The Roles of Oxytocin and Vasopressin in Modulating Caregiver Responses to Juvenile Marmoset Monkeys

Allison Mace

Background and Description of Project. The expression of parental care is very important in humans, marmoset monkeys, and biparental rodents. Biparental care (care given by both parents) contributes to more surviving offspring, because parental care is split between the mother and father (Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010; Storey and Ziegler, 2015). Like humans, marmoset monkeys participate in monogamous pair bonds where both parents and siblings (alloparents) provide care for infants (Nunes, Fite, Patera, & French, 2001). A very important neuropeptide called oxytocin (OT) plays a part in parent-offspring interactions among humans, marmosets, and rodents alike. OT increases social behavior. (Bales and Saltzman, 2015; Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010). Many studies have described the effects of OT on parental behavior in the neonatal care period, but fewer have studied parental care behavior that extends into adolescence. My study will investigate the extended parental care behavior of food sharing, and how it is affected by oxytocin and its sister peptide, arginine-vasopressin (AVP).

Marmosets with young often participate in “food sharing,” which takes place when an adult marmoset allows an infant or pair mate to take food from its hands or mouth. OT has been found to increase the likelihood of food sharing between father marmosets and juvenile offspring (Saito and Nakamura, 2011), but no data is available that describes how OT affects mother, brother, and sister marmosets’ food sharing. When interacting with their pair mates, marmosets had increased prosocial behaviors and were more likely to participate in food sharing when given OT. When given oxytocin receptor antagonists, marmosets had decreased social interactions and would not share any food with their mates (Smith, Agno, Birnie, and French, 2010). It has been found that marmosets have a functional mutation in the oxytocin gene, resulting in a previously unknown OT variant (Pro8-OT; (Lee et al., 2011). Up until this was discovered, researchers conducting behavioral research involving marmosets used the human coding of OT (Leu8-OT).

My project will replicate and expand on Saito and Nakamura’s (2011) study. Saito and Nakamura took father marmosets and administered Leu8-OT or an OT receptor antagonist. Then, the father and his infant were placed in a cage in which only the father had access to the food provided. Behaviors such as sharing food, refusal to share food, and vocalizations were analyzed. From these observations it was concluded that OT increased the likelihood of food sharing.

Saito and Nakamura only studied father marmosets and omitted the populations of mother, brother, and sister marmosets. Also, it only analyzes the effects of Leu8-OT of and the OT receptor antagonist, instead of incorporating Pro8-OT and AVP. AVP is a sister peptide of OT, and has the same genetic coding in both humans and marmosets (Lee et al., 2011). In my study I will analyze data gathered using male and female parent and sibling marmosets given Pro8-OT, Leu8-OT, AVP, and a saline control. I will give an adult marmoset either Pro8-OT, Leu8-OT, AVP, or a saline solution (control) through intranasal drops. I will then put the adult and the infant marmoset in a cage together. The adult marmoset will receive a Cheerio and will then be observed as the infant marmoset tries to take the Cheerio. My study will provide a model for marmoset parent-juvenile care behavior, and can be applied to human parent-adolescent behavior since they co-occur.

Contribution to the Field. As stated above, my study will replicate and expand on Saito and Nakamura’s (2011) study. Very little is known about the effects of OT and AVP on nonhuman primate social behaviors, and even less is known about how OT and AVP affect the behavior of marmoset mothers and alloparents. Extended parental care is not often studied in nonhuman primates or rodents. Rodents don’t participate in very much extended parental care, but humans and marmoset monkeys do.
My study will also yield information about all of these unknowns and could provide insight into similar complex behaviors in humans. The marmosets’ food sharing can be used as a model for human parent-adolescent care behavior, since they co-occur.

**Methodology and Timeline.**

**Behavioral Testing**

This project will be a part of a larger study examining the roles of the neuropeptides OT and AVP in modulating family relationships (IACUC # 15-005-04-FC). Specifically, I will test the effects of Pro\(^8\)-OT, Leu\(^8\)-OT, and AVP on parents’ and alloparents’ food sharing to juvenile/adolescent offspring. I will be using 14 “caregiver” marmosets (6 parents, 8 alloparents) and 5 “stimulus” marmosets (i.e. youngest offspring) from three families in UNO’s marmoset colony. Marmoset parents share food with older offspring (7-9 months of age) less than they do to younger offspring (Saito et al., 2008). Because I predict that OT and AVP will enhance food sharing to juveniles, I will use “stimulus” monkeys aged 7-9 months in order to maximize the potential for increases in food sharing. Each day of testing will proceed as follows:

Before each testing session the caregiver (either parent or alloparent) will be caught and treated with Pro\(^8\)-OT, Leu\(^8\)-OT, AVP, or saline control. Then I will wait 20 minutes to allow uptake. The caregiver and offspring will then be isolated within the home cage, and the caregiver will be given a Cheerio. The offspring will be allowed to interact with the caregiver, and behaviors like food sharing, begging, refusal, and vocalizations will be observed. Each session will consist of ten trials. This will be repeated over the course of several weeks for a total of four food sharing sessions per caregiver monkey, one for each neuropeptide treatment in a counterbalanced order.

I will be assisted in administering the OT and AVP through intranasal drops by my faculty mentor or an experienced graduate student. I will be using the same dosage that these marmosets in this lab are given for every research project involving oxytocin (Cavanaugh et al., 2014). My timeline will be as follows:

<table>
<thead>
<tr>
<th>January to March 2016</th>
<th>Behavioral testing- I will be testing the family group with the oldest juvenile marmosets from January to February and the family group with the youngest juvenile marmosets from February to March.</th>
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<tr>
<td>March 2016</td>
<td>I will present my preliminary results at UNO RCAF.</td>
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<tr>
<td>April to May 2016</td>
<td>Data analysis- I will analyze my data and results in more depth.</td>
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**Data Analysis**

I will be using a repeated measures ANOVA design for this study. I will also use data from the larger overall developmental study to enhance results and interpretation.

**Student/Faculty Mentor Roles.** My role as a student will be to collect and analyze data from the marmoset monkeys. Dr. Jeffrey French will be my mentor, and he will supervise, answer any questions I may have while conducting this research, and make sure the project is being carried out properly.

**Budget Justification.** I am requesting a total of $2500 for this research project. Five hundred dollars will be used to purchase supplies for the project such as OT and AVP, and $2000 will be used as a student stipend to cover the 200 hours I will be spending on this project, which equals ten dollars per hour.
References


10/12/2015

TO: FUSE Award Committee
FR: Jeffrey A. French, Varner Professor of Psychology and Biology
RE: Letter of reference, Allison Mace

I would like endorse Allison Mace’s application for an FUSE Award. Allison has been working in my lab for several months, and shows exceptional promise as a researcher.

I would be delighted to mentor Ms. Allison Mace in her project, which will examine food sharing from adult caregivers to their juvenile offspring and siblings in marmoset monkeys, and the modulation of this behavior by oxytocin and vasopressin. Allison has worked in the marmoset lab for over three months, and she has participated in behavioral data collection in addition to her participation in routine husbandry procedures.

During this project, she will learn first-hand how to design, carry out, and analyze a behavioral pharmacology experiment in its entirety. Our lab has been investigating oxytocin-mediated social behavior for several years, and Allison’s work is aimed at exploring the effects of manipulating neuropeptides at a specific developmental stage (juveniles) and in a social context (active and passive food sharing) that has not yet been studied in my laboratory. Allison’s project will nicely complement the other work that is being done in the lab, serve as important pilot and preliminary data for grant proposals in the near future, and will fill an important niche in our research program.