


John Templeton Foundation



SUPPORTING SCIENCE ~ INVESTING IN THE BIG QUESTIONS

“In keeping with Sir John Templeton's intent, his Foundation serves as a philanthropic catalyst for research and discoveries relating to what scientists and philosophers call the Big Questions. We support work at the world's top universities in such fields as theoretical physics, cosmology, evolutionary biology, cognitive science, and social science relating to love, forgiveness, creativity, purpose, and the nature and origin of religious belief. We also seek to stimulate new thinking about wealth creation in the developing world, character education in schools and universities, and programs for cultivating the talents of gifted children.”


From the Templeton Foundation's Web site

www.templeton.org

CBN –TEMPLETON FOUNDATION INITIATIVE

- CBN has a one year grant from the Templeton Foundation to develop research projects in the area of “positive neuroscience”
- The grant funds planning meetings, workshops, a symposium, and supporting activities 1/09-12/09
- The following slides outline the background for the planning grant, examples of “positive neuroscience research”, and the basic timeline for the project

John Templeton Foundation



SUPPORTING SCIENCE ~ INVESTING IN THE BIG QUESTIONS

Neuroscience is one funding area within the Foundation's Natural Science Division

"The Foundation welcomes proposals that seek to advance discovery in areas engaging life's biggest questions. These areas include questions on the laws of nature and the nature of the universe. Our philanthropic vision is derived from John Templeton's commitment to rigorous scientific research and related cutting-edge scholarship. The Foundation's motto "How little we know, how eager to learn" exemplifies our support for open-minded inquiry and our hope for advancing human progress through breakthrough discoveries at the intersection of the natural sciences and our Core Themes."

Astronomy & Cosmology

Biology

Chemistry

Computer Science

Earth Science

Engineering & Technology

Genetics

Mathematics

Neuroscience

Physics

Planetary Science & Astrobiology

From the Templeton Foundation's Web site

Recent Templeton Foundation Grants in Neuroscience

These all focus on human neuroscience and brain imaging

Expanding Spiritual Knowledge Through Science: Chicago
Multidisciplinary Research Network

Professor John T. Cacioppo, Tiffany & Margaret Blake Distinguished Service Professor; Director, Center for Cognitive and Social Neuroscience
University of Chicago (March 2005: \$1,844,238)

Cortical Mechanisms of the Positive Consequences of Good Acts,
Connectedness, and Spirituality

Professor Howard Nusbaum, Chair, Department of Psychology, Co-Director, Center for Cognitive and Social Neuroscience University of Chicago
(February 2007, \$726,082)

Oxytocin and the Neurobiology of Human Virtues: Resilience,
Generosity, and Compassion

Paul Zak, Ph.D., Professor of Economics, Claremont Graduate University (September 2007, \$1,487,740)

CBN's Templeton Grant:

Planning Grant: The neuroscience of positive emotions and social states

“While the study of positive emotions has now become a vibrant component of several areas of social science, far less work has been done on the fundamental neural processes related to positive emotional and social states. The purpose of this project is to build complementary work in neuroscience in this area by stimulating new advances in **basic neuroscience research** focused on: **social bonding; tolerance; trust; altruism; cooperation; empathy, and hope.**”

Planning grant: Small grant (<\$100,000) to develop an area of funding interest to the Foundation, 1 year duration

- ***Workshops and planning meetings***
- ***Speakers***
- ***Small support for developing proposals***
- ***Major symposium on the topic of interest***

Conceptual Focus for the Project

- “Positive Emotions and Social Traits”
 - Positive in the sense of prosocial or of value to people and society
 - Restricted to the topics listed above
- Probably not:
 - Positive in the sense of rewarding or pleasurable per se
 - Clinically related (not a focus of Templeton)
 - Human imaging work? Needs careful thought for the CBN’s particular grant given its emphasis on basic neuroscience, although fine for Templeton generally

The following slides show examples of neuroscience research in the area of positive emotions to stimulate discussion of topic areas

- These are not projects funded by the Templeton Foundation
- The examples start with human neuroscience and brain imaging and progress to more mechanistic, basic research projects

Well-being and affective style: neural substrates and biobehavioural correlates

Richard J. Davidson

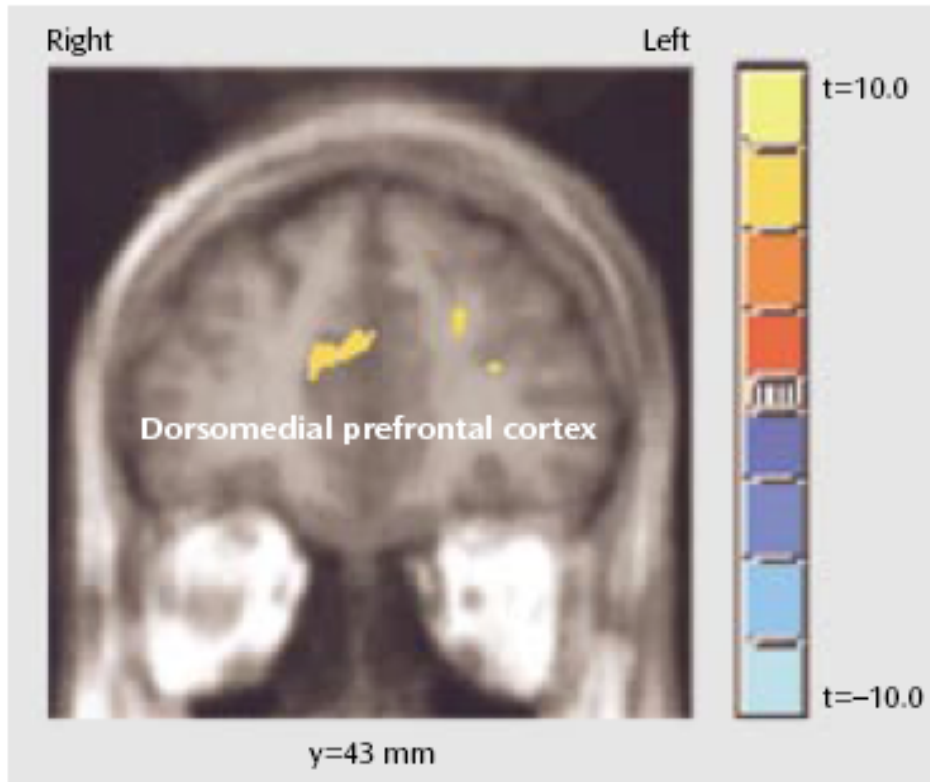
Laboratory for Affective Neuroscience, W. M. Keck Laboratory for Functional Brain Imaging and Behavior, University of Wisconsin-Madison, 1202 West Johnson Street, Madison, WI 53706, USA (rjdavids@wisc.edu)

One of the most salient features of emotion is the pronounced variability among individuals in their reactions to emotional incentives and in their dispositional mood. Collectively, these individual differences have been described as affective style. Recent research has begun to dissect the constituents of affective style. The search for these components is guided by the neural systems that instantiate emotion and emotion regulation. In this article, this body of research and theory is applied specifically to positive affect and well-being. The central substrates and peripheral biological correlates of well-being are described. A resilient affective style is associated with high levels of left prefrontal activation, effective modulation of activation in the amygdala and fast recovery in response to negative and stressful events. In peripheral biology, these central patterns are associated with lower levels of basal cortisol and with higher levels of antibody titres to influenza vaccine. The article concludes with a consideration of whether these patterns of central and peripheral biology can be modified by training and shifted toward a more salubrious direction.

One contribution of 12 to a Discussion Meeting Issue 'The science of well-being: integrating neurobiology, psychology and social science'.

Phil. Trans. R. Soc. Lond. B (2004) 359, 1395–1411

FIGURE 1. Areas in the Dorsomedial Prefrontal Cortex Showing Significant Increase in Activation During Self-Referential Processing of Emotional Words, Relative to Other-Referential Processing, in 10 Healthy Subjects^a



^a Subjects were presented with words describing positive and negative personality traits during fMRI scanning. In the self-referential condition, subjects judged whether they thought each trait described them. In the other-referential condition, subjects judged whether the trait was generally socially desirable. Areas highlighted in red-yellow show contiguous voxels exceeding the statistical cut-off ($-4.75 < t < 4.75$, $p < 0.001$, uncorrected). The y coordinate indicates the location of the coronal slice.

In Search of the Emotional Self: An fMRI Study Using Positive and Negative Emotional Words

**Philippe Fossati, et al.
(*Am J Psychiatry* 2003;
160:1938–1945)**

Connection to Empathy?

Positive Emotions Preferentially Engage an Auditory–Motor “Mirror” System

Jane E. Warren,^{1,3} Disa A. Sauter,⁴ Frank Eisner,⁶ Jade Wiland,⁴ M. Alexander Dresner,² Richard J. S. Wise,^{1,3} Stuart Rosen,⁵ and Sophie K. Scott^{1,6}

¹Magnetic Research Council Clinical Sciences Centre and ²Robert Steiner Magnetic Resonance Imaging Unit, Imaging Sciences Department, Hammersmith Hospital Campus, Imperial College London, London W12N 0NN, United Kingdom, and ³Division of Neuroscience and Mental Health, Departments of ⁴Psychology and ⁵Phonetics and Linguistics, and ⁶Institute of Cognitive Neuroscience, University College London, London WC1E 6BT, United Kingdom

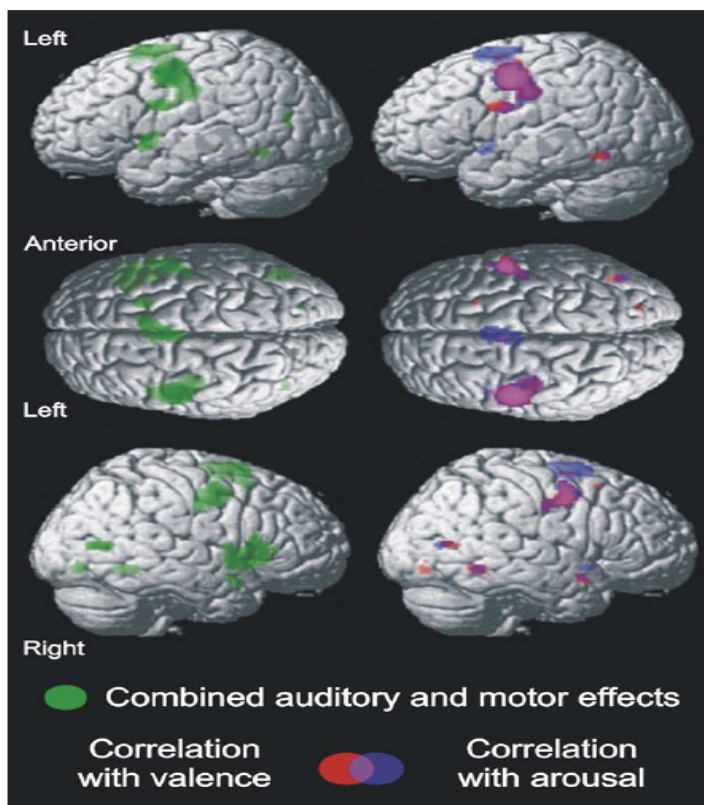


Figure 4. Correlations with emotional valence and arousal in brain regions demonstrating auditory–motor mirror responses. Left, Regions (green) displaying both a significant modulatory effect of emotion category on perceptual activation and significant activation during voluntary facial movements (F contrast, one-way repeated-measures ANOVA, masked inclusively with the contrast of the facial movement condition over baseline), as shown in Figure 2. Statistical thresholds are the same as in Figure 2. Right, Regions demonstrating a significant positive correlation between hemodynamic responses and emotional valence (red), emotional arousal (blue), or both (purple). Statistical thresholds for these contrasts were set at a voxel-level threshold of $p < 0.05$, FDR-corrected across a search volume defined as the suprathreshold voxels from the inclusively-masked ANOVA F contrast (top row images, green). For display purposes, statistical parametric maps of these correlations have been masked to display significant voxels within the search volume only. Statistical parametric maps are displayed on left lateral, superior, and right lateral projections of a canonical brain surface in standard MNI stereotaxic space, with color intensity indicating distance from the cortical surface.

Altruism is associated with an increased neural response to agency

Dharol Tankersley^{1,2}, C Jill Stowe^{2,3} & Scott A Huettel^{1,2}

Although the neural mechanisms underlying altruism remain unknown, empathy and its component abilities, such as the perception of the actions and intentions of others, have been proposed as key contributors. Tasks requiring the perception of agency activate the posterior superior temporal cortex (pSTC), particularly in the right hemisphere. Here, we demonstrate that differential activation of the human pSTC during action perception versus action performance predicts self-reported altruism.

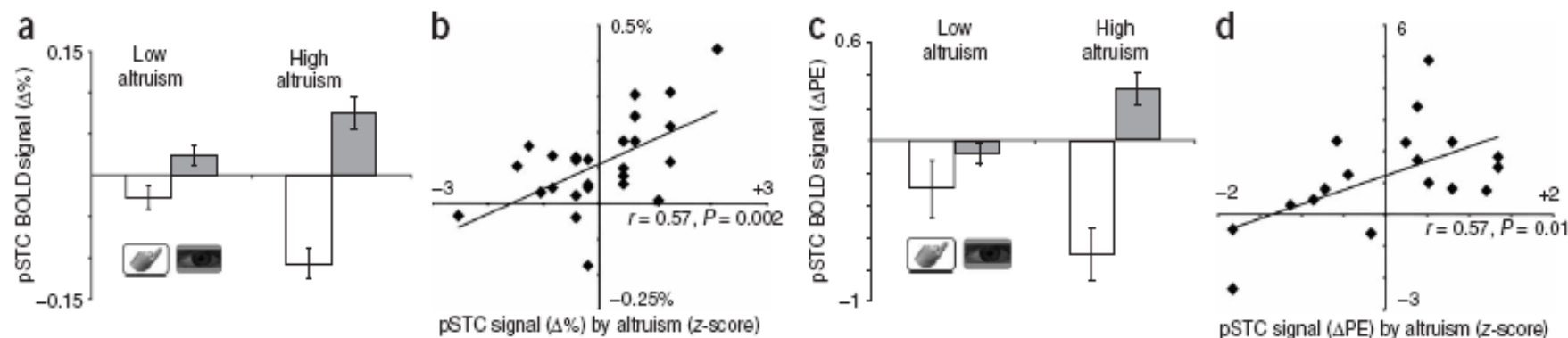


Figure 2 Altruism is predicted by pSTC activation. In each of our two fMRI experiments (E1 and E2), we examined the relation between the subjects' self-reported altruism and the magnitude of activation in pSTC. (a,b) E1. (c,d) E2. All data are drawn from pSTC regions of interest whose centroids are reported in **Figure 1**. Low-altruism subjects showed no difference in pSTC activation between Watching trials (gray bars, indicated by eye) and Playing trials (white bars, indicated by hand) in either E1 (a) or in E2 (c). All bars indicate group mean \pm s.e.m. High-altruism subjects exhibited significantly greater pSTC activation for Watching than for Playing trials. Across subjects, there was a significant correlation between altruism scores and pSTC activation for both E1 (b) and E2 (d). Y-axes for a and b represent the difference in percent blood-oxygenation signal between Watching and Playing, and y-axes in c and d represent the difference in the Watching and Playing parameter estimates, which provides an estimate of relative blood-oxygenation signal, normalized to arbitrary units.

Oxytocin increases trust in humans

Michael Kosfeld^{1*}, Markus Heinrichs^{2*}, Paul J. Zak³, Urs Fischbacher¹ & Ernst Fehr^{1,4}

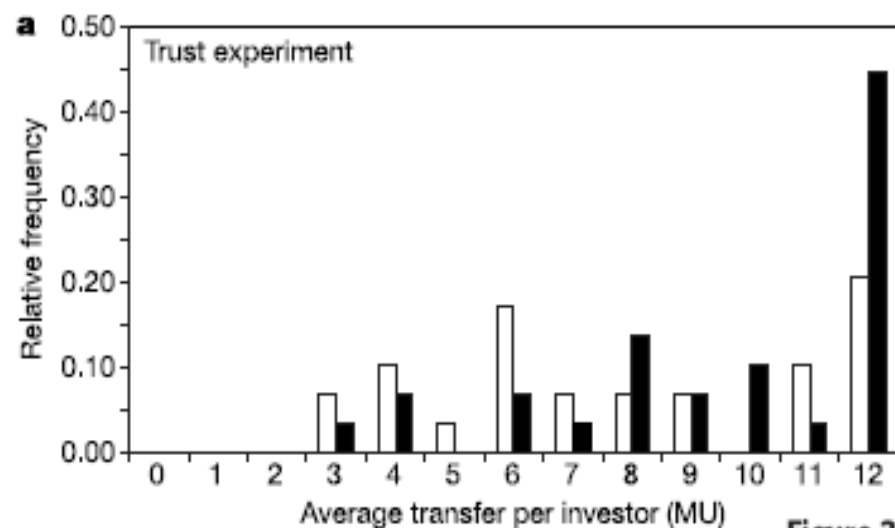


Figure 2 | Transfers in the trust and the risk experiment. Each observation represents the average transfer amount (in MU) over four transfer decisions per investor. **a**, Relative frequency of investors' average transfers in oxytocin (filled bars) and placebo (open bars) groups in the trust experiment ($n = 58$). Subjects given oxytocin show significantly higher transfer levels.

Social Modulation of Pain as Evidence for Empathy in Mice

Dale J. Langford, Sara E. Crager, Zarrar Shehzad, Shad B. Smith, Susana G. Sotocinal, Jeremy S. Levenstadt, Mona Lisa Chanda, Daniel J. Levitin, Jeffrey S. Mogil*

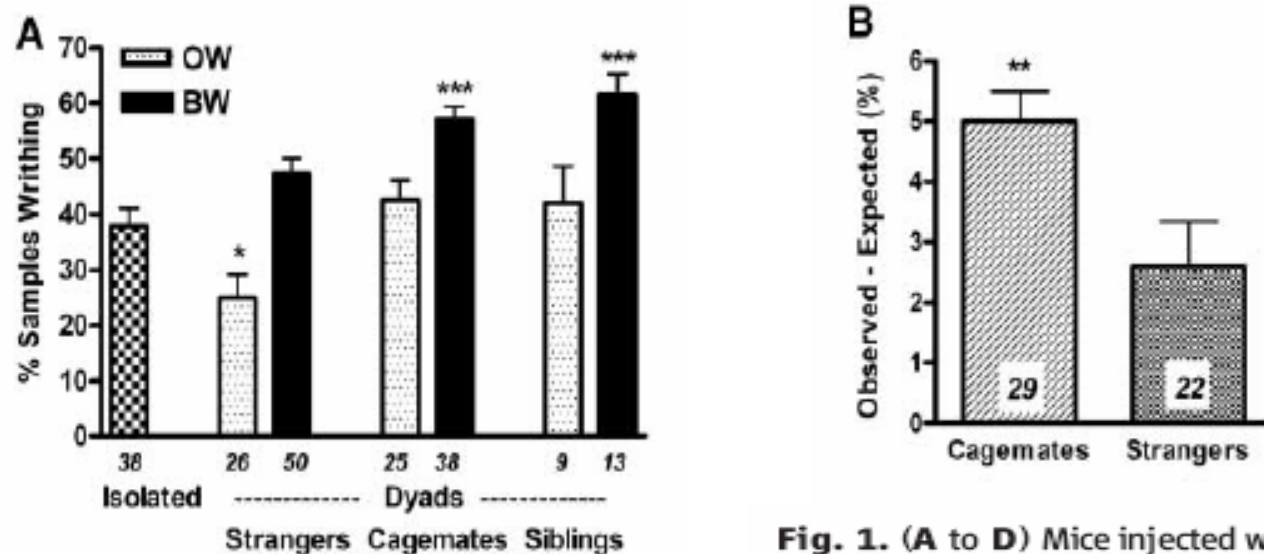


Fig. 1. (A to D) Mice injected with 0.9% acetic acid in the presence of similarly injected cagemates display higher levels of pain behavior, which co-occurs in time. In all graphs, group sample sizes are indicated in italics. (A) Mice were tested in isolation (Isolated), or in dyads where either one mouse (One Writhing; OW) or both mice (Both Writhing; BW) received acetic acid injections. Bars represent the mean \pm SEM percentage of sampled intervals showing writhing behavior (% Samples Writhing). * $P < 0.05$, *** $P < 0.005$ by Dunnett two-way case-control comparison posthoc test compared to Isolated mice. (B) Statistically significant co-occurrence in writhing behavior in the Cagemates and Strangers conditions (sign test, $P < 0.05$ in both cases); the co-occurrence was significantly higher in Cagemates.



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Review

The neurobiology of positive emotions

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Abstract

Compared to the study of negative emotions such as fear, the neurobiology of positive emotional processes and the associated positive affect (PA) states has only recently received scientific attention. Biological theories conceptualize PA as being related to (i) signals indicating that bodies are returning to equilibrium among those studying homeostasis, (ii) utility estimation among those favoring neuroeconomic views, and (iii) approach and other instinctual behaviors among those cultivating neuroethological perspectives. Indeed, there are probably several distinct forms of positive affect, but all are closely related to ancient sub-neocortical limbic brain regions we share with other mammals. There is now a convergence of evidence to suggest that various regions of the limbic system, including especially ventral striatal dopamine systems are implemented in an anticipatory (appetitive) positive affective state. Dopamine independent mechanisms utilizing opiate and GABA receptors in the ventral striatum, amygdala and orbital frontal cortex are important in elaborating consummatory PA (i.e. sensory pleasure) states, and various neuropeptides mediate homeostatic satisfactions.

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Keywords: Affect; Emotions; Pleasure; Play; Seeking; Foraging; Vocalizations; Dopamine

Current CBN Research

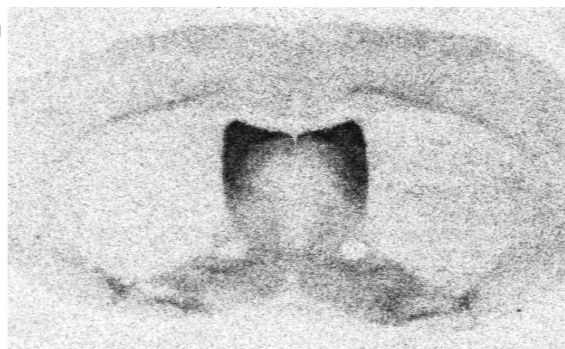
Examples that follow may be a starting point for moving into the area of positive neuroscience

The Evolution of Social Bonding and the Vole V1aR

Can we use the successful approach here to extend studies into other areas? Are there advances to be made with this system?

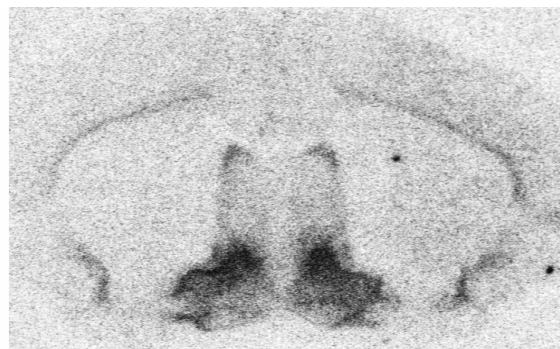
Montane Vole

Solitary, No Bonding
Uniparental



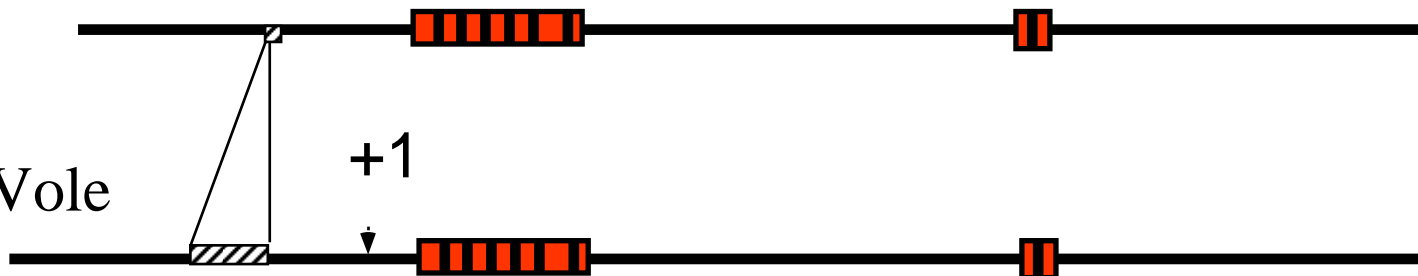
Highly Social, Pair Bonding,
Biparental

Prairie Vole



Montane Vole

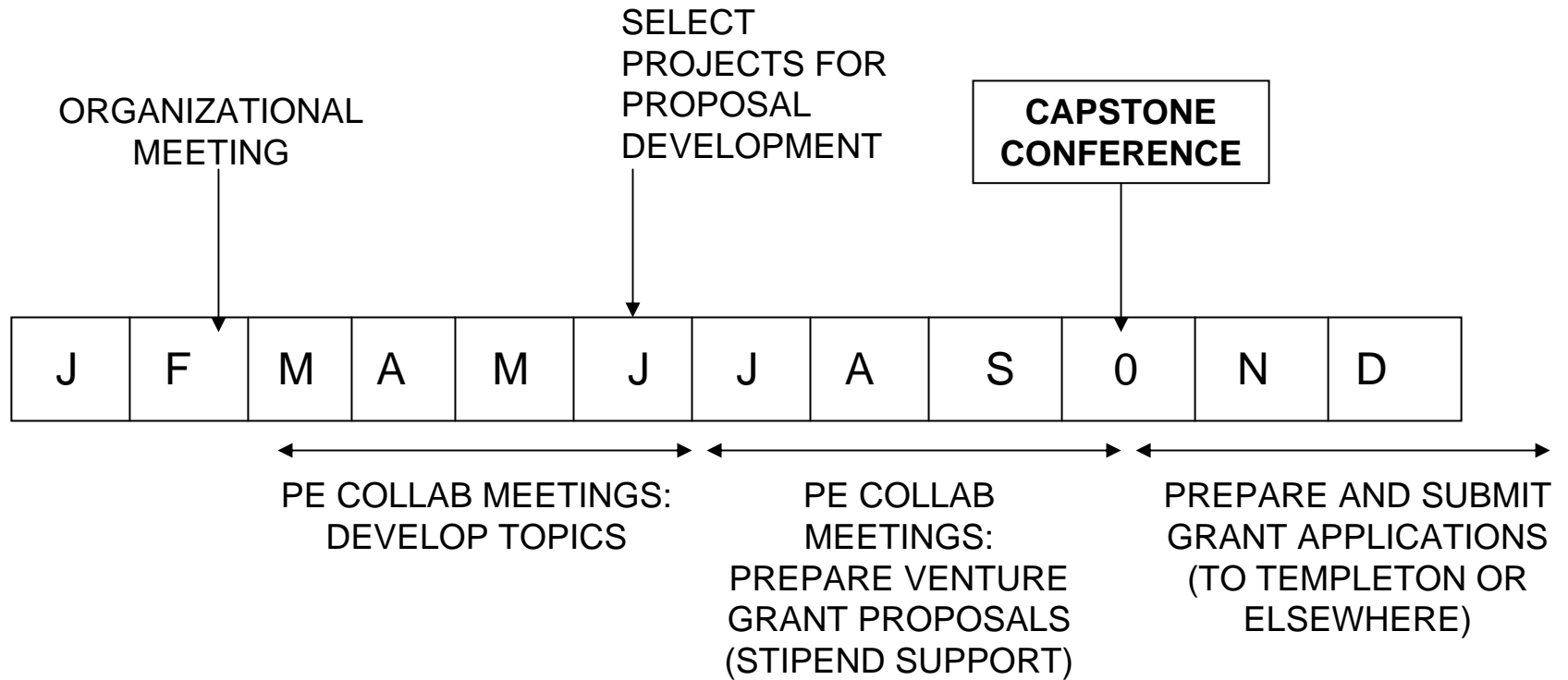
Prairie Vole



Other Areas of CBN Research Relevant to Templeton Initiative

- Oxytocin in nonhuman primates: social recognition, cooperation, trust, altruism
 - Can this be extended to nonprimate models for more basic mechanistic studies?
- Mechanisms of behavioral resilience
 - Can this be seen as a basic component of a “hopeful state”?
- Eusociality in insects
 - Can we exploit this for insights into cooperation and social tolerance?

Tentative Time line for Planning Grant Project



FUNDS ARE ALSO AVAILABLE FOR TWO INVITED SPEAKERS

Neuroscience of Positive Emotions and Social Traits

IDEAS FOR NEUROSCIENCE PROJECTS?

social bonding; tolerance; trust; altruism; cooperation; empathy, and hope

Project Summary Statement from the Templeton Foundation application:

Planning Grant: The neuroscience of positive emotions and social states
Grant ID#14508

This grant supports a year long program leading to the development of research into the fundamental neuroscience of positive emotions and social traits as part of the efforts of the Center for Behavioral Neuroscience (CBN) to develop and support innovative neuroscience research. While the study of positive emotions has now become a vibrant component of several areas of social science, far less work has been done on the fundamental neural processes related to positive emotional and social states. The purpose of this project is to build complementary work in neuroscience in this area by stimulating new advances in basic neuroscience research focused on: social bonding; tolerance; trust; altruism; cooperation; empathy, and hope. The project is a systematic program that begins with planning meetings and builds toward the development of tangible, competitive neuroscience research projects. The project's activities mirror the CBN's successful "collaboratory" model, which provides a mechanism for cross disciplinary, multi-institutional interactions among faculty and student researchers in a collaborative setting. The initial phase of the project will consist of the formation of a Positive Neuroscience Working Group, or "PE Collaboratory," drawn from faculty and students from the seven colleges and universities comprising the CBN. The PE Collaboratory will organize monthly research meetings in which faculty researchers and students will move from discussing the potential field of positive neuroscience, to identifying appropriate and feasible avenues of research, to developing specific "venture projects" in this area. During the second phase of the project, the six most innovative and competitive projects will be selected for preparation as "Venture Grant Applications," proposals for short term research projects on pilot research in the area of positive neuroscience defined by the topics listed above. The capstone event of the project will be a major symposium and workshop devoted to the neuroscience of positive emotions and social states. As a part of this event, the research projects will be critiqued and revised. The end result will be a portfolio of research grant applications in this area of neuroscience that can then be submitted to external entities. Although the immediate audience for this project, particularly for its first phase, is the neuroscience faculty and students from among the CBN's participating institutions, the ultimate target audience is the field of neuroscience itself. As such, the project will make use of the CBN's web-based resources and communications staff to disseminate information about this initiative and advertise the capstone symposium nationally. One outcome of this project is a tangible product: competitive grant applications that will support new neuroscience research in the area of positive neuroscience. A second, but more important, outcome is the development of this area of neuroscience and the demonstration of its feasibility and its exciting potential for the field of behavioral neuroscience.