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A comparison between the effects of interacting with an Unfamiliar Dog and a Human Friend on Stress Recovery

Introduction

Stress is a complex phenomenon of everyday life which affects human health in many ways (Crosswell & Lockwood, 2020). Therefore, examining ways to counterbalance potential risks have been examined. Among these, *social support* (APA, n.d.; Cohen et al., 2000; Uchino, 2006) seems to be one phenomenon which is capable of attenuating the burden of present stressors, assisting stress recovery after stressful experiences or protecting individuals against future stresses.

Although social support is usually provided by a fellow individual — be it a close friend or a family member — literature suggests that its beneficial effects can not only be provided by other humans, but by companion animals as well (Allen, 2003; Herzog, 2011; McNicholas et al., 2005). Besides pets being capable of providing social support similar to close human friends or family members - which seems reasonable, given that many people regard their pets as such (Allen, 2003; Herzog, 2011; McNicholas et al., 2005) — there is also evidence for it to even surpass human social support in terms of stress attenuation (Allen et al., 1991; Polheber & Matchock, 2014). Research within this area has put its focus on dogs, their presence during or before a stress-inducing task and its effects on the human stress response (Wells, 2007).

The *Trier Social Stress* Test (Allen et al., 2017; Kirschbaum et al., 1993), also abbreviated as “the TSST”, seems to be the task of choice when it comes to stress induction. It usually consists of a short presentation and a mental arithmetic task (i.e., subtraction of a prime number from a starting point) in front of an interview panel which is instructed to appear as unresponsive as possible towards participants. Participants are not informed about the mental arithmetic part of the TSST protocol beforehand to include a feeling of uncontrollability and more reliably induce a stress response. In addition, the mental arithmetic task can be altered to further enhance the stress response (e.g., by having to start anew when committing an error). The TSST takes roughly 15 minutes to perform and it appears to be a well-validated, reliable and ethically justifiable procedure to induce stress in individuals within the context of stress research.

Also, corresponding research (Allen et al., 1991; Kertes et al., 2017; Polheber & Matchok, 2014) has focused on the *stress attenuation effect* and/or a *stress buffering effect* of social support figures (i.e., the reduction of the human stress response due to the presence of a support figure *during* or *before* a stressor). In contrast, there seems to be less literature about a potential *stress recovery effect* of social support (i.e., a stronger or faster recovery to an individual's baseline stress level due to a support figure being present *after* the experience of a stressor), not to mention the comparison of pet- and human-induced stress recovery.

Considering all of the above, this thesis has three main goals. First, the current state of knowledge will be described (i.e., an overview of the impact of stress on human health, the relevance of social support as a countermeasure to stress and how social support provided by companion animals is capable of substituting or even exceeding human social support).

Second, to discuss potential standardization issues concerning different group conditions used in research designs which compare the effects of social support elicited by dogs and humans on participants' stress response.

Third, a proposal of a study design shall be made with which pet-induced stress recovery and its comparison to human-induced stress recovery could be examined in future research.

How Stress affects Body and Mind

According to a review paper by Yaribeygi et al. (2017), stressors seem to influence the human body and mind via multiple pathways and a distinction between the following affected systems has been made: the central nervous system (CNS), the immune system, the gastrointestinal system and the endocrine system. Naturally, as these systems are intertwined with each other, structural and functional changes (e.g., due to stress) in one of them can cause alterations within the others. However, each of these systems poses a certain specificity when it comes to how it reacts to stressors which extends to the potential health risks arising from an overstimulation, be it due to intense acute stress or prolonged chronic stress.

As stressors usually activate the sympathetic nervous system, related physiological reactions such as the activation of the hypothalamic-pituitary-adrenal axis, an increase in heart rate and blood pressure as well as other actions take place. A short overview of relevant reactions within affected systems and potential health risks linked to them shall be given in the following sections.

Stress and Brain Function

Considering the effects of stressors on the CNS, two brain areas have received the most attention: the hippocampus and the amygdala (Asalgoo et al., 2015; Yaribeygi et al., 2017). While the hippocampus appears to play the major role in terms of overall memory function, the amygdala seems to be especially relevant for the emotional aspect of memory formation.

In their review, Yaribeygi et al. (2017) note that, depending on the intensity and the duration of a stressor as well as an individual's disposition (i.e., chronic or strong acute stress and non-average reactivity), different structural changes can take place within the brain — such as reduced number and function of dendritic branches or general atrophy of hippocampal tissue. Such profound changes can cause severe consequences in respective functionality. Aside from an impairment of different aspects of memory and overall mental processing, acute or chronic stress can also disturb pathways for mood regulation and learning (Yaribeygi et al., 2017).

Stress and Immune Function

While an organism's immune system protects it against disease and damage alike, its downregulation in order for a mandatory fight-or-flight response can be evolutionary adaptive. While such a response only lasts for a short period of time, literature indicates that even a short-term stress response can already inhibit immune system functioning (Morey et al., 2015). Furthermore, prolonged immune system inhibition might cause a long-term disruption (Morey et al., 2015; Yaribeygi et al., 2017). Potential health risks regarding acute and chronic immune inhibition are an increase in inflammation, likelihood of disease and overall mortality (Morey et al., 2015; Yaribeygi et al., 2017).

Stress and the Cardiovascular System

Upon being triggered along the cascade of physiological stress responses, the cardiovascular system's reaction mainly consists of an increase in blood pressure

and heart rate (Yaribeygi et al., 2017) and an overstimulation of these responses can have deleterious effects on health (Esch et al., 2002; Yaribeygi et al., 2017). Among these are endothelial dysfunction within blood vessels, hypertension and myocardial infarction (Esch et al., 2002; Yaribeygi et al., 2017). Also, not only the likelihood of developing cardiovascular diseases seems to be affected by stress, the overall progression of these or related diseases appear to be as well (Esch et al., 2002).

Stress and the Gastrointestinal Tract

In general, stress seems to affect the gastrointestinal tract mainly in terms of appetite, bowel movement, digestion and gastrointestinal inflammation (Yaribeygi et al., 2017). Studies suggest a link between stress and chronic gastrointestinal diseases such as irritable bowel syndrome and Crohn's disease (Collins, 2001; Yaribeygi et al., 2017).

The Phenomenon of Social Support

Given the diverse risks stress can pose to human health, examining ways to counterbalance its potentially harmful effects stands to reason. One such way appears to be existent in the form of *social support* (APA, n.d.; Cohen et al. 2000; House et al., 1988; Roy, 2011; Uchino, 2006).

Social support can be defined as the positive effects of a support figure on an individual, its health and well-being (APA, n.d.). According to Cohen et al. (2000), among these are access to knowledge or services an individual cannot provide on its own (e.g., medical advice), beneficial behavioral influence on an individual considering medical adherence or useful aspects of appraisal in a specific situation (e.g., reduction of how strongly a negative stimulus is perceived). Additionally, Roy (2011) has mentioned other functional aspects of social support, (i.e., the sense of being part of a community, valued and emotionally cared for).

Naturally, as social networks are highly complex (Roy, 2011), an intricate social network is not guaranteed to have a beneficial effect on an individual's overall health and well-being. For example, more close relationships could also pose a bigger likelihood of negative life events, an increased chance of attending to medically unadvised behavior or the provision of wrong information (Cohen et al., 2000; Roy, 2011).

Furthermore, reviews indicate methodological issues regarding the definition of social support as a phenomenon and its operationalisation which might have contributed to controversial findings regarding its health promoting and stress reducing properties (Cohen et al., 2000; Roy, 2011). However, even if social support is a highly complex phenomenon and scientific literature has shown equivocal findings, studies regarding its health protecting effects should not be neglected and will receive further attention within the next paragraphs (House et al., 1988; Uchino, 2006).

Social Support, Stress and Health

Given its theoretical relevance for an individual's everyday life, the notion to check for the link between support and health appears logical. Within their review, House et al. (1988) have taken a look at different studies which have engaged in tackling this topic in the context of different countries and cultures. And indeed: There appears to be a clear correlation between social support and human health.

More precisely, evidence for an inverse correlation between the level of social integration (i.e., the density and quality of an individual's social network) and overall mortality has been indicated, meaning that the less socially integrated a person seems to be, the bigger the mortality risk. House et al. (1988) even deduced that, due to this, low levels of social integration might even be regarded as a risk factor considering an individual's health.

To get a more precise insight into the correlation between social support and mortality, it might be reasonable to look for evidence linking social support to the deleterious health effects of stress on diverse physiological systems. Fortunately, such research has been committed and Uchino (2006) has provided a corresponding review which appears to further strengthen the significance of social support for human health. The most compelling evidence refers to the connection between social support and the cardiovascular system, especially regarding the progression of cardiovascular diseases and the impact of stress on patients. That is, the higher their level of social integration, the slower their disease progression and the lower the impact of stress on them. Although the number of studies connecting neuroendocrine and immune functioning to social support appears to be smaller, according to Uchino (2006), there still appears to be evidence linking social support to relevant stress hormones such as cortisol.

In fact, he states that especially studies which have included the measurement of salivary cortisol have been able to provide the aforementioned evidence. Thus, despite the methodological issues mentioned earlier, it can be concluded that there appears to be a correlation between the quality and quantity of social support and the short- and long-term impact of stress on an individual which probably affects its health as well.

The Relevance of Companion Animals

Even though there is scientific evidence for how our social network is capable of providing us with resources to deal with stressors and reduce their immediate and long-term impact, getting access to these benefits might prove to be difficult for some individuals. For example, it has been observed that the diagnosis of severe illness can cause the withdrawal of close friends and family members due to the emotional strain it puts on them (Uchino, 2006). Considering this, the question arises whether there is a blind spot of sorts regarding the accessibility to social support.

And indeed, while research indicates that social support is usually provided by friends and family, it might be reasonable to remind ourselves that these do not have to be human necessarily: Companion animals are an important part of many households and, when asked, individuals claim their emotional relevance as close family members and friends (Allen, 2003; McNicholas et al., 2005). Furthermore, there appears to be evidence for the ability of pets to provide social support similar to humans (Allen, 2003; Herzog, 2011; Wells, 2007) or to elicit even better effects (Allen et al., 1991; Kertes et al., 2017; Polheber & Matchock, 2014).

Social Support: Humans vs. Dogs

While it might be intuitive that pets are capable of alleviating stress and providing health benefits, the possibility of companion animals to be more successful in reducing stress than close human friends may not. Despite seeming counterintuitive at first, the phenomenon of *evaluation apprehension* (APA, n.d.) delivers a reasonable explanation for why having a good friend present during a stressful event could enhance a stress response instead of ameliorating it. *Evaluation apprehension* means the inhibition of an individual's performance in the face of being judged by others due to the risk of a potential negative evaluation (i.e., performing a stressful task becomes even more stressful simply

because it is evaluated by others, causing the task to be more difficult). This inhibition can be enhanced even further if said evaluation rises in personal relevance, for example when one is not only judged by strangers but also by a close friend. If a close friend is seen as non-judgmental, however, this effect seems to cease (Allen, 2003). When it comes to pets, though, expecting them to be perceived as non-judgmental by nature makes sense. Thus, in the face of stressful situations where *evaluation apprehension* plays a part, pets could have a natural advantage over human friends when it comes to the amelioration of stress responses.

Also, although many pet owners subjectively attest to the beneficial nature of pet ownership regardless of whichever pet they own (e.g., from dogs to spiders), according to the main body of scientific literature, researching the effects of dog ownership on human health has been the main focus. Within the next sections, two corresponding studies shall receive further attention.

Dogs, Friends and Stress Responses in Women — Allen et al. (1991)

One of the earlier studies on the comparison of social support elicited by dogs and humans has been performed by Allen et al. (1991). Within this study, two distinct hypotheses have been examined.

First, the authors have hypothesized that, with regards to *evaluation apprehension*, participants' performance and stress reactivity during a stressor (i.e., a mental arithmetic task) is affected by the presence and nature of a support figure (i.e., their dog, a close female friend or no support at all). They expected participants to perform worse and exhibit a stronger stress reaction when accompanied by close friends compared to when with their dogs or alone. Second, and complementary to the first hypothesis, the researchers expected participants who had their dogs present during the mental arithmetic task to exhibit a weaker stress response than participants who had been with their friends or alone.

Methodically, Allen et al. (1991) examined a sample of 45 female dog owners (ranging from 27 to 55 years of age), first within a laboratory and afterwards within a field setting (i.e., the participants' homes). During the laboratory sessions, participants' stress reactivity in a mental arithmetic task was measured via changes in *skin conductance*, *systolic and diastolic blood pressure* as well as

heart rate and without assigning individual participants to a specific support condition (which has happened later on before the field experiment). The laboratory part has taken place in order to get a baseline measurement of stress reactivity and to allow for conclusions together with the field experiment regarding differences in stress reactivity and attesting them to specific support conditions.

After arrival at the facility, participants' consent has been obtained and a health survey has been performed in order to control for potential confounding aspects (i.e., diseases, disorders or intake of medication). Then, participants have been equipped with the necessary devices to record the physical stress correlates mentioned above, have received an instruction for the mental arithmetic task and have been asked to relax for five minutes during which a baseline of individual stress level has been assessed. The two-minute mental arithmetic task (i.e., serial subtraction by 7 with increasing difficulty) has been performed after the relaxation period. A second relaxation period of five minutes has taken place, measuring devices have been removed and arrangements have been discussed for the second part of the study: the field experiment.

During the field experiment at participants' homes, they have performed the same task and with the same measures being taken, but randomly assigned to one of three support conditions: close female friend, their dog or alone with the experimenter. Human friends have been assigned to support their friends however they see fit while being seated roughly one meter apart from them. Dogs within the dog condition have been allowed to freely move and interact with their owners during the experiment.

The results have confirmed both hypotheses: Participants' stress reactivity has changed significantly in comparison to their baseline reactivity with regards to the assigned support condition. Within the presence of their close friends, participants have shown a stronger physiological stress response and have committed more errors during the task than participants in the other two conditions. Furthermore, participants within the dog condition have exhibited a significantly weaker stress response than participants in the other two conditions.

This study has, therefore, shown that the nature of a present support figure (i.e., in this case a familiar dog or a close friend) affects the acute stress response in

female dog owners. Confirming the theoretical effects of *evaluation apprehension* on individuals mentioned above, the *stress attenuation effect* of dogs (i.e., the partial inhibition of a stress response due to the presence of a dog) has been shown, whereas the presence of close friends has even caused the opposite. Another study that has found similar effects with slightly different methods shall be looked into in the next section.

An Unfamiliar Dog, Cortisol and Heart Rate — Polheber & Matchock, 2014

Polheber & Matchock (2014) have conducted a study to assess how the presence of a human friend, an unfamiliar dog or no support figure affects participants' stress response. However, different methods in terms of stress measures taken, stress task used and overall frame of support conditions have been applied when compared to the study done by Allen et al. (1991).

First of all, it seems noteworthy that the sample of 48 participants has included both sexes (26 males, 22 females ranging from 18 to 20 years of age) and that the experiment has taken place in a laboratory setting only due to the stress task used. The question whether or not the inclusion of one or both sexes and different age groups might be relevant shall be discussed later on when a research proposal is being made. However, it shall be noted that, in the case of the study by Polheber and Matchock (2014), it seems that the differences in sex and age have not affected the results in terms of stress reactivity.

The stress task of choice has consisted of the *Trier Social Stress Test* (Kirschbaum et al., 1993). Same as with the mental arithmetic task mentioned before, the stressor has been embedded in between a baseline measurement part before the actual stressor and a cooldown period afterwards. However, different to Allen et al. (1991), these periods have lasted roughly 30 minutes while the stress task has taken 10 minutes in total due to the extended protocol of the TSST.

Also, in terms of measures used, the authors have included the *Form Y* of the *State-Trait Anxiety Inventory* (Spielberger et al., 1983) as a subjective measure to complement the use of physiological stress measures. Furthermore, they have used the *Pet Attitude Scale* (Templer et al., 1981) for participant inclusion and their physiological stress measures have consisted of salivary cortisol and heart rate. Cortisol has been assessed before the TSST, seven minutes after the stressor

and 30 minutes after the stressor and, lastly, a mean heart rate has been computed for the three phases (i.e., before, during and after the stressor) respectively.

Last but not least, while there have been three similar support conditions used in the present study, two key differences in comparison to the study by Allen et al. (1991) have taken place. For one, participants have already spent the baseline measurement part during the relaxation period before the TSST in a room together with their respective support figure, meaning they spent their baseline period with a friend, a dog or alone respectively. Regarding the dog condition, another alteration has taken place. Namely, not all participants have had to be dog owners and all of them have been accompanied by an *unfamiliar dog* (i.e., a 7 year old therapy-trained golden retriever named *"Jazz"*). However, similar to the aforementioned study (Allen et al., 1991), participants have performed the TSST in the presence of their assigned support figure as well. The notion of asking human support figures to act as they see fit in order to support their friends has been applied here as well.

Concerning hypotheses, Polheber and Matchock (2014) have postulated participants' heart rate during the TSST to predict their salivary cortisol levels during the cooldown phase, which they have been able to confirm. Also, the authors have hypothesized a *stress attenuation effect* regarding participants within the dog condition in comparison to the other two conditions which they have confirmed as well.

While this study seems to give further confirmation of the findings reported by Allen et al. (1991), it is noteworthy to point out their methodological similarities and differences, how they might influence conclusions or reveal potential knowledge gaps. Considering the latter, the studies performed by Allen et al. (1991) and Polheber and Matchock (2014) have focused on the aspect of *stress attenuation* as they have mainly aimed to reveal how the nature of a present support figure affects a participant's acute stress response. However, an argument can be made that Polheber and Matchock (2014) have actually mixed the aspects of *stress attenuation* and *stress buffering* within their support condition as *Jazz* and participants' respective friends have been present before *and* during the stress task. In consequence, this could raise questions about whether or not the effects which have been observed can be attributed to stress buffering, stress attenuation or the combination of these two aspects. On another

note, considering the study by Allen et al. (1991), one could argue that, while the different support conditions have been standardized in terms of support presence (i.e., a participant's respective support figure has been present only during the stress task), standardization as well as results could have been confounded by the fact of bringing participant's own dogs into the study instead of resorting to an unfamiliar dog. Arguments like these have inspired the following research proposal which takes up the aforementioned studies (Allen et al., 1991; Polheber & Matchock, 2014) and tries to make use of their promising aspects (e.g., used measures, dog condition) while slightly adjusting the potential methodical issues discussed above (e.g., standardization).

An Unfamiliar Dog and Stress Recovery — A Research Proposal

Although evidence has been found for *stress attenuation* (Allen et al., 1991; Polheber & Matchock, 2014), its assessment can potentially be confounded by *evaluation apprehension effects* and the fact that dogs could, by nature, be regarded as less evaluative than humans. Given this limitation, the examination of the other two aspects of social support which have been mentioned within the introductory section of this paper comes to mind: *stress buffering* and *stress recovery*. And despite pets potentially being able to induce both of these effects, animal-induced *stress recovery* seems to have received a lesser number of studies dedicated to it. Aside from this, the assessment of potential *stress buffering effects* comes with methodological difficulties. In order for these effects to take place, participants have to spend the period *before* a stress task in their randomly assigned support condition. However, if there happen to be significant group differences during as well as after the stress task, clearly attributing these to the different support conditions before the stressor is difficult.

In contrast to this, conclusions regarding potential *stress recovery effects* could be drawn with more ease. Participants would undergo the baseline period and the stress task *alone* and only spend the *cooldown phase* in the presence of a support figure. Significant group differences in stress measures taken during this phase could then be attributed to the difference in support conditions more clearly, given the standardization of baseline period and stress task.

Therefore, this research proposal will pick up the aspect of *stress recovery* as its main focus and include an unfamiliar dog for the *dog condition* for further standardization.

Given the fact that dog-provided stress recovery has received nearly no scientific examination so far, it is unclear if the presence of an unfamiliar dog affects a participant's stress recovery better than the presence of a human friend or vice versa. Interacting with a good friend after a stressor could cause a better stress recovery than being with an unfamiliar dog due to a friend knowing how to comfort their counterpart. On the other hand, talking to a friend right after a stress task could cause an individual to relive just experienced stress and/or feel evaluated (i.e., evaluation apprehension). Therefore, the research question will be as follows: Does the presence of an unfamiliar dog affect a participant's stress recovery after a stressor differently than the presence of a human friend? Given this research question, the following hypothesis can be articulated: An unfamiliar dog affects an individual's stress recovery after the Trier Social Stress Test differently than the presence of a human friend.

Participants

According to *GPower* (ANCOVA: Fixed effects, main effects and interactions, Effect size f = 0.25, $\alpha = 0.05$, Power = 0.95, Numerator df = 2, Number of groups = 3, Number of covariates= 2), a sample of 251 participants is suggested for this study. These participants should meet certain inclusion criteria considering sex, age, Pet Attitude Scale score (see below) and overall health condition while also being asked about giving their informed consent before being screened for their inclusion.

It is suggested to use a sample consisting of only one sex due to sex differences in stress reactivity (Allen et al., 2017) while also considering age differences in stress reactivity (Bale & Epperson, 2015). As female individuals experience more stress reactivity changes over the course of their lifespan and hormonal contraceptives might have even further influence, it appears to be more advised to have a male only sample. As male stress reactivity is also influenced by age, the age of included participants should range from 18 to 35 years.

Furthermore, the different support conditions should be taken into account when considering individual inclusion. Participants should have access to a good friend who would be willing to partake in the study (given an individual is randomly assigned to the human friend condition). The friend of choice does not have to meet specific inclusion criteria such as age or sex. Also, as participants

who are randomly assigned to the *dog condition* will be confronted with an unfamiliar dog, it is relevant to exclude individuals with respective phobias, allergies etc. and the *Pet Attitude Scale* (Templer et al., 1981) will be used for screening. Individuals who score below the 50th percentile of this scale should, therefore, be excluded.

Lastly, individuals will fill out a short health survey before inclusion to scan for conditions, disorders or medications which might influence their stress reactivity.

Materials

Support Condition

Individuals who meet inclusion criteria will be randomly assigned to one of three support conditions: *human*, *dog* and *no support*. Participants will spend the *cooldown phase* which will take place after the *stress task* (see below) in the presence of their assigned support figure.

Participants within the *human* support condition will be asked to bring a good friend to the scheduled date of the study. The friend in question does not have to meet any specific inclusion criteria. Within the *dog condition*, assigned participants will spend the cooldown phase in the presence of an *unfamiliar therapy dog* while, lastly, participants in the *no support* condition will spend their cooldown phase alone and thus act as the control group of this study.

Due to this design, the *only difference among groups* is the *type of support figure* present during the *cooldown phase*. This allows for clearer conclusions to be drawn considering potential *stress recovery effects* (see above).

Pet Attitude Scale (Templer et al., 1981)

The Pet Attitude Scale (PAS) is a self-report questionnaire which assesses an individual's attitude towards companion animals in terms of love and interaction as well as the joy of pet ownership. It consists of 18 items which are answered on a 7-point Likert scale. As an unfamiliar dog is an integral part of this study design, the PAS will be used for participant in- or exclusion. Following Polheber and Matchock (2014), the 50th percentile will resemble the cut-off value and participants who score below will not be included.

Trier Social Stress Test (Kirschbaum et al., 1993)

The Trier Social Stress Test (TSST) is a reliable and ethically justifiable stress task which is commonly used within the context of stress research and consists of two phases: an oral presentation and a mental arithmetic task. For this study design, the TSST will take place right after the *baseline period* (see below) and consist of a five-minute *preparation time* before the *oral presentation*, the actual five-minute *presentation* itself and a five-minute *mental arithmetic task* at the end, lasting 15 minutes at maximum.

Although participants will already have received mandatory information about the TSST at the beginning of the study, a more thorough instruction will be given before the task itself. Participants will be instructed to give a speech for a fictional job interview in front of a panel with the goal of convincing the panel that they are the best candidate for the job. The stress task will be held in a different room from where the participants will have spent the *baseline period* and contain a large table with two mix-gendered lab coat-wearing panel members behind it, a camera placed next to the panel, a small table with a chair in front of the panel where participants will be seated, facing the panel, and equipped with a sheet of paper as well as a pen for taking notes. Furthermore, and in accordance with the TSST protocol, the panel members will be instructed to be as unresponsive towards participants as possible while also following a provided script. All participants will be confronted with the same panel members.

Before the actual presentation, participants will be led to the room where the panel will be awaiting them, asked to take a seat and prepare for the interview however they see fit. Furthermore, they will be instructed that the presentation will be videotaped and that the panel will inform them before turning on the camera. After the preparation time is over, participants will be asked to turn down eventual notes while also being informed that the recording will be started (albeit, no recordings will be made).

After the presentation, the camera will be seemingly turned off and the second part of the TSST procedure will commence: the mental arithmetic task. The panel will inform participants that they will have to mentally perform a serial

subtraction task (i.e., serial subtraction of 17 starting from 2023) with the goal of reaching 0 without error. The panel will follow a script for this part as well.

State-Trait Anxiety Inventory — Form Y (Spielberger et al., 1983)

The State-Trait Anxiety Inventory (STAI) self-evaluation questionnaire assesses an individual's *state anxiety* (i.e., the subjective feeling of anxiety in a given moment) and *trait anxiety* (i.e., an individual's baseline anxiety level related to personality) whilst also differentiating between these two aspects. Participants will fill out the *Form Y* of the STAI — consisting of two 20-item scales with a 4-point Likert format — once at the end of each of the three phases of the procedure (i.e., at the end of the *baseline period*, right after the *stress task* and at the end of the *cooldown phase*) to provide a subjective stress measure.

Heart Rate

Heart rate is one of the most commonly used non-invasive measures to assess an individual's stress response (Allen et al., 2017; Crosswell & Lockwood, 2020; 2017; Polheber & Matchock, 2014) and will be used within this study design to provide one of two physical stress measures.

After arriving at the scheduled study date, participants will be equipped with a heart rate transmitter as well as a corresponding receiver in order to measure their heart rate during the procedure and to compute an *average* for *each of the three phases*, meaning computing an average heart rate for every 30 minutes of the experiment. Referring to Polheber and Matchock (2014), the Garmin wireless heart rate transmitter and the corresponding Garmin 305 Forerunner receiver (Garmin Ltd., Olathe, KS, USA) will be used.

Salivary Cortisol

Within the context of stress research, the inclusion of multiple physical correlates of stress is usually advised (Crosswell & Lockwood, 2020) and executed (Allen et al., 1991; Polheber & Matchock, 2014). Among those, salivary cortisol resembles another non-invasive physical stress correlate, making it a suitable second physical stress measure for this study.

During the whole experiment, salivary cortisol will be assessed at *three time points*. The first sample will be taken at the *end of the baseline period*, 30 minutes after beginning the study. The second sample will be taken *10 minutes after the end of the stress task*, meaning 55 minutes after the start of the

experiment. The third and final sample will be assessed at the *end of the cooldown phase*, thus 90 minutes after beginning the study.

Procedure

Following the screening phase, participants who have met inclusion criteria will be randomly assigned to one of the three conditions and invited to attend the study within a laboratory facility on a second date where the main study will take place. After arrival on the second date, chosen friends and corresponding participants will be separated. All participants will be informed about the procedure and the duration of each phase, albeit being told only necessary information considering the TSST in order to not affect their stress reaction to the stress task. Furthermore, they will be equipped with the Garmin wireless heart rate transmitter and the corresponding Garmin 305 Forerunner receiver (Garmin Ltd., Olathe, KS, USA) after which the baseline period will start.

Baseline Period

For this phase, participants will be asked to wait in a separate room. This phase will last for 30 minutes. All participants will spend this phase alone. At the end of this period, individuals will be asked to fill out the *Form Y* of the *State-Trait Anxiety Inventory* (STAI: Spielberger et al., 1983). Furthermore, the first salivary cortisol sample will be taken at the end of the baseline period.

Stress Task

Now, the first part of the TSST protocol will start and participants will be asked to take place in a different room where the job interview will commence. Individuals will then be guided to a room where the interview panel will be waiting and asked to prepare for the presentation. When the preparation time is over, participants will be asked by a panel member to put their notes facedown, a camera will seemingly be turned on and participants will be asked to start their five-minute presentation (participants will not be recorded but left under the impression). According to the TSST protocol, the panel members will be instructed to react to participants in a specific way (e.g., informing participants that they have more time left should they stop talking or to ask them certain questions) all while staying as unresponsive as possible.

When the interview is over, the seemingly recording camera will be turned off and the second part of the TSST protocol will begin which will consist of a five-

minute mental arithmetic task. Participants will be asked to perform a serial subtraction by 17, starting from 2023, with the goal of reaching 0 without making an error. The panel members will be instructed to interrupt participants when errors occur and ask them to start anew. The mental arithmetic task will end after five minutes or if a participant is able to reach 0 without errors. At the end of the TSST, participants will be guided to a third room and the *stress task* will be over.

Cooldown Phase

Right after arrival at the third room, individuals will be asked to fill out the STAI questionnaire a second time, the randomly assigned support conditions will take effect and the *cooldown phase* will begin, meaning that a human friend, an unfamiliar dog or no support figure will enter the room (according to the assigned support condition) and participants will spend the cooldown phase seated next to their respective support figure or alone. Participants in the *friend condition* will be reunited with their chosen friend and allowed to freely talk and interact with them, albeit abstaining from physical activity and/or smartphone use. The ones assigned to the *dog condition* will be introduced to an unfamiliar therapy dog which they are allowed to pet, give treats and talk to while abstaining from other physical activity and/or smartphone use. Individuals in the *no support condition* will be asked to wait for the duration of the cooldown phase while abstaining from physical activity and/or smartphone use.

10 minutes into the cooldown phase (i.e., 10 minutes after the TSST will have ended), a second saliva sample will be taken. The cooldown phase will last for 30 minutes, at the end of which the third STAI score and saliva sample will be taken, participants will be debriefed, compensated (e.g., € 15.00) and dismissed.

Data Analysis

As the sample will be divided into three groups, differing only in the type of support received during the *cooldown phase* of the experiment, the *support type* (i.e., human friend, unfamiliar dog or no support) will be the independent variable.

Furthermore, *stress recovery* will resemble the dependent variable and will be assessed via the *post-cooldown phase stress scores* (i.e., the third STAI, heart rate and salivary cortisol scores) whilst also controlling for *baseline and peak*

stress scores via adding them as *covariates* in order to prevent participants with above or below average stress reactivity to produce confounding effects.

Thus, a one-way design will be applied and data will be analyzed via One-Way ANCOVA. If the statistical test is significant and due to the undirected nature of the hypothesis mentioned (see above), post-hoc t-tests will be performed to see which of the groups significantly differ from the others. This study's hypothesis would receive confirmation if the *dog condition* significantly differs from the *human condition* and both of those significantly differ from the *no support condition* (i.e., the control group).

Discussion

The study proposal at hand is intended to test a non-directional hypothesis which has received little to no attention in corresponding literature: namely if the presence of an unfamiliar dog affects a participant's stress recovery after a stress task differently than the presence of a human friend does. Filling this knowledge gap could add to the current body of research concerning social support, how it is elicited by humans and animals alike, how it affects stress depending on its provision and, therefore, human health as well.

Still, this proposal poses certain limitations. First, the inclusion of only male participants within a relatively narrow age range might make sense from an internal validity perspective, however, this certainly reduces external validity of potential results because drawing conclusions for the broader population appears to be questionable. Furthermore, including only two biomarkers of stress (i.e., cortisol and heart rate), although scientifically relevant ones (Crosswell & Lockwood, 2020), only sheds light on two narrow aspects of the human stress response which consists of many aspects. In any case, it seems reasonable and promising to wish for future research within this field to include many and diverse aspects of the human stress response in order to infer conclusions within a broader context and to answer vastly different questions (see www.stressmeasurements.org).

Despite its limitations, the proposed study might complement what is already being known on pet-provided social support. The phenomena of stress and social support certainly are of everyday relevance for human life and getting to know

more about how they interact with one another can come a long way in regards to human health and well-being.

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