



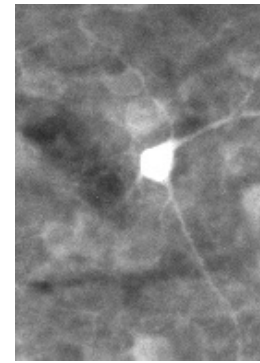
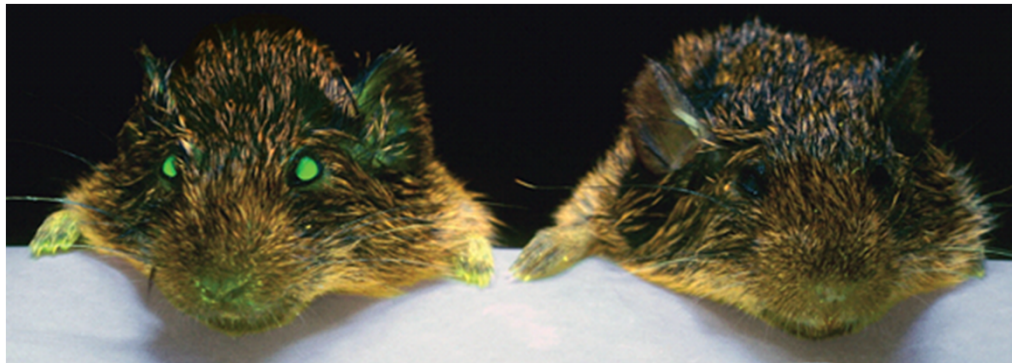
Neurobiology Of Grief International Network (NOGIN)

presents

SOCIAL NEUROSCIENCE OF GRIEF: 2020 VISION

January 24 - 26, 2020

Behavioral metrics of bonding and loss: the prairie vole model



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Overview

1. Origins of NOGIN
2. Prairie voles as a model for pair bonding and loss
3. Measuring pair-bond directed motivation
4. Partner separation results in distress (more from Oliver Bosch)
5. Evidence for adaptive/recovery processes following bond loss

1. Origins of NOGIN



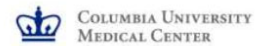
The Sackler Institute for Developmental Psychobiology
Columbia University College of Physicians & Surgeons



Kathy Shear



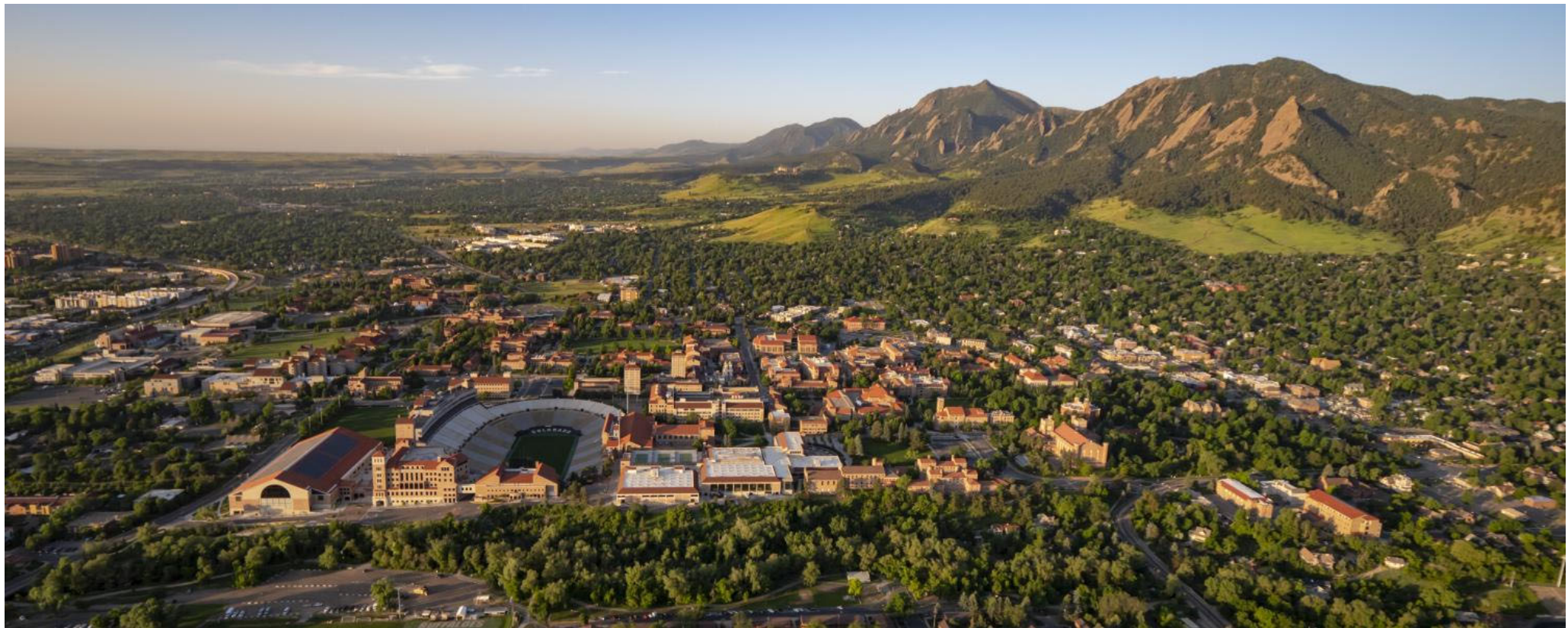
Harry Shair



IRVING INSTITUTE FOR
clinical and translational research

SEVENTH ANNUAL REQUEST FOR APPLICATIONS

Phase I: Planning Grants for
Collaborative and Multidisciplinary Pilot Research (CaMPR)



Mary-Frances O' Connor takes the reins!



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Construct: Loss

RDoC Classification

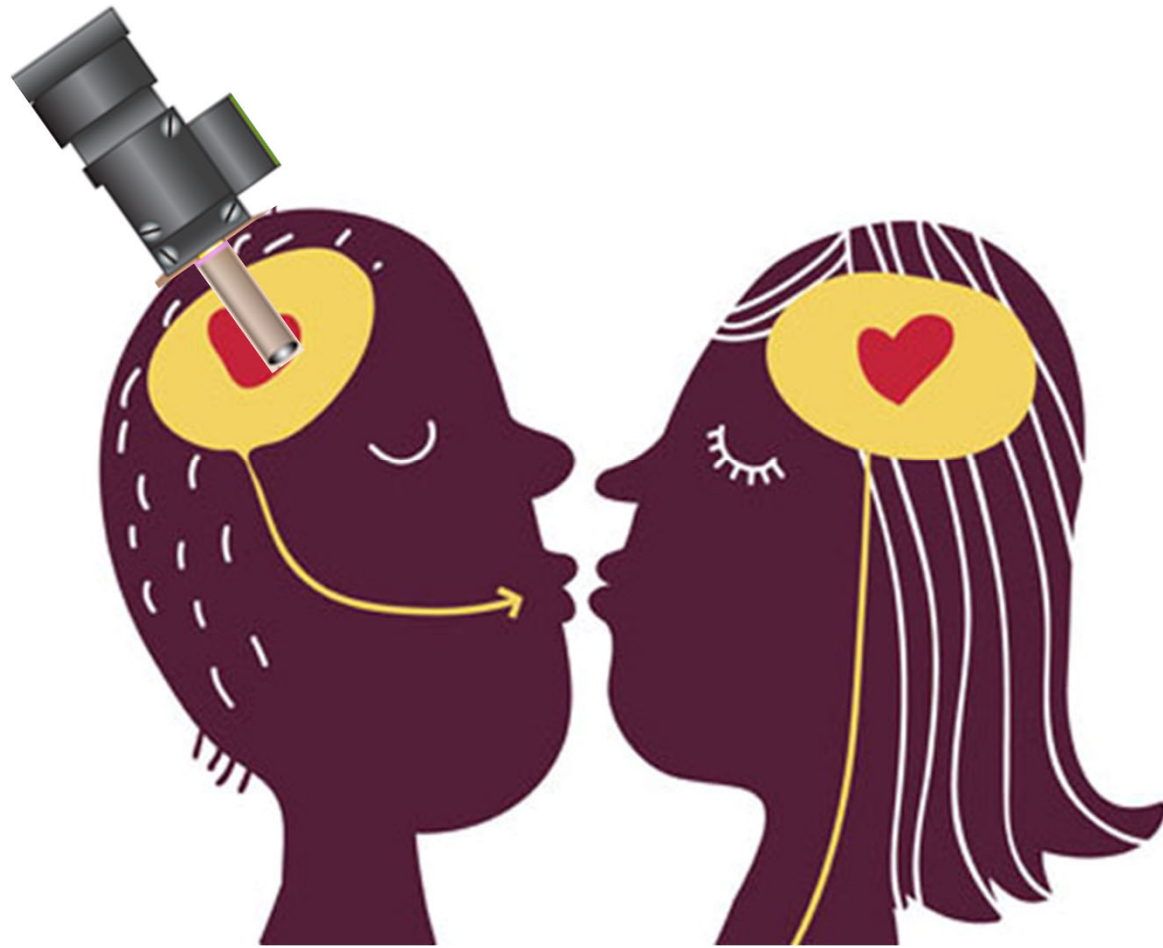
Domain: Negative Valence Systems

Description

A state of deprivation of a motivationally significant con-specific, object, or situation. Loss may be social or non-social and may include permanent or sustained loss of shelter, behavioral control, status, loved ones, or relationships. The response to loss may be episodic (e.g., grief) or sustained.

2. Prairie voles as a model for pair bonding as a form of adult attachment







Mice don't pair bond

Construct: Affiliation and Attachment

RDoC Classification

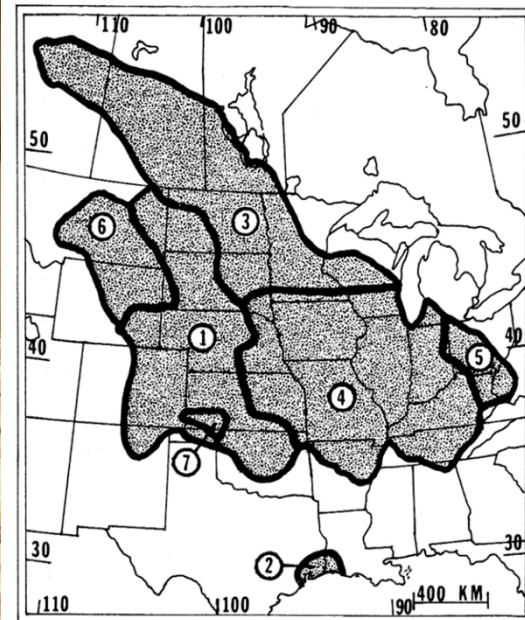
Domain: Social Processes

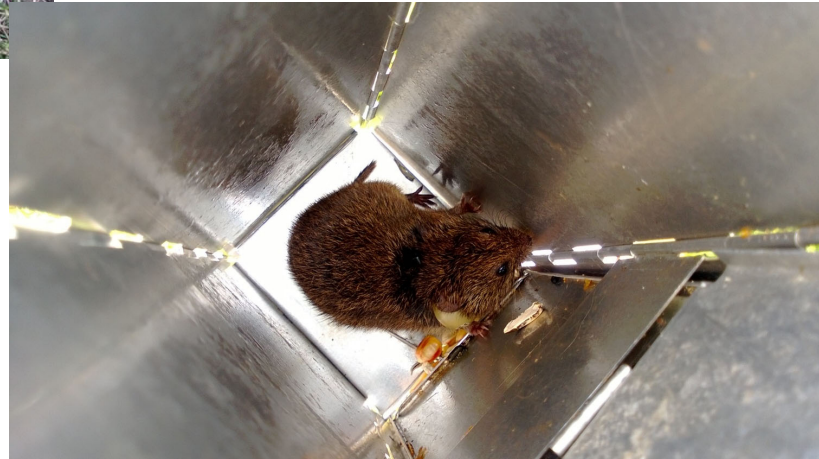
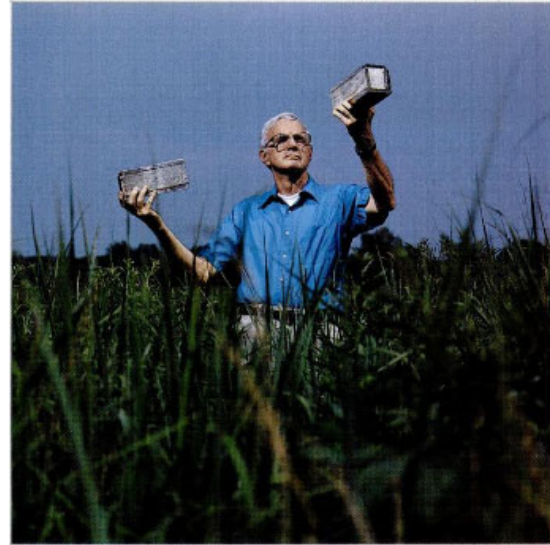
Description

Affiliation is engagement in positive social interactions with other individuals. Attachment is selective affiliation as a consequence of the development of a social bond. Affiliation and Attachment are

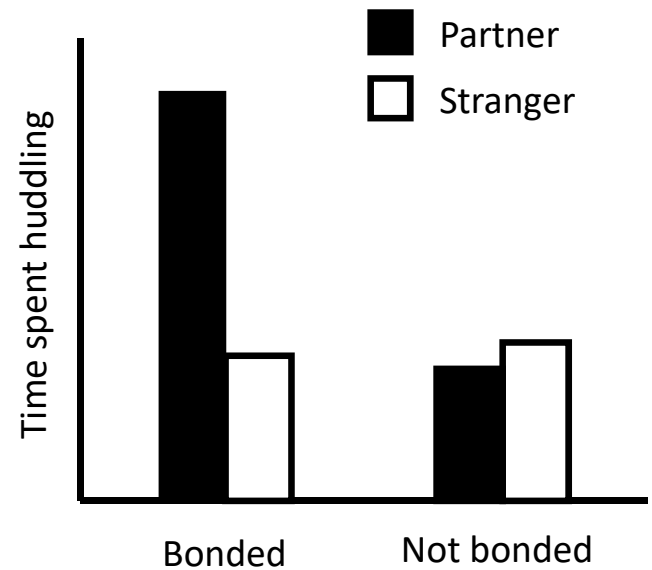
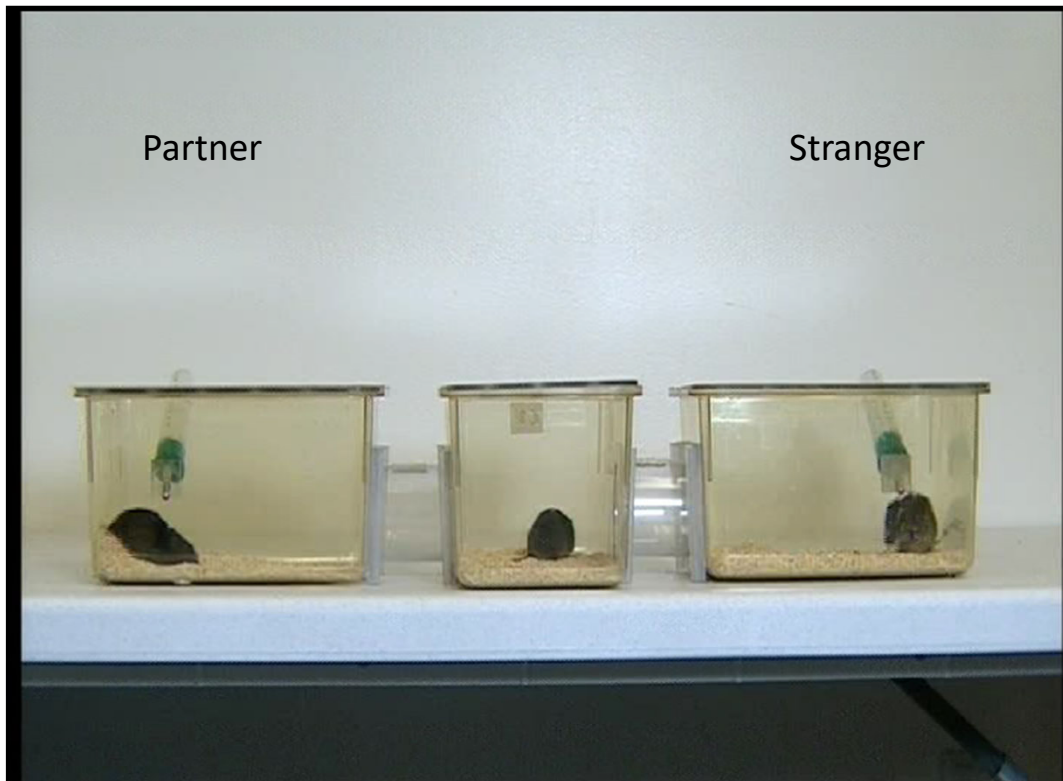
“For such a large number of problems there will be some animal of choice, or a few such animals, on which it can be most conveniently studied.” -August Krogh

Prairie Vole (*Microtus ochragaster*)

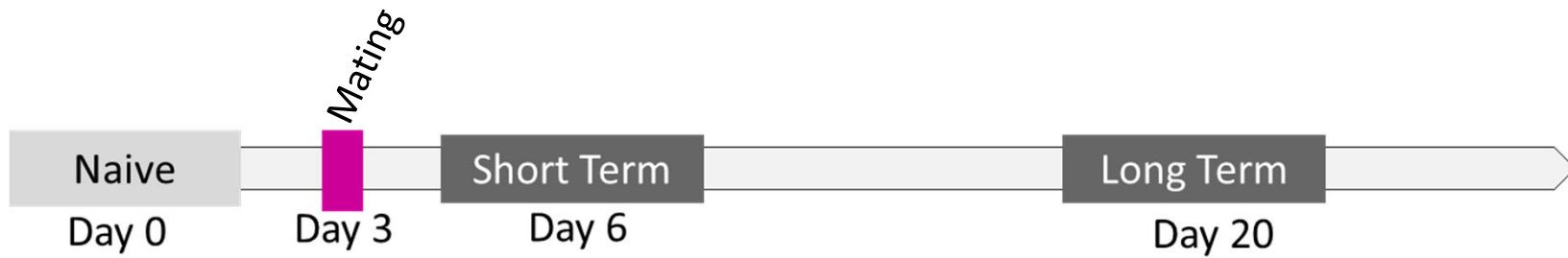




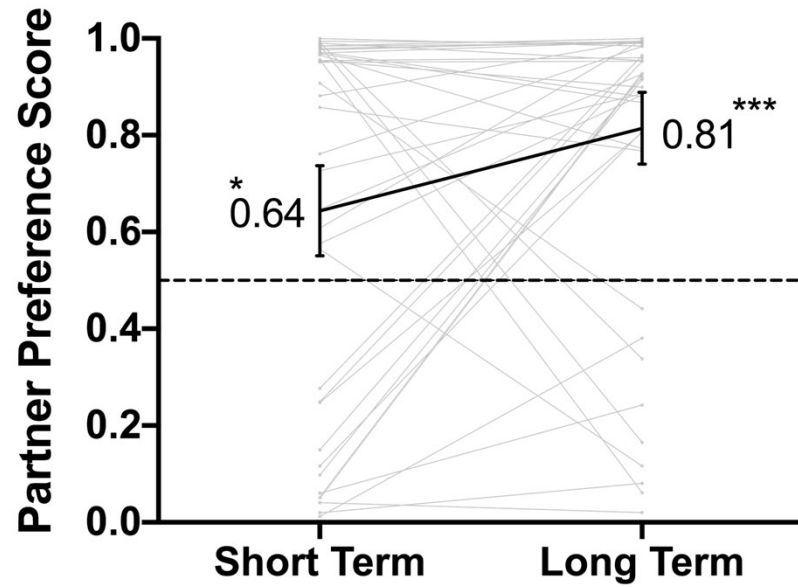
How can you tell if a rodent has formed a bond?



Pair bonds strengthen with time



Another example...



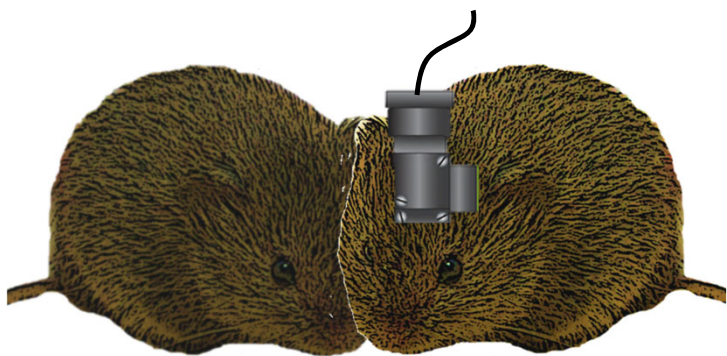
Pair bonding elicits selective aggression



Summary and considerations

- Pair bonding results in large changes in social behavior in voles.
 - Development of a selective affiliative mate preference
 - Onset of selective aggression
- Selective nature of the bond provides opportunities to examine pair bond disruption (loss).
- Arguably, behavioral assessment of bond formation and loss are not as well developed as in humans.

3. Measuring the motivation to reunite with a partner



Partner preference does not really quantify motivation.





Courtesy of Kayla Siletti

How can we use operant tasks to gain insight into bond-directed motivation following loss?

- We can use this to study something that isn't there!
- Recreate the frustrative non-reward inherent in the impossibility of reunion.

Will I ever
see you
again?



by Kayla Siletti

Summary and considerations

- Prairie voles will exert effort to reunite with their partner.
- A given vole's motivation for reunion is not correlated with their preference score.
- Novel operant task enables real-time, time-locked examination of neural dynamics.
- Much behavioral characterization remains
 - social choice in an operant task
 - how we can measure motivational changes resulting from pair bond disruption?

4. Separation distress following pair bond disruption

Forced swim test



Tail suspension test



Limitations:

Not naturalistic

Translational relevance?

Acute SSRI treatments reverse passive coping behaviors in this test

The CRF System Mediates Increased Passive Stress-Coping Behavior Following the Loss of a Bonded Partner in a Monogamous Rodent

Oliver J Bosch^{*1}, Hemanth P Nair², Todd H Ahern², Inga D Neumann¹ and Larry J Young²

¹Department of Behavioural Neuroendocrinology, University of Regensburg, Regensburg, Germany; ²Department of Psychiatry, Center for Behavioral Neuroscience, Yerkes National Primate Research Center, Emory University, Atlanta, GA, USA

Autonomic Neuroscience: Basic and Clinical 180 (2014) 9–16



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Contents lists available at ScienceDirect

Autonomic Neuroscience: Basic and Clinical

journal homepage: www.elsevier.com/locate/autneu



Disruption of social bonds induces behavioral and physiological dysregulation in male and female prairie voles

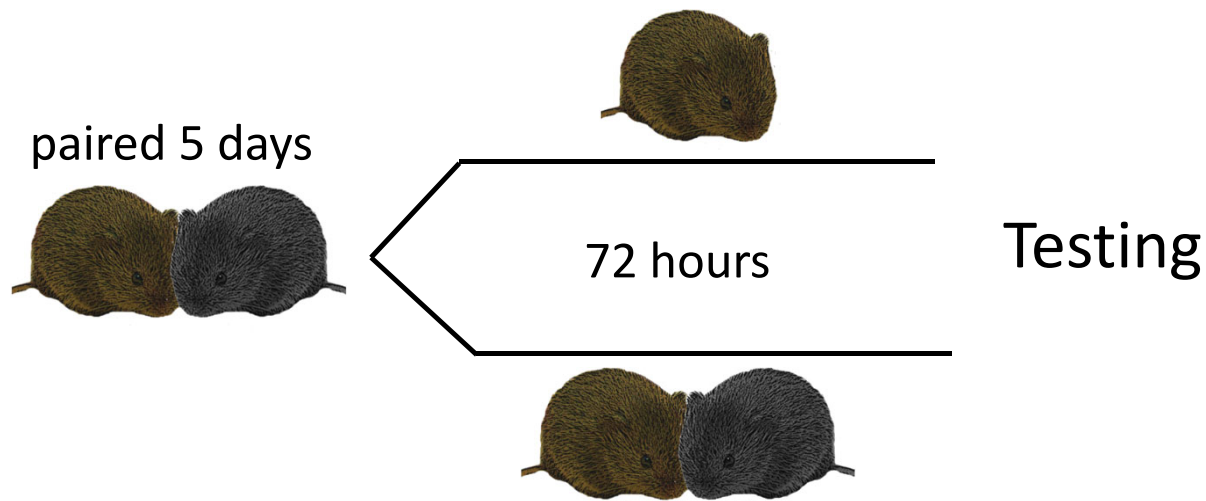


Neal McNeal^a, Melissa-Ann L. Scotti^{a,b}, Joshua Wardwell^a, Danielle L. Chandler^a, Suzanne L. Bates^a, Meagan LaRocca^a, Diane M. Trahanas^a, Angela J. Grippo^{a,*}

^a Department of Psychology, Northern Illinois University, United States

^b Department of Psychiatry and Brain Body Center, University of Illinois at Chicago, United States

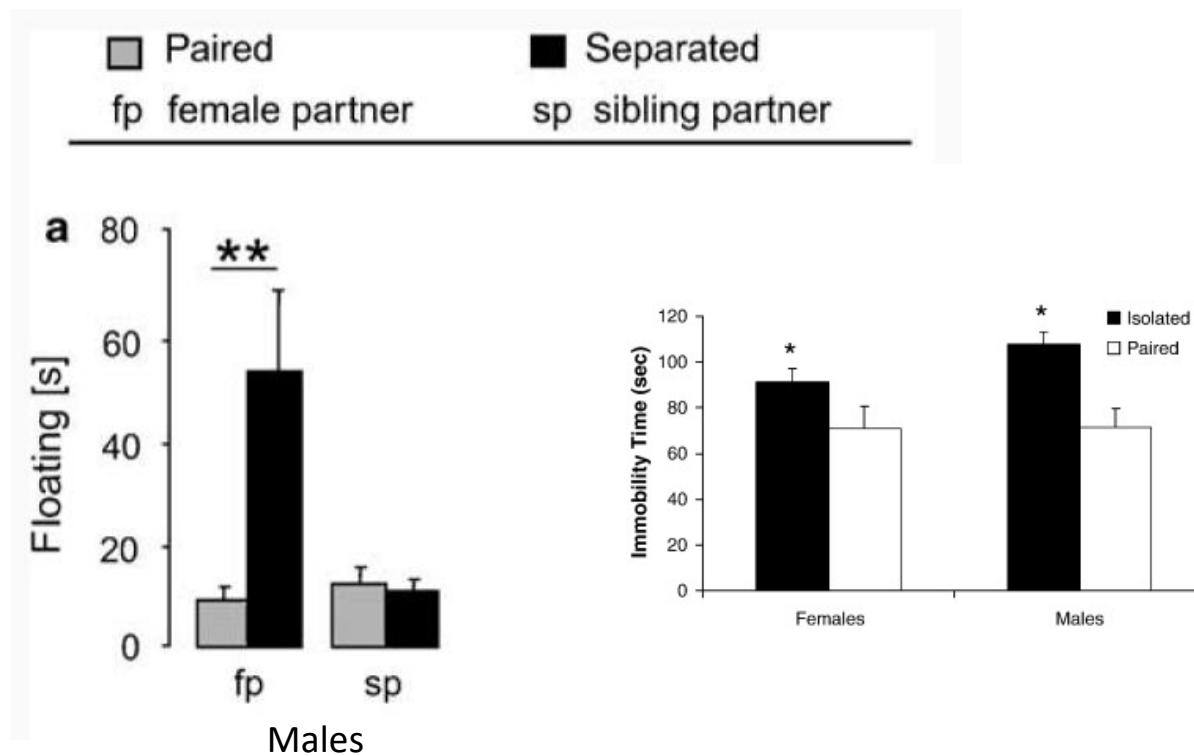
Study design considerations



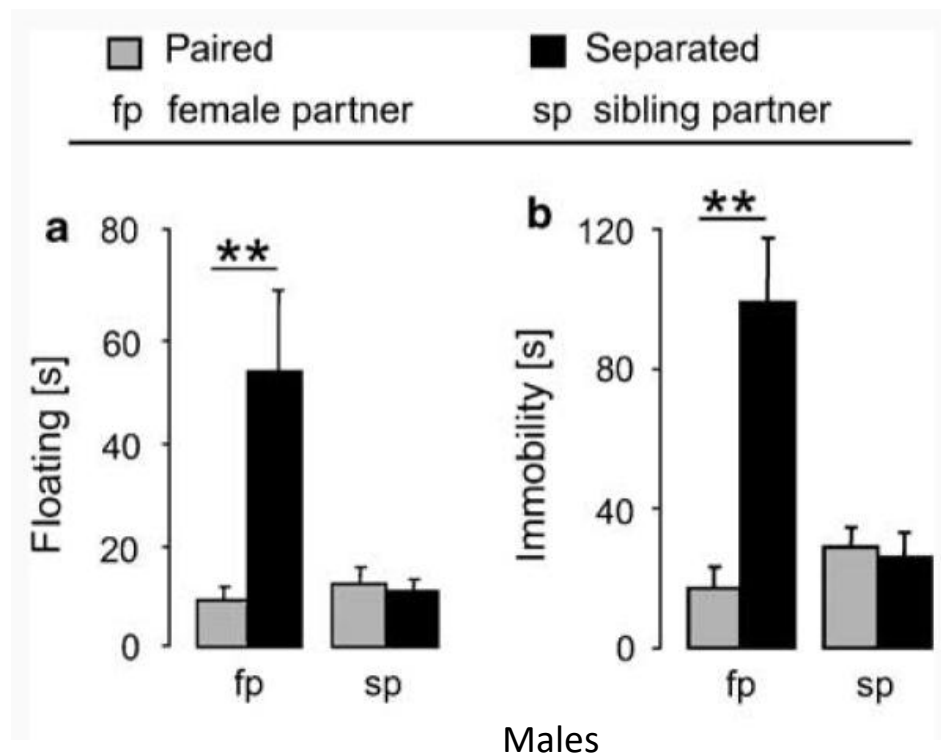
How do we know
it's not just social
isolation?

Repeat with same sex separation

Only pair bond separated animals show separation-mediated increases in passive coping



Only pair bond separated animals show separation-mediated increases in passive coping



Summary and considerations

- Pair bond disruption results in stress coping changes that are not evident following same-sex separation, suggesting that pair bond disruption is substantively different than social isolation alone.
- Provides validity for model by supporting the hypothesis that pair bond disruption is traumatic/stressful.
- Time course of recovery from stress effects is unknown.

5. Adaptation/recovery from bond loss

Behavioural Brain Research 265 (2014) 22–31



Contents lists available at ScienceDirect

Behavioural Brain Research

journal homepage: www.elsevier.com/locate/bbr



Research report

Breaking bonds in male prairie vole: Long-term effects on emotional and social behavior, physiology, and neurochemistry



P. Sun^{a,b,1}, A.S. Smith^{b,1,2}, K. Lei^b, Y. Liu^b, Z. Wang^{b,*}

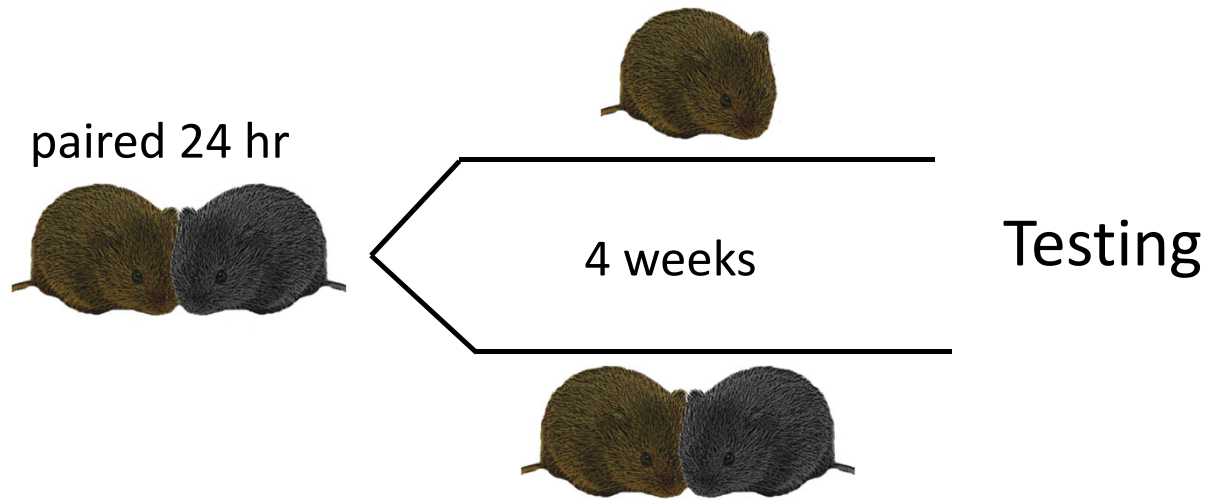
^a Animal Academy of Scientific and Technology, Henan University of Science and Technology, Luoyang 471003, China

^b Department of Psychology and Program in Neuroscience, Florida State University, Tallahassee, FL 32306, USA

HIGHLIGHTS

- Male prairie voles express bond loss via increased stress behavior and physiology.
- Partner loss disrupt bond-related behavior in a time-dependent manner in male voles.
- Partner loss alter neuropeptide systems involved in vole pair bonding.
- We review the distinct effects of social isolation and bond loss in voles.

Study design considerations

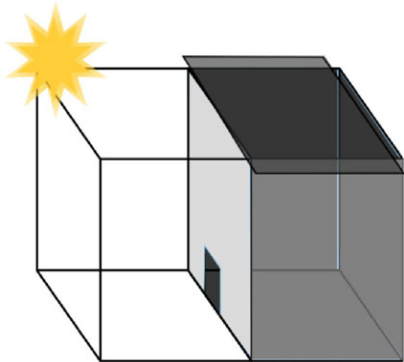
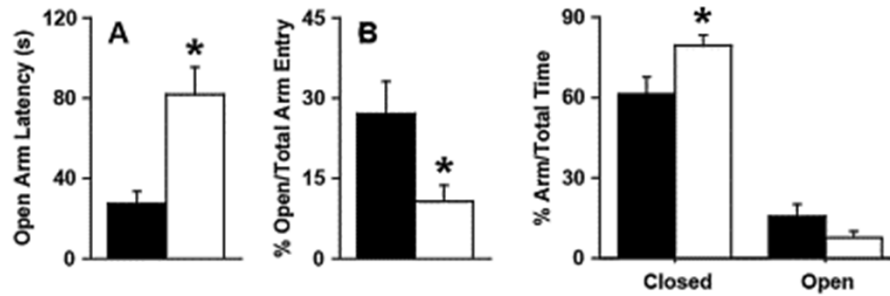


No data on same sex separation

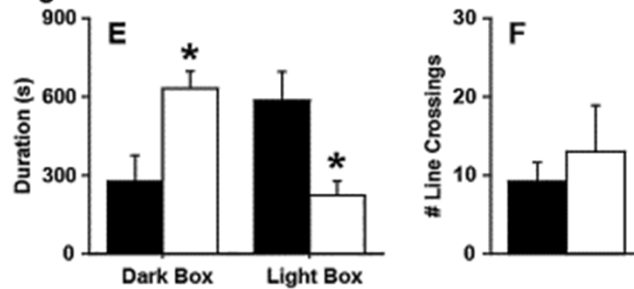
Replication of anxiety effects in separated males



Elevated Plus Maze



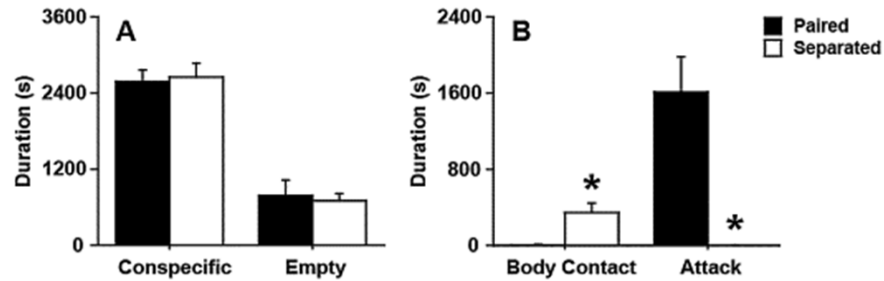
Light Dark Box



Take home: Separated males spend less time/entries in anxiety-provoking parts of the arena

Separated males display more affiliative and less aggressive behavior towards novel voles

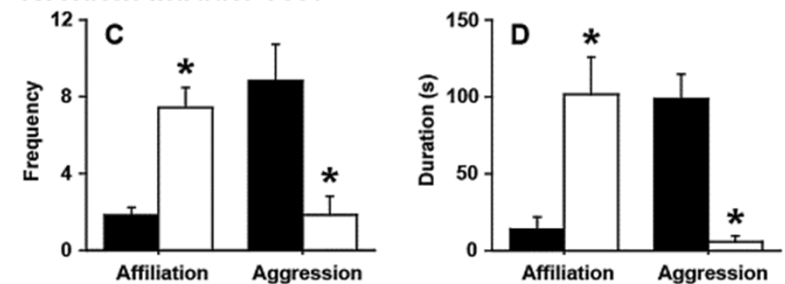
Affiliation Test



Get RI video from Anne

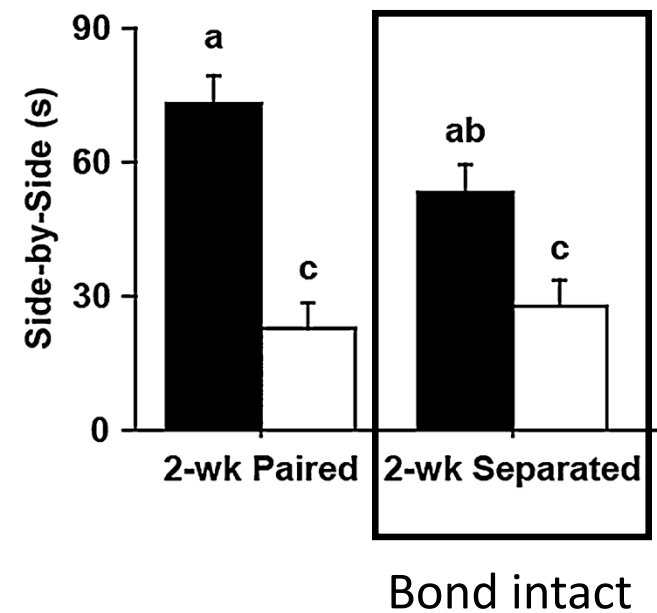
60 min free interaction with novel opposite sex vole

Resident-Intruder Test

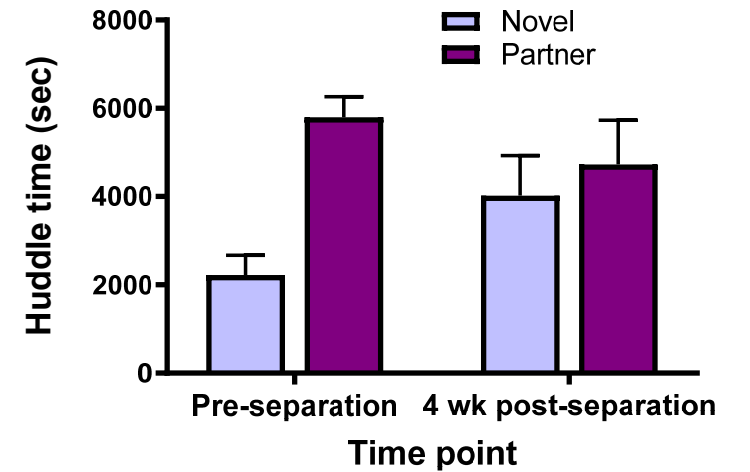


Pair bonds dissolve four weeks post-separation

Males

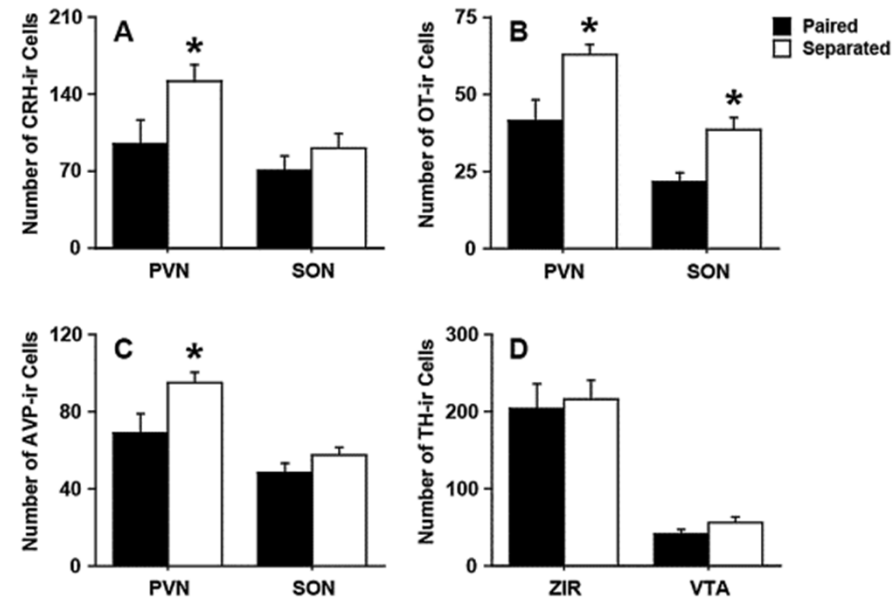
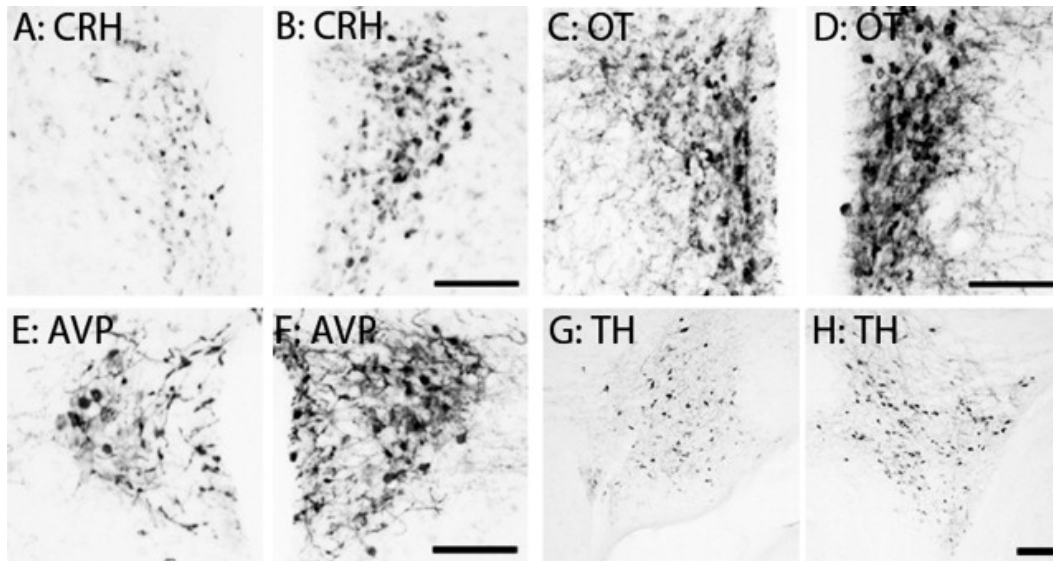


Females



n = 8; unpublished, Donaldson Lab

Do changes in neuromodulatory systems represent a return to baseline or adapted state?



Summary and considerations

- Bonds remain intact for at least 2 week post-separation.
- Following 4 weeks of separation, partner preference is no longer evident and selective aggression is greatly reduced.
- How much variation is there in this timecourse?

5. Rebonding as a metric of adaptation/recovery

Hormones and Behavior 113 (2019) 47–54



Contents lists available at ScienceDirect

Hormones and Behavior

journal homepage: www.elsevier.com/locate/yhbeh



Rewritable fidelity: How repeated pairings and age influence subsequent pair-bond formation in male prairie voles



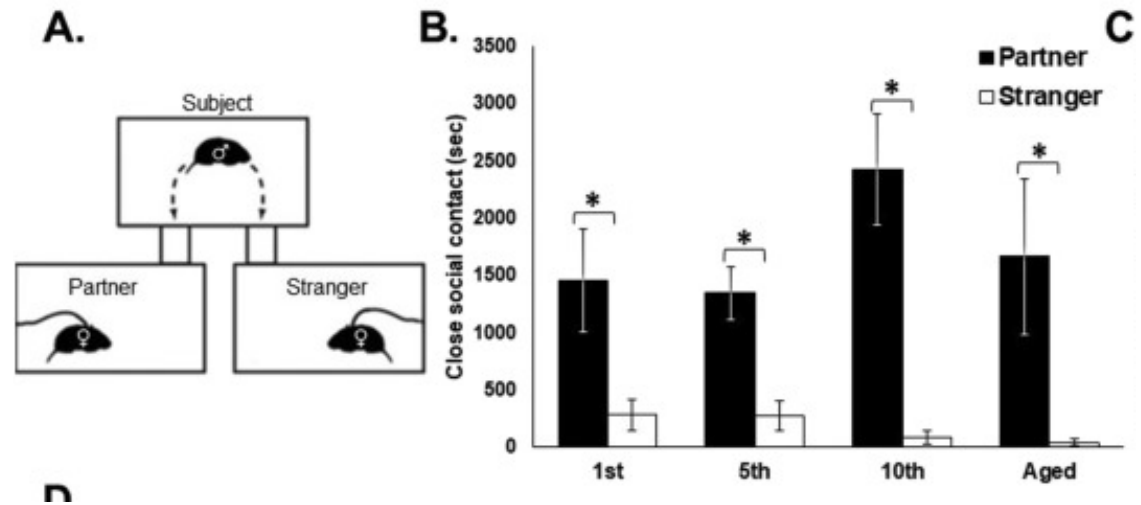
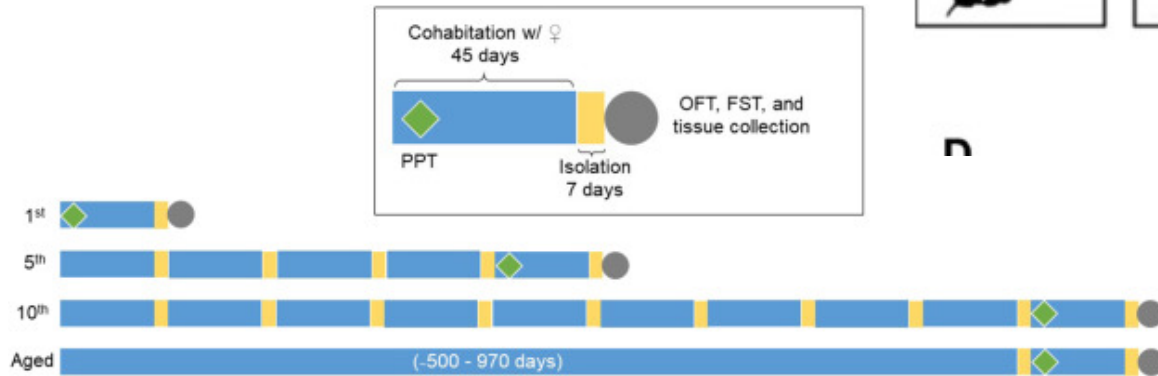
William M. Kenkel^{a,b,*}, Allison M. Perkeybile^b, Jason R. Yee^c, C. Sue Carter^b

^a Neuroscience Institute, Georgia State University, United States of America

^b Kinsey Institute, Indiana University, United States of America

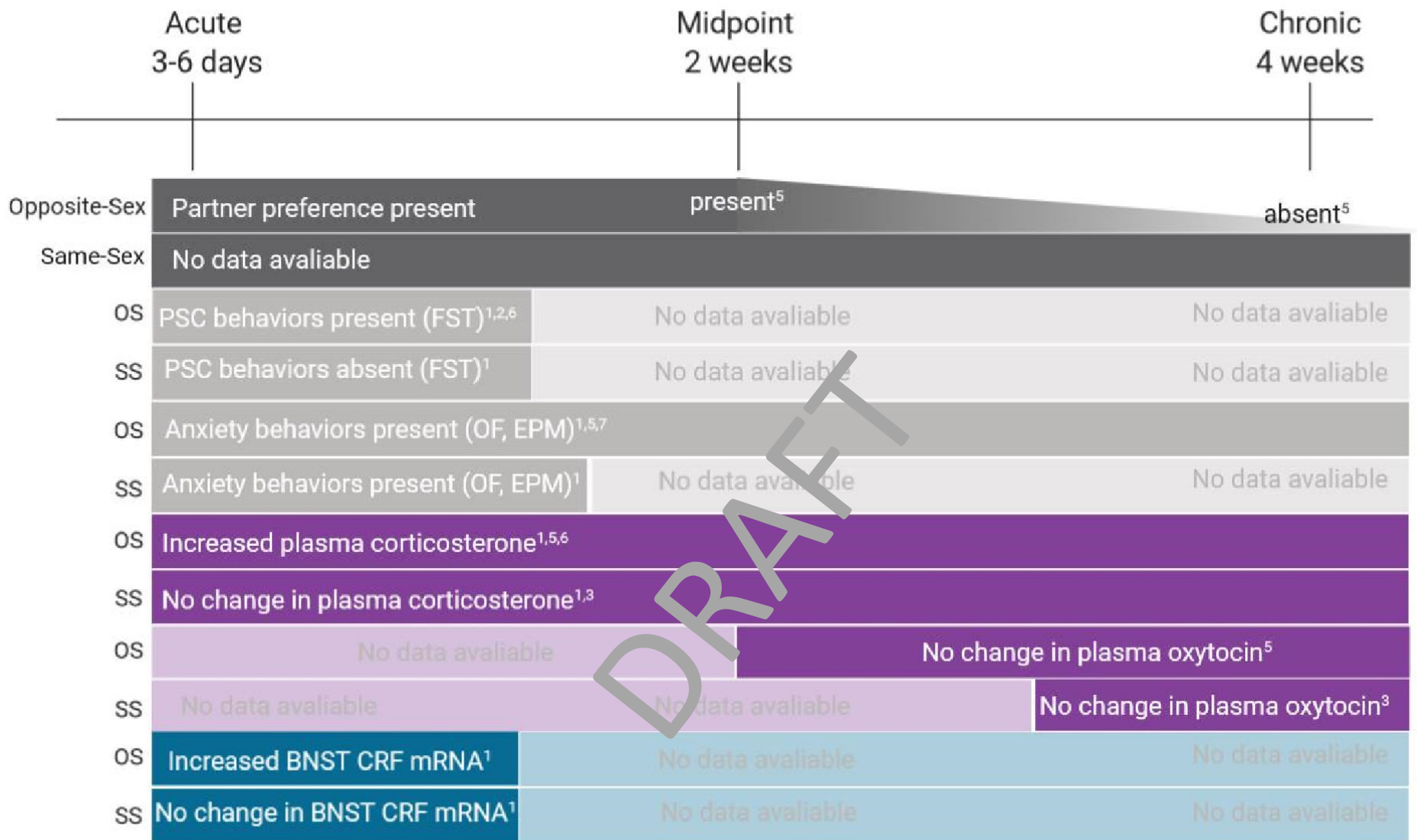
^c University of Veterinary Medicine, Vienna, Austria

Prior pair bonds do not negate future partner preference formation



Summary and considerations

- Prairie vole pair bonds dissolve by 4 weeks post-separation.
- Second bonds are less behaviorally “stable” if the separation period has been less than 4 weeks.
- 4 weeks of separation is required to form a second bond that supplants the first.



Overall summary

- Prairie voles are a novel model for studying adult attachment and its disruption.
- Partner separation, but not social isolation more generally, results in increased passive coping.
- Prairie voles can form more than one pair bond, but it appears to take 4 weeks after separation before a pair bond is dissolved and the new bond can supplant the old one.

Overall considerations

- Does pair bond duration matter?
- Can we measure different attachment types in voles?
- What are the best metrics for separation anxiety?
- How much individual variation is there?
 - Bond strength versus genetics?