The Effects of Social Support During and After TMT Stress in Prairie Voles

Duration of Project: 10 weeks

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A. The Research Question

Social support can protect you from the negative consequences of stress, but does it matter if this support is provided during or after the stressful event? Answering this question will help us understand how best to support people as they experience stressful events like medical procedures or sharing difficult news. Social support is powerfully protective. This experiment will provide an essential foundation for a series of experiments that will help us better understand *why* and *how* social support is helpful.

Loneliness has been shown to be an important factor when it comes to mental and physical health. It has been linked to sleep problems, depression, low self-esteem, cardiovascular difficulties and many other biological and psychological issues in humans and other animals that form social bonds (Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004)(Grippo et al., 2009). Having meaningful social bonds, on the other hand, has shown positive outcomes such as longer life span, reduced depression, increased emotional maturity, and a strong ability to buffer stress (Berkman & Syme, 1979)(Manne et al., 2018)(Meuwly et al., 2012). Stress, generally, is an event or factor that disturbs the resting state of the body, and results in the release of a chemical called cortisol or corticosterone (CORT) that stays elevated in the bloodstream until the body can return back to prestress conditions over time (de Kloet, Joëls, & Holsboer, 2005). Social support via the presence of a partner has been shown to buffer stress by reducing CORT levels and reducing recovery time from the stressor. This buffer from stress via a partner has been demonstrated in humans and animals including prairie voles, a highly social mamman especially suited for studies of social support (Meuwly et al., 2012)(Smith & Wang, 2014).

The presence of a supportive partner during a stressor reduces physiological responses to stress in humans. Studies have examined how social support affects stress coping abilities both during the stressor and in recovery from the stressor. In Meuwly et al. (2012), humans were put through the stressful task of public speaking and then were allowed to recover with or without a partner. Participants that were allowed to recover with a supportive partner recovered from the stress more quickly. Another study with humans examined stress responses of people while they completed a difficult timed math test with or without a partner. When participants had a supportive friend during the stressor, they had reduced blood pressure reactivity compared to the participants with no partner or those who had a stranger as a partner (Phillips, Gallagher, & Carroll, 2009). Thus, data shows that social support is beneficial both during and after a stressor has been administered, but is one better at buffering the effects of stress? Here, I propose an experiment to investigate the effects of social support during and/or after a stressor, which will give insight as to ideal timing of social support, and will provide critical information for designing my future experiments on the underlying neuroscience and physiology of the protective effects of social support.

Studies in animals have also investigated the social buffering of stress, but typically these studies have focused on social support during *recovery from* stress, rather than during stress. In a study by Smith and Wang (2014), prairie voles that recovered with a partner following restraint stress (in which they were immobilized in a tube that prevented any movement) had lower levels of CORT and displayed fewer anxiety-related behaviors than animals that recovered alone. Similarly, social isolation resulted in elevated CORT levels in mice, but being

returned to a partner led to rapid recovery of CORT levels (Hodges et al., 2014), suggesting that the presence of a partner facilitates recovery from stress.

Animal studies have rarely focused on the benefits of social support *during* a stressor. This is likely due to the difficulty of testing an animal with a partner in the most typically used stressors, such as restraint stress or a forced swim test, in which only one animal can be placed in the apparatus at a time. Another shortcoming of the most frequently used stressors is that they are not realistic to a vole's natural environment. They wouldn't encounter these stressors in the wild; therefore, these stressors would not have played a role in shaping stress physiology and behavior in these animals throughout evolution. TMT, a chemical that is extracted from fox feces is a stressor that relevantly simulates stress responses in prairie voles because foxes are a key predator for prairie voles. TMT has been shown to work as an intensive natural stressor in rodents for whom foxes are a natural predator (Janitzky, D'Hanis, Kröber, & Schwegler, 2015)(Morrow, Redmond, Roth, & Elsworth, 2000). Thus, TMT exposure is an ecologically relevant stressor in which the highly social prairie vole can be tested alone or with a partner.

The goal of my experiment is to determine if social support during TMT exposure, during *recovery from* TMT exposure, or throughout TMT exposure *and* recovery is most beneficial. We predict that having a partner during *and* after a TMT exposure will result in the lowest stress-induced CORT level and the fastest CORT recovery, as well the fewest anxiety-related behaviors compared to having a partner during either exposure *or* recovery, but that having a partner at any point will be beneficial. Once I have defined the optimal timing for the social buffering of stress, I will conduct follow-up experiments in the 2021-2022 academic year aimed at identifying the biological mechanisms responsible for the benefits of social support.

B. Project Description

The prairie voles will be randomly assigned to one of four experimental conditions (12 male and 12 female animals per condition): 1. isolated during stressor; paired during recovery, 2. isolated during stressor; isolated during recovery, 3. paired during stressor; paired during recovery, 4. paired during stressor; isolated during recovery. The stressor will consist of 30 minutes exposure to TMT. Blood samples will be taken the day before the experiment to establish a baseline level of CORT. Twenty-four hours later the voles will be placed with or without a partner into a chamber containing a piece of filter paper to which TMT has been applied. At the end of the 30 minute exposure, another blood sample will be taken to examine peak stress response CORT levels. Animals will then be moved to a clean cage where they will recover with or without a partner for another thirty minutes. Afterwards, a third and final blood sample will be collected to assess recovery of CORT levels. CORT will be measured using a radioimmunoassay. Each trial will be video recorded to observe and analyze behavioral responses to stress, such as digging and rearing, and also to observe social behavior, such as side-by-side contact and grooming, for those that have a partner.

My research will be conducted in Dr. Stevenson's lab over a 10 week period at Bucknell University. I am currently getting a half credit for doing work in Dr. Stevenson's lab this semester in order to learn how to perform all of the necessary methods to carry out this experiment successfully. Some of these techniques include handling prairie voles, caring for prairie voles, analyzing prairie vole behavior, collecting blood from prairie voles, proper lab safety and techniques, data analysis, ethics, and experience dissecting primary literature. The prairie voles will be able to start the experiment as they reach 7 weeks old, so animals will be randomly assigned to a treatment group and then tested as they come of age. We will be testing

96 prairie voles throughout the experiment as to test males and females and have a meaningful sample size for each condition. Animal testing will take approximately 8 weeks. This will leave two weeks for CORT analysis. I will be able to analyze videos and begin writing the background section for the publication of these data during the 8 week animal testing period. I will complete the preparation of a manuscript during the following semester.

C. Research Value

Stress is a necessary part of life. Typically, CORT levels increase and then after the stressful event they come back down to normal levels. However, increasingly, people are not able to cope with stress effectively, partly due to increased incidence of social isolation (de Kloet et al., 2005). As a result of ineffective stress coping, people experience higher occurrences of the flu, decline in cognitive ability, increased risk of heart disease, and earlier death (DeLongis, Folkman, & Lazarus, 1988)(Marshall, Cooper, Segrave, & Geeraert, 2015)(Low, Salomon, & Matthews, 2009). Until recently, psychologists and health professionals have tended to focus on individual factors that improve stress coping. However, as a growing body of research has shown the extreme negative consequences of social isolation, greater focus is moving to the powerful role of social connections in stress coping. I am excited to begin studying how social support helps us get through the trials of life. Understanding when social support is most beneficial will help us find better ways to assist people through stressful situations, and also give us some insight into how and why social support is helpful.

In the future, I aspire to get my Ph.D., possibly in clinical psychology. The work I do in this and follow up experiments will give me a great foundation in the importance of social support in physical and mental health. Regardless of what aspect of clinical psychology I choose to study, the topic of social support is certain to be relevant. The skills I learn working on this independent project will help me build my research skill set, and allow me to determine if a career in clinical research is the right fit for me. Having conducted my own research and immersed myself in full-time lab work, and publishing this study will make a big difference for getting into a Clinical Psychology program, which is often said to be more competitive than medical school. Most importantly, I am excited that my work might lead to new techniques and methods of helping people. Findings from this and future experiments could help those who suffer from stress-related disorders and also help find preventative treatments that postpone or even eliminate the negative health effects associated with stress.

D. Sharing the Results

The results of this study will be included in a manuscript for submission to the peer-reviewed journal, *Physiology and Behavior* or *Psychoneuroendocrinology*, along with being presented at the Kalman Research Symposium.

E. Faculty Mentoring Relationship

I will be meeting with Dr. Stevenson on a daily basis throughout the 10 week period. Dr. Stevenson will be readily available to assist me with any questions I have and to lead me through any procedures needed in this experiment. Together we will discuss how to analyze primary literature, the ethical treatment of animals, and the importance of proper research techniques. We will also have weekly lab meetings where I can practice sharing my research progress and data and get feedback on my work.

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