effects model). More clearly, the significant effect of environment means, that there is an overall higher probability to choose HQ in the park environment (Figure 3.1.). This suggests, that the dogs differentiated between the plates better in the park than in the street from the very beginning on, which we confirmed via additional analysis that compared the probability of choosing HQ in the very first trial (distance = 0) between the two environments (test and its result). Additionally, the main effects model discovered a significant effect of tray distance, as such that with increasing tray distance the probability to choose the high reward decreased for both the street and the park environment.

Even though this measure was included as control variables, I mention that, we did not find an effect of latency to choosing HQ (Figure 3.3.). This means, that the distractedness score (measured as the time to obey caretaker's commands) did not reflect the performance in the SDT task. On the other hand, the first testing environment did have a significant effect on the dogs' performance. Subjects which completed the SDT firstly in the green condition displayed superior performance during subsequent testing, in contrast to their counterparts who were initially tested in an urban condition. It may be, that that exposure to natural surroundings stimulated and facilitated cognitive processing in dogs to a greater extent than exposure to an urban street, ultimately resulting in more efficacious learning abilities.

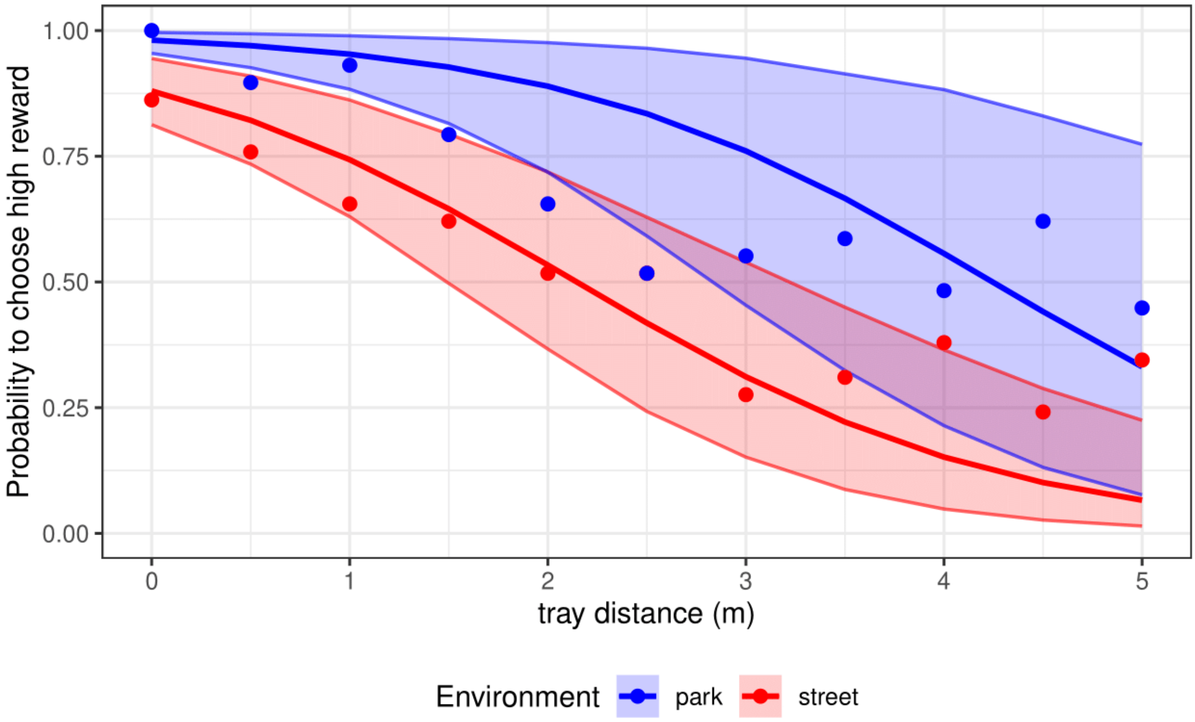

Figure 3.1. Probability of choosing the higher reward as a function of environment and tray distance. Circles represent the average probability per environment * tray distance (red=street, blue=park) combination. The lines depict the fitted model for each environment (thicker lines) and their respective confidence intervals (thinner lines) with DIAS score and latency and dummy coded factors centred to a mean of zero.

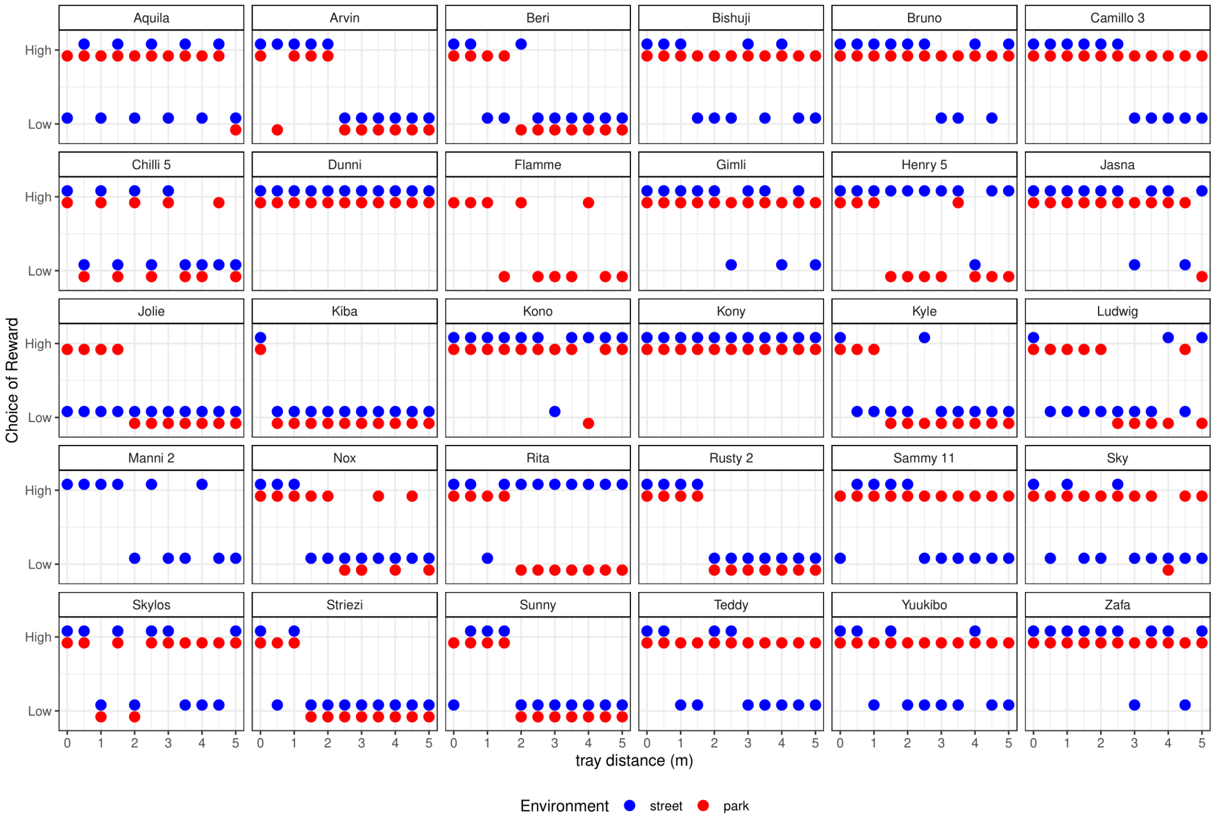

Figure 3.2. Individual choice. Concrete choices (red=street, blue=park) between the higher quantity and the lower quantity rewards in the Spatial discounting task of all subjects in both environments.

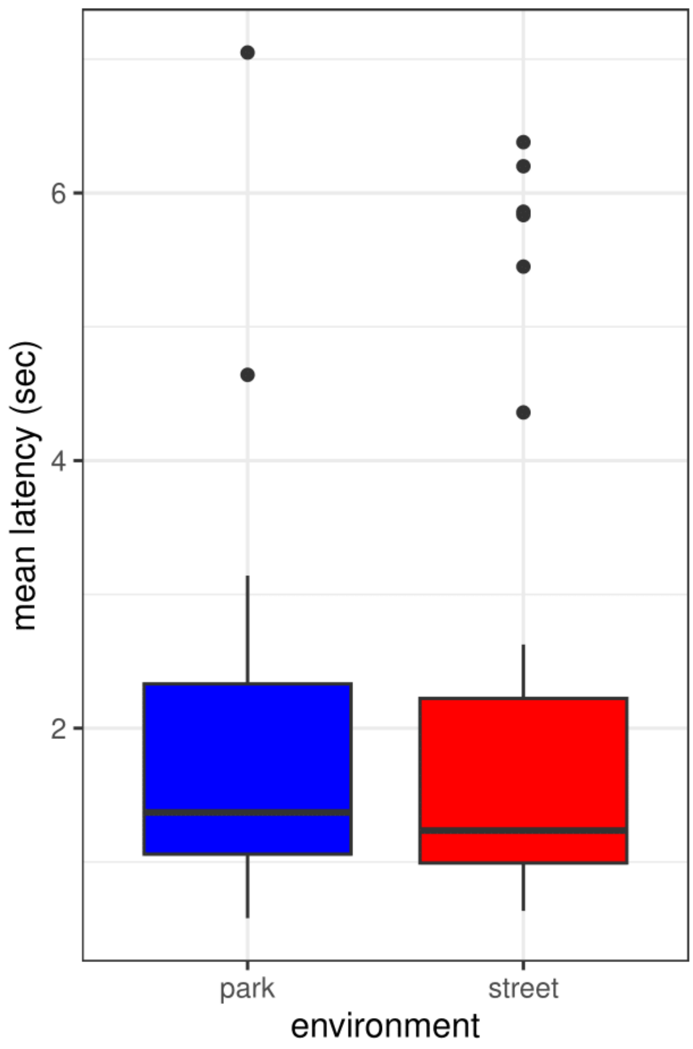

Figure 3.3. Latency scores depicting a mediating factor (distractedness) in the green or built condition (red=street, blue=park). A separate analysis revealed no environmental effect on the distractedness of dogs.

Results of the main effects model:									
Term	Estimate	*SE*	lower cl	upper cl	χ^2	*df*	*P-value*	min	max
Intercept	-1.207	0.584	-2.271	-0.229			(3)	-1.473	-0.941
The effect of environment (1)	1.934	0.638	1.055	4.215	12.316	1	p < 0.001	1.756	2.293
Tray distance (Meters) (2)	-1.346	0.264	-1.952	-0.9	21.553	1	p < 0.001	-1.415	-1.24
Behavioural regulation score (2)	-0.393	0.285	-1.03	0.153	1.825	1	0.177	-0.586	-0.281
Median latency (Secs) (2)	-0.193	0.287	-0.738	0.498	0.389	1	0.533	-0.415	-0.075
The effect of first environment (1)	1.238	0.603	0.137	2.472	4.666	1	0.031	0.985	1.643
The effect of country (1)	0.789	0.624	-0.356	2.025	1.806	1	0.179	0.538	1.275

Table 3.1. Main effects results of the Generalized Linear Mixed Model analysing the effect of the choice of tray (small reward tray = 0, high reward tray = 1). The test predictors are the environment as a factor with levels street and park; tray distance and the interaction between the two.

(1) Environment and First environment were dummy coded with 'street' being the reference categories, Country was dummy coded with Austria being the reference category

(2) Tray distance; BR and Median latency were z-transformed to a mean of zero and a standard deviation of one, mean (sd) of Tray distance was 2.50 (1.58), mean (sd) of BR was 0.48 (0.14), mean (sd) of Median latency was 2.09 (1.61)

(3) = not indicated because of having a very limited interpretation.

Chapter Four

Discussion and Conclusion

4.1 Factors affecting canine performance: Impulsivity and Distraction

Both people and their pets are feeling the effects of today's fast-paced urbanisation. The purpose of this research was to determine if, like humans, canines have less success in a self-control task when exposed to an urban environment. Thus, the performance of Austrian and Slovak pet dogs was analysed using the spatial discounting task (STD) when they were subjected to either green or built stimuli outdoors. It was also of interest to investigate whether or not distraction served as a mediator of this potential impact. To that end, the time needed to complete obedience test during a walk in the respective environment was used as a control variable in the model. As a result, a number of interesting results emerged.

The statistically significant main effect of tray distance in the SDT provided conclusive evidence that impulsivity had been adequately evaluated. The findings also indicate that the green surroundings have a significant impact on the overall performance of the dog. They match earlier human (e.g., Berry *et al.* 2015) and canine (Puurunen *et al.* 2020, Westgarth *et al.* 2020) research demonstrating that time spent in nature leads to increased cognitive capacity. It is uncertain whether impulsivity alone accounts for the improved performance of dogs in obedience test, as their performance seemed to improve even from zero distance. This points to the presence of additional factor, such as distraction, which could exacerbate impulsivity. The distractedness score did not explain the differences in SDT performance. Moreover, a separate analysis revealed no improvement in obedience performance in the green condition.

That indicates that there may be extra factors at play besides impulsivity and distractedness, or that our test did not capture the essence of distraction correctly.

Thanks to the trial-and-error approach used to develop the practical test for evaluating canine impulsivity in the field, I now have a better understanding of self-regulation evaluation through the STD. In what follows, the outcomes will be examined in turn, noting where the current study aligns with and departs from other studies.

4.2 Green and built settings

The SDT was carried out to see whether or not dogs could pick the larger of two rewards even when they had to bypass the lower reward and get to one which was placed further away from them. However, this SDT modification was mainly designed to compare two types of environments—one natural (green) and the other built. After examining the data, a statistically significant difference in the subjects' ability to select the greater reward in green condition was revealed. Given that SDT is used to measure canine impulsivity and the analysis found a main effect of environment on tray distance in the SDT, one is tempted to conclude that canines exposed to natural environments are more likely to exhibit self-control. However, we remain sceptical that impulsivity was the sole factor governing dog's decision-making throughout the test. This is because canines performed better in the park right from the bat. In reality, they do not need to inhibit their responses while the trays are at zero distance. Because impulsivity only comes in question after the plates are gradually pushed further away, there has to be an additional factor at work alongside impulsivity. Therefore, the results cannot give firm answer about what precisely does dog performance rely on, especially since no two-way interaction of environment and tray distance was found.

Actually, Brucks and colleagues (2017a) emphasized the need to assess whether the various inhibitory tests accurately represent the specific attribute of impulsivity. They warranted caution when asserting whether impulsivity is present in studied behaviours. To avoid such uncertainty, the authors used a test battery in order to examine a wide spectrum of impulsivity (e.g., motor inhibition, cognitive inhibition/flexibility, self-control) at once. Despite this, delay of discounting paradigm has been used the most commonly to test impulsivity (Fagnani *et al.* 2016), where usually only a single measure is empolyed (Miller *et* *al.* 2010, Bray *et al.* 2014). Moreover, it is possible that different cognitive processes are working simultaneously or mediate each other while dogs decide between greater and lesser rewards. Hence, there can always be an experiment or battery examining a broader range of executive function. Because of this, I first tested dogs' distractedness before carrying out the SDT (see chapter 3).

As mentioned above, we still lack a good grasp on the precise cognitive processes at play, and further research is needed to clarify these questions. Countless reports from human literature attest to nature's ameliorative effects (Kaplan, 1995, Lederbogen *et al.*, 2011, Lorenc *et al.*, 2012, Ulrich *et al.*, 1991; Wang *et al.* 2017). It's possible there may be clues about the underlying principles that govern them. In a study conducted by Rousselet and Fabre in 2005, it was observed that humans displayed a substantial advantage in processing speed of natural scenes compared to artificial scenes in two separate experiments. Notably, this advantage was not attributed to colour cues, as the same effect was observed with black and white images.

Similarly, Grassini and colleagues (2019) conducted a study using EEG recordings to examine the mental effort of natural and urban scenery. The researchers found that photographs with greenery needed less cognitive processing and attention than urban ones. Specifically, the authors observed differences in brain activity level and cognitive effort as revealed by signal spectrum analysis. Their results suggest that natural scenery may be processed with greater ease and efficiency by the human brain as compared to urban scenery.

Functional magnetic resonance imaging was utilized by Kim *et al.* (2010) to monitor brain activity in patients as they saw various pictures. The amygdala, which is responsible for the processing of fear and anxiety as well as reward-related impulsive behaviour (Nakajima *et al.* 2018), had increased blood flow in the brains of the participants when they saw urban images. Conversely, natural scenes stimulated the anterior cingulate gyrus and other parts, which are linked to compassion and altruism. However, the authors noted that it is unclear whether the activation areas were associated with high or low arousal evoked the respective scenes (Williams 2021). It is possible that similar cognitive mechanisms could explain the superior performance of dogs in the green condition. However, more investigation catered towards processing speed in opposing environments is required to verify this speculation.

4.3 Walk the talk

In addition to the SDT, a second test was caried out, whose the results were being incorporated into the model as a control variable. The goal here was to determine whether differences in impulsivity between the two settings might be mediated by the distraction from the environment. That is why the dogs' obedience in response to four commands (such as sit, lay down, give a paw, etc.) was tested in the middle of an ordinary walk with their caretakers. To my surprise, it was discovered that latency to obey (=distraction) did not affect the performance success in the SDT. That may mean, that distractedness did not mediate the significant effect of environment reported in chapter 2. On the other hand, it remains unclear whether or not this method accurately reflects the concept of distractedness in dogs. That might be due to the fact that no environmental influence was found on the time it took to complete the set of commands. Considering the lack of studies on this topic in the current canine literature and the lack of conclusive evidence presented here, more investigation into this test and its implications is necessary.

Owing to the complexity of impulse control and the existence of discrepancies between tasks in a test battery (Brucks *et al.* 2017a), it is debatable whether a solitary measure can be regarded as a comprehensive assessment of an individual's impulsivity. Interestingly, impulsivity has also been connected to other skills, such as problem solving (Müller *et al.* 2016). Brucks and colleagues (2017a) concluded in their study that knowing whether or not particular tests are accurately capturing the impulsivity of a species is crucial for forming reliable claims regarding the inhibitory control in more complicated behaviours.

Apart from cognitive factors, a number of physical influences may account for the enhanced performance of dogs in green environments. For instance, the texture of the ground may make it more comfortable for dogs to walk on or explore their surroundings. This may be due to the fact that grass and soil are typically softer in green settings than concrete pavement in urban ones. It's possible that visual cues vary between green and urban settings as well. Shadows cast by leaves in green environments can make it difficult for dogs to see, while shadows cast by buildings in urban areas do not shift with the wind and are typically larger. Dogs may also feel more relaxed and less restrained if they are allowed more freedom to run around in natural areas with their owners. This could train them to expect to spend more time away from their caretakers in the park, which in turn could affect their performance in the test.

Any of these physical influences could serve as an alternative explanation to higher impulsivity on the street than in the park condition. Importantly, however, none of them can explain why dogs differentiated between the two plates better in the park than on the street already when the plates were still in the default zero-meter position. Nevertheless, it is important to keep in mind that various physical conditions may play a significant role in determining canine performance on cognitive tests, especially if they are situated outdoors.

Diving into human realm, recent years have seen the publication of many studies highlighting the various positive effects that may be achieved by just going for a walk outdoors in nature. When Burton and colleagues (2021) analysed walking patterns, they found that being in nature reduced the momentary requirements for our brains. Participants' gaits were tracked while they were shown either green or built real-time photos, and upon seeing images of cities, subjects processed the environment around them slower. Furthermore, this was reflected also in more reluctant walking speed. In other words, viewing urban scenery used more brain capacity than seeing natural features. The authors claimed that time spent walking in natural settings reduces mental strain when compared to the same amount of time spent in an urban setting.

Similar results were seen when Bratman and colleagues (2015) examined the brains of human participants prior to and following a long walk in either a spacious park or a bustling street in California. The subgenual prefrontal cortex, associated with depression and self-criticism, was less active after a stroll in the park as opposed to the street. The researchers then asked volunteers to evaluate their mindsets, where city walkers reported higher distressed rumination. Therefore, it's possible that nature affects where our brain allocates its processing power and whether or not it dwells on negative feelings. Consistently with Bratman *et al.* (2015), greenery enhanced executive attention skills, while a walk down a street did not in another study (Williams 2021). Having a visual representation of the brain's regions responsible for interpreting environmental cues would be very useful to gauge the mind of our pets and compare them to humans. Thus, any research along those lines is essential for proper deduction.

The tendency toward improved self-regulation and less distractedness found in our study has profound implications for understanding the role that nature plays in shaping canine impulsivity. It's important to remember that impulsivity is a major problem in canine behaviour, one that can lead to a wide range of undesirable results, including aggression, disobedience, and other behavioural issues (Olsen 2018). Hence, the outcomes of the current study have potentially far-reaching consequences, indicating that canine impulsivity and/or distractedness may be mitigated by preventative measures involving exposure to natural habitats. It's possible that by providing dogs with a more natural setting for a walk, we can enhance their self-regulation, concentration and possibly learning abilities.

4.4 Dogs learn better in nature

My study yielded one unforeseen significant trend related to the control variable, which merits further examination. Each participating dog experienced the test in one of the priming conditions first, with the order being randomly assigned prior to the test. Notably, dogs that were first primed in a park demonstrated superior performance during the subsequent urban meeting. When the priming order was switched (the first test occurred in an urban setting), subjects tended to perform worse the second time. In particular, that would mean that when dogs undergo the STD for the first time in a park, they are able to learn and integrate the system more effectively, resulting in improved choices during subsequent urban encounters.

Learning the process of the delay of discounting paradigm is what the first stage of training is all about. The aforementioned need to learn the task has been pointed up as a potential complication in studies of dog impulsivity. Actually, as a possible explanation for the discrepancy in results across inhibitory tasks, it was proposed that measurements of apparent impulsivity may instead represent the dogs' capacity to learn (Fagnani *et al.* 2016). When Mongillo and colleagues (2019) compared the dogs' learning rates in the initial stages of training for the delay of gratification task to the DIAS score, they discovered a significant association. Thus, they reason that the questionnaire likely represented the dogs' capacity for learning rather than their inherent impulsivity. This is, of course, pure conjecture; and a dedicated study to the topic is required to determine the extent to which inhibition is influenced by learning.

The physical environment shapes how dogs behave on an everyday level (Brown *et al.* 2022). The same is true for humans. Learners and educators alike are becoming more curious about the impact of their environmental surroundings on classroom performance. There is evidence that spending time in nature may improve learning outcomes by lowering stress levels, boosting happiness, and clearing the mind. Classes outside, eco-friendly play areas, hikes, indoor plants, and window scenery are all examples of nature-based treatments. Current findings provide potential credence to the idea that therapies involving nature might improve concentration, working memory, and other cognitive abilities in humans (Vella-Brodrick and Gilowska 2022). Could it be true that the same applies for dogs? One may hypothesise they could also be designated patients of "nature", given that the present analysis discovered improved learning of dogs in the green condition. In summary, spending time in natural surroundings may be a simple and nearly instant strategy to boost city inhabitants' spirits. Such a prescription has no known adverse effects and could improve our cognitive functioning at zero cost (Gretchen 2015). Yet, there still remain numerous unanswered concerns.

4.5 DIAS and Behavioural regulation

Owner 's perception as measured by the DIAS is included as a control variable, allowing for incorporation of two inhibitory control indicators. In light of the recent debate (Barela *et al.* 2023), it comes as neither a surprise nor a revelation that the dogs' impulsivity, as judged by a validated questionnaire (Wright *et al.*, 2011), was not correlated with their performance in the SDT. The finding that the sub-scale of the DIAS did not affect performance in the SDT in the current study supports a growing body of literature (Mongillo *et al.* 2019, Brucks *et al.* 2017b, Fagnani *et al.* 2016, Stevens *et al.* 2022). But then again, it conflicts with the results of a strong correlation between the DIAS and the maximum distance travelled reported by Brady *et al.* (2018) or of a delayed gratification task (Wright *et al.* 2012, Riemer *et al.* 2013).

In particular, we examined data from the first DIAS sub-scale (the Behavioural regulation score - BR), which measures a principally narrow and focused aspect of impulsivity (Sellers-Sasher *et al.* 2022). Dogs with higher BR scores are thought to be more easily startled, restless, and agitated than those with lower scores (Fagnani *et al.* 2016). In the experiment that Riemer and colleagues administered in 2013, BR was the only sub-scale significantly linked to the delay of the discounting task. Brady *et al.* (2018) found the same thing to be true in their SDT, wherein only the first factor (BR) out of all three was related to the dog's performance in the laboratory task. Given that it is not a parameter that commonly changes (Brady *et al.* 2018), we decided to use it as our variable in the model.

Impulse control, according to the outcomes of multiple studies, is situation-dependent (Bray *et al.* 2013, Marshall-Pescini 2015, Brucks *et al.* 2017a, Mongillo *et al.* 2019). Because of this, it is feasible that the DIAS and other impulsivity tests examine distinctive characteristics of the same process. There can be several reasons why that might be the case. For example, surveys depend on caretakers' judgments of their pets' behaviour, which involves substantial subjectivity (Mongillo *et al.* 2019). Subjectivity may also be introduced via disparities in the 'values' ascribed by the pet's owner to the rewards used in the physical impulsivity tests. During their lives, all dogs are subjected to various forms of human-initiated learning, including positive and negative reinforcement and their owners' social inhibition. In other words, the experiences that dogs have in their daily lives may affect how well they exhibit self-control during experiments. If only one element is compromised by subject's unique history, the likelihood of disparity across numerous tests increases. Consequently, when evaluating impulsivity, it is crucial to extract a concrete facet from the dogs' inherent capacity for self-control omitting dogs' past experiences (Brucks *et al.* 2017a).

Another argument suggested by Mongillo *et al.* (2019) is that different cultural backgrounds and translation-related subtleties cause interpretation issues. We used the English version of the DIAS questionnaire for Austrian volunteers and not yet validated Slovak translation for Slovak volunteers. This might pose a problem as surveys undertaken in non-English speaking countries, whether based on the original English form (e.g., Brucks *et al.* 2017a) or a translation (Fagnani *et al.* 2016, Mongillo *et al.* 2019) were usually uncorrelated. In contrast, research in English-speaking regions (e.g., Brady *et al.* 2018) has shown a direct relationship between the DIAS and measures of impulsivity. Hence, it is worth making sure that the survey is culturally and linguistically appropriate for the study area by validating it in the local language.

In sum, the DIAS questionnaire is a helpful tool for gauging impulsivity across the board, but it may not be definitive evidence of the trait's presence. Upon seeing the differences, I must ask whether there is really a single, reliable way to assess an animal's capacity for restraint (Brucks *et al.* 2017a). The context-specific nature of inhibitory control and the subjectivity of questionnaire-based evaluations limit the tool's effectiveness. As such, future research needs to focus on developing more specific and reliable assessment tools (such as multi-task test batteries) that can measure inhibitory control consistently.

4.6 Limitations of the study

There were many promising aspects of our research. The comprehensiveness of the participants was a major strength. Our results can be more broadly applied because we included dogs of many different breeds and backgrounds in our sample. And because we tested canines in two countries, we were able to get a more representative sample of the population as a whole, which strengthens the generalisability of our results. This allowed us to investigate how dogs' decision-making processes vary across different cultural and environmental contexts, providing valuable insights into the cognitive processes of dogs worldwide.

However, during the process of planning and executing our research, we identified some limitations to be considered when interpreting the results. For example, the absence of small dogs in this experiment is one downside to our investigation. This was due to the nature of the task, which may have been too inappropriate or not suitable for smaller pet varieties. Therefore, the results cannot be generalized to all dog breeds, and caution should be taken when extrapolating the results to all dogs.

Urban-trained working dogs are also not ideal for this evaluation. Five dogs trained specifically for searching amongst ruin debris performed flawlessly in my experiment. It's possible that they have been exposed to different environmental stimuli, leading to changes in their behaviour and decision-making processes. That's why their responses may not be representative of dogs in general, especially rescue dogs reaching the highest international standards.

As discussed by Gerencsér *et al.* (2018), food isn't the only thing that motivates dogs; they can also be motivated by other things, like playtime with humans or new toys. The delay of discounting task typically uses food as a reward, which may not be the most effective motivator for all dogs (Brucks *et al.* 2017b). Our findings might not be applicable to subjects which are not primarily motivated by food because of this.

Another constraint is that extreme weather changes can also alter the results of the test since it is performed outdoors. When temperatures are high, for instance, dogs may lose interest or energy for the task at hand. Similarly, a dog's discomfort caused by extremely cold weather may hinder the animal's performance. In my case, there were a couple of occasions when the temperature was exceptionally high, causing a particular subject to perform noticeably worse. This is an extra element that might contribute to the introduction of irregularities, although it is inevitable given the type of the experiment.

Additional drawback is that the existing literature does not present a unified methodology and/or terminology (Olsen 2018). This makes it challenging to compare results across studies and to ascertain the best strategy for carrying out the test.

Last but not least, conducting this kind of research in the field has its challenges, which makes comparing performances across settings and specific dogs especially hard. On several occasions, for instance, walkers disrupted the testing process, leading to minor conflicts. The presence of unwelcome strollers may cause stress for the subjects or divert their attention, which could affect their performance. One way to lessen the impact of this limitation is to administer the test in a secluded or restricted location. However, doing so carries the risk of undermining the test's external validity. Especially in urban areas, where there are often a lot of people walking around and various things that can serve as a distraction.

Ultimately, the delay of discounting tasks, including the STD adaptation, are valuable methods for investigating canine decision-making, but it's important to keep in mind a few caveats before jumping to any conclusions. If this test was to be repeated in the future, we would aim to standardize the methodology used to administer it and to account for the influence of outside factors (such as heat or unwanted guests). Additionally, efforts should be made to include a diverse range of dog breeds in the study to provide a more comprehensive understanding of how impulsivity is affected by the momentary environment.

4.7 Conclusion

This study contributes to the growing collection of literature demonstrating that dogs benefit from being outside in nature (Puurunen *et al.* 2020, Westgarth *et al.* 2020). The present data shows that exposure to natural surroundings may reduce impulsivity and/or distractedness in dogs. Such a conclusion is based on the bigger amount of larger quantity of choices in the SDT within green opposed to built environments. This is in line with earlier research showing the positive effects of natural environments on canine behaviour and well-being. Although it remains unclear if my reasoning is the sole predictor of dog impulsivity, considering hold true for other species, considering different aspects of inhibitory control, we need to be cautious when drawing conclusions about the involvement of inhibitory control in other cognitive processes (Brucks *et al.* 2017a).

The implications of our findings are potentially substantial, especially for dog owners and animal welfare groups. By providing dogs access to natural habitats, we may be able to increase their cognitive function and well-being as a whole. Exposure to green surroundings, in addition to having a favourable effect on impulsivity, may be also able to increase people's ability to engage with their pets. Since companion animals improve the health of their human owners (Wells 2009), promoting direct contact to wilderness and urban planning overall (Alcock *et al.* 2014, Kardan *et al.* 2015) could benefit both parties. Such an approach would fit the biophilia hypothesis, which holds that people have a fundamental psychological and physiological need to interact with the natural world.

It is worth noting that the relationship between dogs and their owners is a complex and dynamic one and that the influence of environmental factors on canine behaviour may be affected by a range of individual and contextual factors. As there have been found multiple mechanisms proving the benefits of connecting with nature (Capaldi *et al.* 2015), extending the research area also in canine species is imperative. Nonetheless, the present study emphasizes the importance of considering the role of environmental influence in shaping behaviour of our fur companions, and suggests that exposure to natural settings may be effective for promoting optimal task performance in dogs. All in all, this study laid the groundwork for future studies that aim to further our knowledge of the cognitive processes underlying canine behaviour and the complex interplay between dogs, their owners, and the environment in which they live and interact.

Supplementary material

Results of the reduced model:									
Term	Estimate	*SE*	lower cl	upper cl	χ^2	*df*	*P-value*	min	max
Intercept	-1.189	0.596	-2.180	-0.123			(3)	-1.498	-0.953
The effect of environment (1)	2.001	0.798	0.717	4.637			(3)	1.734	2.317
Tray distance (Meters) (2)	-1.355	0.274	-2.040	-0.867			(3)	-1.426	-1.245
Behavioural regulation score (2)	-0.388	0.287	-1.006	0.176	1.791	1	0.181	-0.594	-0.276
Median latency (Secs) (2)	-0.194	0.290	-0.830	0.478	0.450	1	0.502	-0.433	-0.071
The effect of first environment (1)	1.230	0.605	0.192	2.404	4.640	1	0.031	0.974	1.649
The effect of country (1)	0.789	0.622	-0.354	2.121	1.813	1	0.178	0.536	1.276
Envrironment * Tray distance	0.087	0.613	-1.107	1.647	0.019	1	0.890	-0.139	0.287

Table 3.2. Reduced model results of the Generalized Linear Mixed Model analysing the effect of the choice of tray (small reward tray = 0, high reward tray = 1). The test predictors are the environment as a factor with levels street and park; tray distance and the interaction between the two.

(1) Environment and First environment were dummy coded with ‘street’ being the reference categories, Country was dummy coded with Austria being the reference category

(2) Tray distance; BR and Median latency were z-transformed to a mean of zero and a standard deviation of one, mean (sd) of Tray distance was 2.50 (1.58), mean (sd) of BR was 0.48 (0.14), mean (sd) of Median latency was 2.09 (1.61)

(3) = not indicated because of having a very limited interpretation.

Results of the Full model:									
Term	Estimate	*SE*	lower cl	upper cl	*χ2*	*df*	*P-value*	min	max
Intercept	-1.165087	0.569327	-2.2987	-0.2455			(3)	-1.4587	-0.8998
The effect of environment (1)	2.020046	0.799489	0.6971	5.1202			(3)	1.2326	2.3539
Tray distance (Meters) (2)	-1.361494	0.273033	-2.0223	-0.9245			(3)	-1.4683	-1.2526
Behavioural regulation score (2)	-0.729709	0.357395	-1.6489	-0.0155			(3)	-0.8979	-0.6115
Median latency (Secs) (2)	-0.242749	0.290011	-0.8528	0.3963	0.70294	1	0.4018	-0.4283	-0.1396
The effect of first environment (1)	1.170044	0.59433	0.1505	2.4104	5.37773	1	0.0204	0.9377	1.5845
The effect of country (1)	0.71815	0.607866	-0.4043	1.9166	1.36306	1	0.24301	0.4725	1.2003
Envrironment * Tray distance	0.204024	0.611286	-1.134	1.9717			(3)	-0.0532	0.3714
Environment * BR	-0.457697	0.74259	-2.9171	0.978			(3)	-0.9948	-0.1629
Tray distance * BR	-0.211148	0.246004	-0.8839	0.2923			(3)	-0.3018	-0.0976
Envrironment * Tray distance * BR	-0.493894	0.580597	-2.3674	0.6569	0.7692	1	0.38046	-0.7714	-0.246

Table 3.3. Full model results of the Generalized Linear Mixed Model analysing the effect of the choice of tray (small reward tray = 0, high reward tray = 1). The test predictors are the environment as a factor with levels street and park; tray distance and the interaction between the two.
(1) Environment and First environment were dummy coded with 'street' being the reference categories, Country was dummy coded with Austria being the reference category
(2) Tray distance; BR and Median latency were z-transformed to a mean of zero and a standard deviation of one, mean (sd) of Tray distance was 2.50 (1.58), mean (sd) of BR was 0.48 (0.14), mean (sd) of Median latency was 2.09 (1.61)
(3) = not indicated because of having a very limited interpretation.

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ANNEXES

Appendix A

Database file including all raw data is freely accessible for anyone with this link:

https://docs.google.com/spreadsheets/d/1ofI-OvcL58RRbn7nOQMOokOJksjEjY4xV8Kyho94ULc/edit?usp=sharing

Appendix B
DIAS Questionnaire

(Wright, Mills & Pollux, 2011)
Blank DIAS (2 pages):

<u>For each of the statements below please place a cross in the box that most accurately describes your level of agreement:</u> The answer should reflect the *general personality of the dog*, so for example if a statement applies to your dog in some situations but not others, please make a judgement as to how much you agree

		Strongly agree	Mainly agree	Partly agree, partly disagree	Mainly disagree	Strongly disagree	Don't know / not applicable
1	My dog shows extreme physical signs when excited (e.g. drooling, panting, raising hackles, urination, licking lips, widening of eyes)						
2	When my dog gets very excited it can lead to fixed repetitive behaviour (i.e. an action that is repeated in the same way over and over again), such as tail chasing or spinning around in circles						
3	I would consider my dog to be very impulsive (i.e. has sudden, strong urges to act; acts without forethought; acts without considering effects of actions)						
4	My dog doesn't like to be approached or hugged						
5	My dog becomes aggressive (e.g. growl, snarl, snap, bite) when excited						
6	My dog <u>appears</u> to be 'sorry' after it has done something wrong						
7	My dog does not think before it acts (e.g. would steal food without first looking to see if someone is watching)						
8	My dog can be very persistent (e.g. will continue to do something even if it knows it will get punished or told off)						
9	My dog may become aggressive (e.g. growl, snarl, snap, bite) if frustrated with something						
10	My dog is easy to train						

		Strongly agree	Mainly agree	Partly agree, partly disagree	Mainly disagree	Strongly disagree	Don't know / not applicable
11	My dog is not keen to go into new situations						
12	My dog takes a long time to lose interest in new things						
13	My dog calms down very quickly after being excited						
14	My dog appears to have a lot of control over how it responds						
15	My dog is very interested in new things and new places						
16	My dog reacts very quickly						
17	My dog is not very patient (e.g. gets agitated waiting for its food, or waiting to go out for a walk)						
18	My dog seems to get excited for no reason						

Appendix C
Tutorial

Session Number: 1 of 2

Time: circa 75 min

Location: Vienna: Nippongasse STUWO areal/Theresa-Tauscher Park

BEFORE PARTICIPANTS ARRIVE:

Ask participants to fill in the consent forms as well as the DIAS questionnaire.

Set up the apparatus.

Meet the participants.

AS PARTICIPANTS ARRIVE:

Greet the participants and introduce myself as they come in.

Good morning, thank you so much for participating in our study. I am NM…

Ask participants to sign consent forms (if they did not fill them out prior to the meeting).

Here is a consent form, please read it carefully and sign if you agree to the terms. If you have any questions before signing, please don't hesitate to ask me. If, for any reason, you do not wish to participate please let me know… Are there any questions related to the consent form? Feel free to interrupt me anytime with any other questions. Let me talk you through the procedure as we walk together.

Tell the participants information about the procedure as we walk to the location.

The procedure today will not take long. Once we reach the location of the study, I will ask you to walk your dog on a leash two short laps around the area. Whole walk will last around 5 minutes. Could you please give your dog 4 basic commands of your choice after the first lap is finished? Once s/he successfully finishes the tasks, we will move on to the second lap. Your walk as well as the test procedure will be video-recorded so that we can code the behaviour throughout the whole process. Is this clear, do you have any questions?

This experiment will begin with a brief practice session to help familiarise you and your dog with the setup. The practice session will be followed by a real session. There will be two trays *presented to your dog and s/he will choose between them once you release him/her from the leash. I will slowly increase the distance of the tray with the higher reward and collect the number of times he opts for this treat. Once we are done with the walk, I will tell you more concrete information about the setup and trial sessions. Are you comfortable with these events so far?*

DURING THE WALK:

Tell the participants: *Please now walk a circle around here with your dog as you would usually do on any other day. Once you finish one lap, please ask your dog to do 4 obedience tasks. I will record the whole walk.*

Set a timer for 5 minutes.

Tell the participants to do obedience tasks, then continue with the second lap.

Thank you, that is perfect, now start with the 4 obedience tasks. … Perfect, you can continue walking now. After you finish the second lap, please follow me to the experiment location.

Walk together to the setup.

DURING THE EXPERIMENT:

Show the participant their place and explain the concrete instructions.

Thank you for successfully completing the first part of our experiment, let´s now move on the choice task. Could you please stand here and make sure your dog sits on the designated spot marked via cross on the ground? Does this position feel okay?

Moving to the procedure, we will start with the trial session, which will accommodate your dog to the whole apparatus setup and two different rewards. As s/he can see, I will always offer a bigger reward of 3 pieces always on the left/right side and a smaller reward of a single piece on the other one. Your dog will choose between these two trays 6-12 times in this trial session, to make sure s/he really has a preference for the better reward type. Most dogs will prefer 3 pieces if they are the same distance apart and what we want to explore today is how much further your dog is willing to go to get this reward. Initially, both trays will always be put on the same spot, but I will slowly transit from baiting being visible to your dog to doing everything behind this partition panel. Once we perform the first trial session, we will continue with 12-18 trials behind the partition panel. Then we are ready to start the real *experiment. You can expect the trial session to last a maximum of 20 minutes and the real procedure to last roughly the same time. Is this okay for you?*

Now, please put on your sunglasses, to prevent your dog from seeing your eyes. This is to stop your dog from trying to read where you are looking so they have to make the choice themselves. Obviously, there is no good or wrong choice, we are mainly interested in how differently will "dog name" behave in the respective environments. I will give you a verbal cue when you can release your dog so that s/he can retrieve his/her reward. Afterwards, please ask him/her to come back, so that he only has a chance to choose only one tray. S/He will start from the same spot marked on the ground each time. I will now start with trial number 1 of 12.

Perform trials:

3 trials with the dog sniffing and looking at each tray,

3 trials with trays on the ground, me standing next to the owner,

3 trials with the partition panel being shortly placed in front of the dog (baiting visible),

12 trials with everything happening behind the partition wall. In case the subject only chooses the HQ reward, the trial session can end after the tenth choice.

End the trial session and have a short break before the real procedure.

Thank you, both of you did an amazing job, let us have a short break and then start with the real procedure. We will do the same thing as during the last 12-18 trials, but this time I will move the tray with the higher reward 50cm away up to 5m distance. Whichever tray s/he chooses, please call him back after each task. As I said, there is no right answer here – we are genuinely trying to learn how far dogs will travel for the extra reward in different settings. We will be done shortly, how are you feeling?

Unsuccessful 1. Trial session:

Your dog did not show a clear preference so far, that´s a perfect time for a short pause, s/he can take a sip of water in case is s/he thirsty? We will continue with a second session of 12 additional trials to try whether s/he has an affinity for the 3 pieces plate after s/he is refreshed.

Unsuccessful 2. Trial session:

It is the case that today "dog´s name" did not choose the bigger tray enough. There are several types of motivation, and therefore it might be possible we did not tap into the one your dog favours. Additionally, we never know what other factors impact the decision-making. Therefore, if s/he finds a certain side unappealing for whichever reason, we can do nothing about this. For these reasons, we will stop the experiment here. Let´s not sweat it though, every chance that I get to practise are precious for us and for the methods that we use. Hence, I sincerely thank you for granting me this opportunity. Do you have any suggestions for me on how to improve the experience for you?

ONCE THE EXPERIMENT FINISHES:

Thank the participant and ask them to fill in the feedback sheet about the experiment.

Thank you for agreeing to participate in this research experiment. How did you feel? Is everything okay? Could you please answer these simple questions about your perception of our study? ... Thank you. Do you have any other questions? If not, see you next time in the other setting, I look forward to meeting you and Name of the companion dog.

AFTER THE EXPERIMENT:

Collect all materials (consent forms, feedback questions, results sheet).

Pack up the apparatus.

Upload the videos as well as all paperwork.

Fill in the data table.

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Appendix D
Ethogram

Command	Description
Sitz	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject's butt touches the ground. Some subjects take several steps while doing the downward movement, and each time one of their paws comes into contact with the ground. In case there are such consecutive steps during the move, then the first frame when the last paw touches the ground (either front or back) is counted (even though the butt is not completely on the ground).
Platz **Down**	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the last paw touches the ground (either front or back) during the downward move. Same as in "Sitz", these steps are made when the subject moves during the command to complete it successfully. During each step, paws come into contact with the ground, and the last step of the move counts. If there are no consecutive steps on the way down, then the first frame when the subject's belly and front elbows are on the ground are coded (if belly never touches the ground, then only the elbows are coded – as it is a breed dependent behaviour, how a dog lies down).
Steh **Auf**	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the last paw touches the ground (either front or back) on the way up during the movement. Same as in "Sitz", these steps are made when the subject moves during the command to complete it successfully. During each step, paws come into contact with the ground, and the last step of the move counts. In case there are no consecutive steps, the first frame when the subject's legs are all straight and on the ground is coded.
Touch **Nose**	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject's nose touches the owner's hand.
Sit back **Sit on back legs**	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject lifts both legs up to the air at their highest point (considering he is already sitting mostly on its butt and has the front feet up). The lift can only be considered complete if all of the following are true: both front legs are in the air at the same time.

Paw up	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the paw is lifted up and at its peak height. Only the lift, where the highest point occurs is counted.
Jump	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when one of the back feet touches the ground for the first time after jump initiation.
Bark (Schau mal)	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when we hear the barking sound. (Usually well initiated by the movement of the head.)
Up	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject's back legs are both straight.
Walk around me	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject walks its first round motion and stands next to the owner with all 4 paws on the ground (first frame the last paw touching the ground).
Futte (Pfote)	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the paw touches the owner's hand (and accepted by the owner - unsuccessful attempts do not count). The accepted paw is touching the owner's hand directly.
Twist	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the earliest time when the dog turns around, and his momentum stops and the last paw touches the ground.
Komm zu mir **Hier** **Fuss** **Zu fuss** **Run to me** **Come here**	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when: a.) the subject is 0.3 m in front of the owner and stops, meaning all four paws are on the ground longer than a second, the first frame of the last paw touching the ground counts, b.) or, if trained to do so, the first frame the subject touches the owner's body (most likely the hand). Only the first approach counts, even if the subject then walks away.

Mitte	Latency: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject's butt touches the ground in between the owner's legs.
Run to me (Henry)	The video is cut off at the very end of the four tasks, therefore the distance is lengthened for both environments. The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject comes to the owner at a distance of 150 cm.
Zu fuss (Camillo 3)	Given that Camillo lays down immediately after the command, the coding is altered: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject is 0.3 m away from the owner and stops, the last paw touches the ground.
Steh (Kiba)	The owner was commanding very fast, therefore the altered coding: The timer begins when the owner speaks out the first syllable of her/his command and ends at the first frame when the subject's butt takes off the ground and there is 10 cm distance between the butt and the ground.

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