Stanford

Brian Knutson

Professor of Psychology

Bio

BIO

My lab and I seek to elucidate the neural basis of emotion (affective neuroscience), and explore implications for decision-making (neuroeconomics) and psychopathology (neurophenomics).

ACADEMIC APPOINTMENTS

- Professor, Psychology
- Member, Bio-X
- Faculty Affiliate, Institute for Human-Centered Artificial Intelligence (HAI)
- Member, Wu Tsai Human Performance Alliance
- Affiliate, Stanford Woods Institute for the Environment
- Member, Wu Tsai Neurosciences Institute

PROGRAM AFFILIATIONS

- Symbolic Systems Program

PROFESSIONAL EDUCATION

- Ph.D., Stanford University , Psychology (1993)

LINKS

- spanlab: http://stanford.edu/group/spanlab/index.html

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My primary interest is in the neural basis of emotion. I believe that a certain class of neurotransmitters (the biogenic amines) can powerfully modulate emotional experience at specific brain locations. I have addressed this topic with progressively more intricate methods including self-report, measurement of nonverbal behavior, comparative ethology, psychopharmacology, and functional brain imaging. My long-term goal is to understand the neurochemical and neuroanatomical mechanisms responsible for emotional experience and to explore the implications of these findings for the assessment and treatment of clinical disorders of affect and addiction, as well as economic behavior.

Teaching

COURSES

2025-26

- Affective Neuroscience: PSYCH 257 (Spr)
- Brain and Decision Making: PSYCH 134 (Spr)
- Graduate Seminar in Affective Science: PSYCH 269 (Aut, Win, Spr)
- Judgment and Decision-Making: PSYCH 154 (Win)

2024-25

- Affective Neuroscience: PSYCH 257 (Spr)
- Brain and Decision Making: PSYCH 134, PSYCH 232 (Spr)
- Graduate Seminar in Affective Science: PSYCH 269 (Aut, Win, Spr)
- Judgment and Decision-Making: PSYCH 154 (Win)

2023-24

- Brain and Decision Making: PSYCH 134, PSYCH 232 (Spr)
- Graduate Seminar in Affective Science: PSYCH 269 (Aut, Win, Spr)
- Judgment and Decision-Making: PSYCH 154 (Win)

2022-23

- Brain and Decision Making: PSYCH 134, PSYCH 232 (Spr)
- Feeling in Japan: Culture, Emotion, and Brain: OSPKYOTO 69 (Aut)
- Graduate Seminar in Affective Science: PSYCH 269 (Aut, Win, Spr)
- Neuroforecasting: PSYCH 24N (Win)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Leili Mortazavi

Doctoral Dissertation Advisor (AC)

Tara Srirangarajan, Cynthia Wu, Ryan Yan

Doctoral (Program)

Ryan Yan

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **Contributions of the basolateral amygdala and nucleus accumbens to sustaining not just initiating cognitive effort.** *Proceedings of the National Academy of Sciences of the United States of America*
  Dixon, M. L., Blevins, E., Dweck, C. S., Görgen, K., Knutson, B.
  2026; 123 (19): e2601231123

- **Brain activity reveals how wildlife imagery evokes engagement on social media.** *PNAS nexus*
  Srirangarajan, T., Sawe, N., Thys, T., Wu, X. C., Knutson, B.
  2026; 5 (2): pgag012
- **STRATIFYING MDMA RESPONSE USING NEGATIVE AFFECT CIRCUIT BIOTYPES WITH CLINICAL VALIDATION**
  Zhang, X., Hack, L., Bertrand, C., Hilton, R., Gray, N., Boyar, L., Laudie, J., Heifets, B., Suppes, T., Van Roessel, P., Rodriguez, C. I., Deisseroth, K., Knutson, et al
  SPRINGERNATURE.2026
- **Females have shorter scalp-to-cortex distances and receive stronger TMS electrical fields: Implications for clinical treatment.** *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*
  McCalley, D. M., Cadicamo, N. J., Weijerman, F., Tenekedjieva, L. T., Knutson, B., Padula, C. B.
  2025
- **Brain activity explains message effectiveness: A mega-analysis of 16 neuroimaging studies.** *PNAS nexus*
  Scholz, C., Chan, H. Y., Ahn, J., Boksem, M. A., Cooper, N., Coronel, J. C., Doré, B. P., Genevsky, A., Huskey, R., Kang, Y., Knutson, B., Lieberman, M. D., Brook O'Donnell, et al
  2025; 4 (11): pgaf287
- **The impact of affective congruence on charitable giving.** *Social cognitive and affective neuroscience*
  Genevsky, A., Yoon, C., Lin, T. Y., Shaw, S. D., Knutson, B.
  2025
- **How we stumbled upon the rat play vocalizations: A recollection.** *Behavioural brain research*
  Knutson, B.
  2025: 115773
- **Deconstructing neural predictors of risky choice.** *PNAS nexus*
  Mortazavi, L., Wu, C. C., Ghasemi, E., Knutson, B.
  2025; 4 (7): pgaf204
- **Negative Affect Circuit Subtypes and Neural, Behavioral, and Affective Responses to MDMA: A Randomized Clinical Trial.** *JAMA network open*
  Zhang, X., Hack, L. M., Bertrand, C., Hilton, R., Gray, N. J., Boyar, L., Laudie, J., Heifets, B. D., Suppes, T., van Roessel, P. J., Rodriguez, C. I., Deisseroth, K., Knutson, et al
  2025; 8 (4): e257803
- **Neuroforecasting reveals generalizable components of choice.** *PNAS nexus*
  Genevsky, A., Tong, L. C., Knutson, B.
  2025; 4 (2): pgaf029
- **Mapping the cellular etiology of schizophrenia and complex brain phenotypes.** *Nature neuroscience*
  Duncan, L. E., Li, T., Salem, M., Li, W., Mortazavi, L., Senturk, H., Shahverdizadeh, N., Vesuna, S., Shen, H., Yoon, J., Wang, G., Ballon, J., Tan, et al
  2025
- **Effects of intermittent theta burst to the left dorsolateral prefrontal cortex on brain volumes and neurometabolites in people with alcohol use disorder: a preliminary investigation.** *Frontiers in human neuroscience*
  Durazzo, T. C., Beauregard, L. H., Gu, M., Kraybill, E. P., Joseff, B. D., Herrold, A. A., Humphreys, K., McNerney, M. W., Knutson, B., Padula, C. B.
  2025; 19: 1613993
- **Cultural Variation in the Smiles We Trust: The Effects of Reputation and Ideal Affect on Resource Sharing** *EMOTION*
  Cachia, J. Y. A., Blevins, E., Chen, Y., Ko, M., Yen, N., Knutson, B., Tsai, J. L.
  2024
- **Cultural variation in the smiles we trust: The effects of reputation and ideal affect on resource sharing.** *Emotion (Washington, D.C.)*
  Cachia, J. Y., Blevins, E., Chen, Y. C., Ko, M., Yen, N. S., Knutson, B., Tsai, J. L.
  2024
- **BRAIN-WIDE, GENOME-WIDE ANALYSES IDENTIFY CELL TYPES FOR COMPLEX BRAIN PHENOTYPES INCLUDING SCHIZOPHRENIA, PTSD, DEPRESSION, HOT FLASHES, MULTIPLE SCLEROSIS, AND ALZHEIMER'S DISEASE**

Duncan, L., Li, T., Salem, M., Li, W., Mortazavi, L., Shargh, N., Senturk, H., Vesuna, S., Yoon, J., Wang, G., Ballon, J., Tan, L., Pruett, et al
SPRINGERNATURE.2024: 326

- **Two Faces of Reward: Alcohol-Cue and Monetary Assessment of Reward Circuit Functioning Reveals Neural Predictors of Relapse in Alcohol Use Disorder**
  Padula, C., MacNiven, K., Tenekedjieva, L., McCalley, D., Knutson, B., Williams, L.
  SPRINGERNATURE.2024: 217-218
- **Structural projections to the nucleus accumbens link to impulsive components of human risk preference.** *Imaging neuroscience (Cambridge, Mass.)*
  Tisdall, L., MacNiven, K., Leong, J., Frey, R., Rieskamp, J., Hertwig, R., Knutson, B., Mata, R.
  2024; 2
- **News source bias and sentiment on social media.** *PloS one*
  Knutson, B., Hsu, T. W., Ko, M., Tsai, J. L.
  2024; 19 (10): e0305148
- **Multi-dimensional predictors of first drinking initiation and regular drinking onset in adolescence: A prospective longitudinal study.** *Developmental cognitive neuroscience*
  Nguyen-Louie, T. T., Thompson, W. K., Sullivan, E. V., Pfefferbaum, A., Gonzalez, C., Eberson-Shumate, S. C., Wade, N. E., Clark, D. B., Nagel, B. J., Baker, F. C., Luna, B., Nooner, K. B., de Zambotti, et al
  2024; 69: 101424
- **A pilot, randomized clinical trial: Left dorsolateral prefrontal cortex intermittent theta burst stimulation improves treatment outcomes in veterans with alcohol use disorder.** *Alcohol, clinical & experimental research*
  Padula, C. B., McCalley, D. M., Tenekedjieva, L., MacNiven, K., Rauch, A., Morales, J. M., Knutson, B., Humphreys, K., Williams, L. M., Durazzo, T. C.
  2024; 48 (1): 164-177
- **Commentaries on "Reconsidering the path for neural and physiological methods in consumer psychology"** *JOURNAL OF CONSUMER PSYCHOLOGY*
  Hutchinson, J., Reimann, M., Knutson, B., Huber, J.
  2023
- **Left Dorsolateral Prefrontal Cortex Intermittent Theta Burst Stimulation Improves Treatment Outcomes in Veterans With Alcohol Use Disorder: A Randomized, Sham-Controlled Clinical Pilot Trial**
  McCalley, D., Tenekedjieva, L., MacNiven, K., Rauch, A., Morales, J., Knutson, B., Humphreys, K., Williams, L., Durazzo, T., Padula, C.
  SPRINGERNATURE.2023: 449
- **Leveraging neuroscience for climate change research** *NATURE CLIMATE CHANGE*
  Doell, K. C., Berman, M. G., Bratman, G. N., Knutson, B., Kuhn, S., Lamm, C., Pahl, S., Sawe, N., Van Bavel, J. J., White, M. P., Brosch, T.
  2023
- **Cultural variation in neural responses to social but not monetary reward outcomes.** *Social cognitive and affective neuroscience*
  Blevins, E., Ko, M., Park, B., Qu, Y., Knutson, B., Tsai, J. L.
  2023
- **Ketamine's acute effects on negative brain states are mediated through distinct altered states of consciousness in humans.** *Nature communications*
  Hack, L. M., Zhang, X., Heifets, B. D., Suppes, T., van Roessel, P. J., Yesavage, J. A., Gray, N. J., Hilton, R., Bertrand, C., Rodriguez, C. I., Deisseroth, K., Knutson, B., Williams, et al
  2023; 14 (1): 6631
- **Blunted neurobehavioral loss anticipation predicts relapse to stimulant drug use.** *Biological psychiatry*
  MacNiven, K. H., Mortazavi, L., Knutson, B.
  2023
- **Blunted Neurobehavioral Loss Anticipation Predicts Relapse to Stimulant Drug Use** *Biological Psychiatry*
  Mortazavi*, L., MacNiven*, K. H., Knutson, B.
  2023

- **Acute Effects of MDMA on Intrinsic Functional Connectomes Associated With Altered States of Consciousness and Defensiveness**
  Zhang, X., Hack, L., Heifets, B., Suppes, T., van Roessel, P., Yesavage, J., Gray, N., Hilton, R., Rodriguez, C., Deisseroth, K., Knutson, B., Williams, L.
  ELSEVIER SCIENCE INC.2023: S87-S88
- **Ketamine's Acute Effects on Negative Brain States are Mediated Through Distinct Altered States in Humans**
  Zhang, X., Hack, L., Heifets, B., Suppes, T., Van Roessel, P., Yesavage, J., Gray, N., Hilton, R., Rodriguez, C., Deisseroth, K., Knutson, B., Williams, L.
  ELSEVIER SCIENCE INC.2023: S312
- **Acute Effects of MDMA on Negative Affective Brain Circuit Function: A Randomized Controlled Mechanistic Trial**
  Hack, L., Zhang, X., Heifets, B., Suppes, T., van Roessel, P., Yesavage, J., Gray, N., Hilton, R., Rodriguez, C., Deisseroth, K., Knutson, B., Williams, L.
  ELSEVIER SCIENCE INC.2023: S88
- **Replication of neural responses to monetary incentives and exploration of reward-influenced network connectivity in fibromyalgia.** *Neuroimage. Reports*
  Park, S. H., Deng, E. Z., Baker, A. K., MacNiven, K. H., Knutson, B., Martucci, K. T.
  2022; 2 (4)
- **Disentangling the Skeins of Brain.** *Journal of cognitive neuroscience*
  Knutson, B., Srirangarajan, T.
  2022: 1-5
- **Neural responses clarify how ecolabels promote sustainable purchases.** *NeuroImage*
  Sawe, N., Srirangarajan, T., Sahoo, A., Tang, G. S., Knutson, B.
  2022: 119668
- **Brain tract structure predicts relapse to stimulant drug use.** *Proceedings of the National Academy of Sciences of the United States of America*
  Tisdall, L., MacNiven, K. H., Padula, C. B., Leong, J. K., Knutson, B.
  2022; 119 (26): e2116703119
- **Deconstructing Ketamine-Induced Changes in Cortisol and Dissociative and Affective States in a Controlled Mechanistic Study**
  Hack, L. M., Zhang, X., Brawer, J., Gray, N., Heifets, B., Suppes, T., van Roessel, P., Rodriguez, C., Knutson, B., Williams, L.
  ELSEVIER SCIENCE INC.2022: S178-S179
- **Acute Ketamine Modulates Cognitive Control Network Activity During Cognitive Inhibition: Evidence From a Mechanistic Trial**
  Zhang, X., Hack, L., Brawer, J., Gray, N., Heifets, B., Suppes, T., van Roessel, P., Rodriguez, C., Knutson, B., Williams, L.
  ELSEVIER SCIENCE INC.2022: S225
- **Longitudinal tracking of human plasma oxytocin suggests complex responses to moral elevation.** *Comprehensive psychoneuroendocrinology*
  Parkitny, L., Carter, C. S., Peckins, M. K., Hon, D. A., Saturn, S., Nazarloo, H. P., Hurlbut, W., Knutson, B., Crane, S., Harris, X., Younger, J.
  2022; 9: 100105
- **Taking gambles at face value: Effects of emotional expressions on risky decisions.** *Frontiers in psychology*
  Winkielman, P., Trujillo, J. L., Bornemann, B., Knutson, B., Paulus, M. P.
  2022; 13: 958918
- **Targeting the Salience Network: A Mini-Review on a Novel Neuromodulation Approach for Treating Alcohol Use Disorder.** *Frontiers in psychiatry*
  Padula, C. B., Tenekedjieva, L., McCalley, D. M., Al-Dasouqi, H., Hanlon, C. A., Williams, L. M., Kozel, F. A., Knutson, B., Durazzo, T. C., Yesavage, J. A., Madore, M. R.
  2022; 13: 893833
- **Multi-band FMRI compromises detection of mesolimbic reward responses.** *NeuroImage*
  Srirangarajan, T., Mortazavi, L., Bortolini, T., Moll, J., Knutson, B.
  2021: 118617
- **Social media users produce more affect that supports cultural values, but are more influenced by affect that violates cultural values.** *Journal of personality and social psychology*

Hsu, T. W., Niiya, Y., Thelwall, M., Ko, M., Knutson, B., Tsai, J. L.
2021

- **Striatal and septo-hypothalamic responses to anticipation and outcome of affiliative rewards.** *NeuroImage*
  Bortolini, T., Melo, B., Basilio, R., Fischer, R., Zahn, R., de Oliveira-Souza, R., Knutson, B., Moll, J.
  2021: 118474
- **The rise of affectivism.** *Nature human behaviour*
  Dukes, D., Abrams, K., Adolphs, R., Ahmed, M. E., Beatty, A., Berridge, K. C., Broomhall, S., Brosch, T., Campos, J. J., Clay, Z., Clement, F., Cunningham, W. A., Damasio, et al
  2021
- **Brain activity foreshadows stock price dynamics.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*
  Stallen, M., Borg, N., Knutson, B.
  2021
- **White-matter tract connecting anterior insula to nucleus accumbens predicts greater future motivation in adolescents.** *Developmental cognitive neuroscience*
  Leong, J. K., Ho, T. C., Colich, N. L., Sisk, L., Knutson, B., Gotlib, I. H.
  2020; 47: 100881
- **Medial forebrain bundle structure is linked to human impulsivity.** *Science advances*
  MacNiven, K. H., Leong, J. K., Knutson, B.
  2020; 6 (38)
- **Brain activity forecasts video engagement in an internet attention market.** *Proceedings of the National Academy of Sciences of the United States of America*
  Tong, L. C., Acikalin, M. Y., Genevsky, A., Shiv, B., Knutson, B.
  2020
- **Brain-Responsive Neurostimulation for Loss of Control Eating: Early Feasibility Study.** *Neurosurgery*
  Wu, H. n., Adler, S. n., Azagury, D. E., Bohon, C. n., Safer, D. L., Barbosa, D. A., Bhati, M. T., Williams, N. R., Dunn, L. B., Tass, P. A., Knutson, B. D., Yutsis, M. n., Fraser, et al
  2020
- **Culturally valued facial expressions enhance loan request success.** *Emotion (Washington, D.C.)*
  Park, B., Genevsky, A., Knutson, B., Tsai, J.
  2019
- **Neural responses to monetary incentives in bipolar disorder.** *NeuroImage. Clinical*
  Johnson, S. L., Mehta, H. n., Ketter, T. A., Gotlib, I. H., Knutson, B. n.
  2019; 24: 102018
- **Toward a Deep Science of Affect and Motivation**
  Knutson, B., Srirangarajan, T.
  edited by Neta, M., Haas, I. J.
  SPRINGER INTERNATIONAL PUBLISHING AG.2019: 193–220
- **Neural responses to monetary incentives in bipolar disorder.** *NeuroImage. Clinical*
  Johnson, S. L., Mehta, H. n., Ketter, T. A., Gotlib, I. H., Knutson, B. n.
  2019; 24: 102018
- **Association of Neural Responses to Drug Cues With Subsequent Relapse to Stimulant Use.** *JAMA network open*
  MacNiven, K. H., Jensen, E. L., Borg, N., Padula, C. B., Humphreys, K., Knutson, B.
  2018; 1 (8): e186466
- **Striatal dopamine deficits predict reductions in striatal functional connectivity in major depression: a concurrent 11C-raclopride positron emission tomography and functional magnetic resonance imaging investigation.** *Translational psychiatry*
  Hamilton, J. P., Sacchet, M. D., Hjornevik, T., Chin, F. T., Shen, B., Kampe, R., Park, J. H., Knutson, B. D., Williams, L. M., Borg, N., Zaharchuk, G., Camacho, M. C., Mackey, et al
  2018; 8 (1): 264

- **Neural sensitivity to personal and vicarious reward differentially relates to prosociality and well-being** *SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE*
  Morelli, S. A., Knutson, B., Zaki, J.
  2018; 13 (8): 831–39
- **Distinct neural circuits support incentivized inhibition.** *NeuroImage*
  Leong, J. K., MacNiven, K. H., Samanez-Larkin, G. R., Knutson, B.
  2018; 178: 435–44
- **Altered prefrontal correlates of monetary anticipation and outcome in chronic pain.** *Pain*
  Martucci, K. T., Borg, N., MacNiven, K. H., Knutson, B., Mackey, S. C.
  2018
- **Neuroforecasting Aggregate Choice** *CURRENT DIRECTIONS IN PSYCHOLOGICAL SCIENCE*
  Knutson, B., Genevsky, A.
  2018; 27 (2): 110–15
- **Reward and loss anticipation in panic disorder: An fMRI study** *PSYCHIATRY RESEARCH-NEUROIMAGING*
  Held-Poschardt, D., Sterzer, P., Schlagenhauf, F., Pehrs, C., Wittmann, A., Stoy, M., Haegele, C., Knutson, B., Heinz, A., Stroehle, A.
  2018; 271: 111–17
- **Closing the loop on impulsivity via nucleus accumbens delta-band activity in mice and man.** *Proceedings of the National Academy of Sciences of the United States of America*
  Wu, H. n., Miller, K. J., Blumenfeld, Z. n., Williams, N. R., Ravikumar, V. K., Lee, K. E., Kakusa, B. n., Sacchet, M. D., Wintermark, M. n., Christoffel, D. J., Rutt, B. K., Bronte-Stewart, H. n., Knutson, et al
  2018; 115 (1): 192–97
- **Association of Neural Responses to Drug Cues With Subsequent Relapse to Stimulant Use** *JAMA Netw Open*
  MacNiven, K. H., Jensen, E. L., Borg, N., Padula, C. B., Humphreys, K., Knutson, B.
  2018
- **Individual differences in skewed financial risk-taking across the adult life span** *COGNITIVE AFFECTIVE & BEHAVIORAL NEUROSCIENCE*
  Seaman, K. L., Leong, J. K., Wu, C. C., Knutson, B., Samanez-Larkin, G. R.
  2017; 17 (6): 1232–41
- **When Brain Beats Behavior: Neuroforecasting Crowdfunding Outcomes.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*
  Genevsky, A., Yoon, C., Knutson, B.
  2017; 37 (36): 8625-8634
- **Neurocultural Evidence That Ideal Affect Match Promotes Giving.** *Social cognitive and affective neuroscience*
  Park, B., Blevins, E., Knutson, B., Tsai, J. L.
  2017
- **Blunted ventral striatal responses to anticipated rewards foreshadow problematic drug use in novelty-seeking adolescents.** *Nature communications*
  Büchel, C., Peters, J., Banaschewski, T., Bokde, A. L., Bromberg, U., Conrod, P. J., Flor, H., Papadopoulos, D., Garavan, H., Gowland, P., Heinz, A., Walter, H., Ittermann, et al
  2017; 8: 14140-?
- **Blunted ventral striatal responses to anticipated rewards foreshadow problematic drug use in novelty-seeking adolescents** *NATURE COMMUNICATIONS*
  Buechel, C., Peters, J., Banaschewski, T., Bokde, A. L., Bromberg, U., Conrod, P. J., Flor, H., Papadopoulos, D., Garavan, H., Gowland, P., Heinz, A., Walter, H., Ittermann, et al
  2017; 8
- **Brains, environments, and policy responses to addiction.** *Science (New York, N.Y.)*
  Humphreys, K. n., Malenka, R. C., Knutson, B. n., MacCoun, R. J.
  2017; 356 (6344): 1237–38

- **A Genetic Polymorphism of the Human Dopamine Transporter Determines the Impact of Sleep Deprivation on Brain Responses to Rewards and Punishments** *JOURNAL OF COGNITIVE NEUROSCIENCE*
  Greer, S. M., Goldstein, A. N., Knutson, B., Walker, M. P.
  2016; 28 (6): 803-810
- **Nucleus accumbens D2R cells signal prior outcomes and control risky decision-making.** *Nature*
  Zalocusky, K. A., Ramakrishnan, C., Lerner, T. N., Davidson, T. J., Knutson, B., Deisseroth, K.
  2016; 531 (7596): 642-646
- **Neural evidence for cultural differences in the valuation of positive facial expressions.** *Social cognitive and affective neuroscience*
  Park, B., Tsai, J. L., Chim, L., Blevins, E., Knutson, B.
  2016; 11 (2): 243-252
- **White-Matter Tract Connecting Anterior Insula to Nucleus Accumbens Correlates with Reduced Preference for Positively Skewed Gambles** *NEURON*
  Leong, J. K., Pestilli, F., Wu, C. C., Samanez-Larkin, G. R., Knutson, B.
  2016; 89 (1): 63-69
- **Prefrontal cortical regulation of brainwide circuit dynamics and reward-related behavior.** *Science*
  Ferenczi, E. A., Zalocusky, K. A., Liston, C., Grosenick, L., Warden, M. R., Amatya, D., Katovich, K., Mehta, H., Patenaude, B., Ramakrishnan, C., Kalanithi, P., Etkin, A., Knutson, et al
  2016; 351 (6268)
- **Neural valuation of environmental resources.** *NeuroImage*
  Sawe, N., Knutson, B.
  2015; 122: 87-95
- **Neural Affective Mechanisms Predict Market-Level Microlending.** *Psychological science*
  Genevsky, A., Knutson, B.
  2015; 26 (9): 1411-1422
- **Cost Conscious? The Neural and Behavioral Impact of Price Primacy on Decision Making** *JOURNAL OF MARKETING RESEARCH*
  Karmarkar, U. R., Shiv, B., Knutson, B.
  2015; 52 (4): 467-481
- **Decision making in the ageing brain: changes in affective and motivational circuits** *NATURE REVIEWS NEUROSCIENCE*
  Samanez-Larkin, G. R., Knutson, B.
  2015; 16 (5): 278-289
- **Probing psychiatric symptoms with the monetary incentive delay task.** *Biological psychiatry*
  Knutson, B., Heinz, A.
  2015; 77 (5): 418-420
- **Advancing consumer neuroscience** *MARKETING LETTERS*
  Smidts, A., Hsu, M., Sanfey, A. G., Boksem, M. A., Ebstein, R. B., Huettel, S. A., Kable, J. W., Karmarkar, U. R., Kitayama, S., Knutson, B., Liberzon, I., Lohrenz, T., Stallen, et al
  2014; 25 (3): 257-267
- **Control of nucleus accumbens activity with neurofeedback** *NEUROIMAGE*
  Greer, S. M., Trujillo, A. J., Glover, G. H., Knutson, B.
  2014; 96: 237-244
- **Inferring affect from fMRI data** *TRENDS IN COGNITIVE SCIENCES*
  Knutson, B., Katovich, K., Suri, G.
  2014; 18 (8): 422-428
- **Adult age differences in frontostriatal representation of prediction error but not reward outcome** *COGNITIVE AFFECTIVE & BEHAVIORAL NEUROSCIENCE*
  Samanez-Larkin, G. R., Worthy, D. A., Mata, R., McClure, S. M., Knutson, B.
  2014; 14 (2): 672-682

- **Adult age differences in frontostriatal representation of prediction error but not reward outcome.** *Cognitive, affective & behavioral neuroscience*
  Samanez-Larkin, G. R., Worthy, D. A., Mata, R., McClure, S. M., Knutson, B.
  2014; 14 (2): 672-682
- **Dissociating Motivation from Reward in Human Striatal Activity** *JOURNAL OF COGNITIVE NEUROSCIENCE*
  Miller, E. M., Shankar, M. U., Knutson, B., McClure, S. M.
  2014; 26 (5): 1075-1084
- **Affective traits link to reliable neural markers of incentive anticipation.** *NeuroImage*
  Wu, C. C., Samanez-Larkin, G. R., Katovich, K., Knutson, B.
  2014; 84: 279-289
- **Neural Underpinnings of the Identifiable Victim Effect: Affect Shifts Preferences for Giving** *JOURNAL OF NEUROSCIENCE*
  Genevsky, A., Vastfjall, D., Slovic, P., Knutson, B.
  2013; 33 (43): 17188-17196
- **Interpretable whole-brain prediction analysis with GraphNet** *NEUROIMAGE*
  Grosenick, L., Klingenberg, B., Katovich, K., Knutson, B., Taylor, J. E.
  2013; 72: 304-321
- **Neural Sensitivity to Absolute and Relative Anticipated Reward in Adolescents** *PLOS ONE*
  Vaidya, J. G., Knutson, B., O'Leary, D. S., Block, R. I., Magnotta, V.
  2013; 8 (3)
- **Spatial smoothing systematically biases the localization of reward-related brain activity** *NEUROIMAGE*
  Sacchet, M. D., Knutson, B.
  2013; 66: 270-277
- **Serotonergic Genotypes, Neuroticism, and Financial Choices** *PLOS ONE*
  Kuhnen, C. M., Samanez-Larkin, G. R., Knutson, B.
  2013; 8 (1)
- **BRAIN TO BANK: NEURAL PREDICTORS OF FINANCIAL RISK TAKING** *20th Annual Meeting of the Cognitive-Neuroscience-Society*
  Wu, C., Knutson, B.
  MIT PRESS.2013: 265–265
- **SPATIAL SMOOTHING AND THE FUNCTIONAL LOCALIZATION OF NUCLEUS ACCUMBENS ACTIVITY** *20th Annual Meeting of the Cognitive-Neuroscience-Society*
  Sacchet, M., Knutson, B.
  MIT PRESS.2013: 231–232
- **Spatial smoothing systematically biases the localization of reward-related brain activity.** *NeuroImage*
  Sacchet, M. D., Knutson, B.
  2012; 66C: 270-277
- **Hyporeactivity of ventral striatum towards incentive stimuli in unmedicated depressed patients normalizes after treatment with escitalopram** *JOURNAL OF PSYCHOPHARMACOLOGY*
  Stoy, M., Schlagenhauf, F., Sterzer, P., Bermpohl, F., Haegele, C., Suchotzki, K., Schmack, K., Wrase, J., Ricken, R., Knutson, B., Adli, M., Bauer, M., Heinz, et al
  2012; 26 (5): 677-688
- **Frontostriatal White Matter Integrity Mediates Adult Age Differences in Probabilistic Reward Learning** *JOURNAL OF NEUROSCIENCE*
  Samanez-Larkin, G. R., Levens, S. M., Perry, L. M., Dougherty, R. F., Knutson, B.
  2012; 32 (15): 5333-5337
- **Interactivity and Reward-Related Neural Activation during a Serious Videogame** *PLOS ONE*
  Cole, S. W., Yoo, D. J., Knutson, B.
  2012; 7 (3)

- **Ventral striatal activation during reward processing in subjects with ultra-high risk for schizophrenia.** *Neuropsychobiology*
  Juckel, G., Friedel, E., Koslowski, M., Witthaus, H., Ozgürdal, S., Gudlowski, Y., Knutson, B., Wrase, J., Brüne, M., Heinz, A., Schlagenhauf, F.
  2012; 66 (1): 50-56
- **Ventral Striatal Activation during Reward Processing in Subjects with Ultra-High Risk for Schizophrenia** *NEUROPSYCHOBIOLOGY*
  Juckel, G., Friedel, E., Koslowski, M., Witthaus, H., Oezguerdal, S., Gudlowski, Y., Knutson, B., Wrase, J., Bruene, M., Heinz, A., Schlagenhauf, F.
  2012; 66 (1): 50-56
- **Toward an affective neuroscience account of financial risk taking** *FRONTIERS IN NEUROSCIENCE*
  Wu, C. C., Sacchet, M. D., Knutson, B.
  2012; 6
- **Toward an affective neuroscience account of financial risk taking.** *Frontiers in neuroscience*
  Wu, C. C., Sacchet, M. D., Knutson, B.
  2012; 6: 159-?
- **Gain and Loss Learning Differentially Contribute to Life Financial Outcomes** *PLOS ONE*
  Knutson, B., Samanez-Larkin, G. R., Kuhnen, C. M.
  2011; 6 (9)
- **Reward processing in male adults with childhood ADHD-a comparison between drug-naive and methylphenidate-treated subjects** *PSYCHOPHARMACOLOGY*
  Stoy, M., Schlagenhauf, F., Schlochtermeier, L., Wrase, J., Knutson, B., Lehmkuhl, U., Huss, M., Heinz, A., Stroehle, A.
  2011; 215 (3): 467-481
- **The Influence of Affect on Beliefs, Preferences, and Financial Decisions** *JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS*
  Kuhnen, C. M., Knutson, B.
  2011; 46 (3): 605-626
- **Expected value information improves financial risk taking across the adult life span** *SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE*
  Samanez-Larkin, G. R., Wagner, A. D., Knutson, B.
  2011; 6 (2): 207-217
- **The Affective Impact of Financial Skewness on Neural Activity and Choice** *PLOS ONE*
  Wu, C. C., Bossaerts, P., Knutson, B.
  2011; 6 (2)
- **REINFORCEMENT LEARNING AND AGE-RELATED CHANGES IN RELATIVE CODING IN MESOLIMBIC BRAIN REGIONS**
  Samanez-Larkin, G. R., Worthy, D. A., McClure, S. M., Knutson, B.
  OXFORD UNIV PRESS INC.2010: 10–10
- **When Giving Is Good: Ventromedial Prefrontal Cortex Activation for Others' Intentions** *NEURON*
  Cooper, J. C., Kreps, T. A., Wiebe, T., Pirkl, T., Knutson, B.
  2010; 67 (3): 511-521
- **Variability in Nucleus Accumbens Activity Mediates Age-Related Suboptimal Financial Risk Taking** *JOURNAL OF NEUROSCIENCE*
  Samanez-Larkin, G. R., Kuhnen, C. M., Yoo, D. J., Knutson, B.
  2010; 30 (4): 1426-1434
- **The Reward Circuit: Linking Primate Anatomy and Human Imaging** *NEUROPSYCHOPHARMACOLOGY*
  Haber, S. N., Knutson, B.
  2010; 35 (1): 4-26
- **Available alternative incentives modulate anticipatory nucleus accumbens activation** *SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE*
  Cooper, J. C., Hollon, N. G., Wimmer, G. E., Knutson, B.
  2009; 4 (4): 409-416
- **Ventral Striatal Activation During Reward Anticipation Correlates with Impulsivity in Alcoholics** *BIOLOGICAL PSYCHIATRY*

Beck, A., Schlagenhauf, F., Wuestenberg, T., Hein, J., Kienast, T., Kahnt, T., Schmack, K., Haegele, C., Knutson, B., Heinz, A., Wrase, J.
2009; 66 (8): 734-742

- **Correction. "Affect dynamics, affective forecasting, and aging".** *Emotion*
  Nielsen, L., Knutson, B., Carstensen, L. L.
  2009; 9 (5): ii-?
- **Reward Processing After Catecholamine Depletion in Unmedicated, Remitted Subjects with Major Depressive Disorder** *BIOLOGICAL PSYCHIATRY*
  Hasler, G., Luckenbaugh, D. A., Snow, J., Meyers, N., Waldeck, T., Geraci, M., Roiser, J., Knutson, B., Charney, D. S., Drevets, W. C.
  2009; 66 (3): 201-205
- **Don't stop thinking about tomorrow: Individual differences in future self-continuity account for saving** *JUDGMENT AND DECISION MAKING*
  Ersner-Hershfield, H., Garton, M. T., Ballard, K., Samanez-Larkin, G. R., Knutson, B.
  2009; 4 (4): 280-286
- **Don't stop thinking about tomorrow: Individual differences in future self-continuity account for saving.** *Judgment and decision making*
  Ersner-Hershfield, H., Garton, M. T., Ballard, K., Samanez-Larkin, G. R., Knutson, B.
  2009; 4 (4): 280-286
- **Saving for the future self: Neural measures of future self-continuity predict temporal discounting** *SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE*
  Ersner-Hershfield, H., Wimmer, G. E., Knutson, B.
  2009; 4 (1): 85-92
- **Dissociable neural representations of future reward magnitude and delay during temporal discounting** *NEUROIMAGE*
  Ballard, K., Knutson, B.
  2009; 45 (1): 143-150
- **Anticipatory affect: neural correlates and consequences for choice** *PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES*
  Knutson, B., Greer, S. M.
  2008; 363 (1511): 3771-3786
- **Interpretable Classifiers for fMRI Improve Prediction of Purchases** *IEEE TRANSACTIONS ON NEURAL SYSTEMS AND REHABILITATION ENGINEERING*
  Grosenick, L., Greer, S., Knutson, B.
  2008; 16 (6): 539-548
- **Incentive-elicited striatal activation in adolescent children of alcoholics** *ADDICTION*
  Bjork, J. M., Knutson, B., Hommer, D. W.
  2008; 103 (8): 1308-1319
- **Neural antecedents of the endowment effect** *NEURON*
  Knutson, B., Wimmer, G. E., Rick, S., Hollon, N. G., Prelec, D., Loewenstein, G.
  2008; 58 (5): 814-822
- **Affect dynamics, affective forecasting, and aging** *EMOTION*
  Nielsen, L., Knutson, B., Carstensen, L. L.
  2008; 8 (3): 318-330
- **Neural responses to monetary incentives in major depression** *BIOLOGICAL PSYCHIATRY*
  Knutson, B., Bhanji, J. P., Cooney, R. E., Atlas, L. Y., Gotlib, I. H.
  2008; 63 (7): 686-692
- **Individual differences in insular sensitivity during loss anticipation predict avoidance learning** *PSYCHOLOGICAL SCIENCE*
  Samanez-Larkin, G. R., Hollon, N. G., Carstensen, L. L., Knutson, B.
  2008; 19 (4): 320-323
- **Nucleus accumbens activation mediates the influence of reward cues on financial risk taking** *NEUROREPORT*

Knutson, B., Wimmer, G. E., Kuhnen, C. M., Winkielman, P.
2008; 19 (5): 509-513

- **Reward system activation in schizophrenic patients switched from typical neuroleptics to olanzapine** *PSYCHOPHARMACOLOGY*
  Schlagenhauf, F., Juckel, G., Koslowski, M., Kahnt, T., Knutson, B., Dembler, T., Kienast, T., Gallinat, J., Wrase, J., Heinz, A.
  2008; 196 (4): 673-684
- **Reward anticipation and outcomes in adult males with attention-deficit/hyperactivity disorder** *NEUROIMAGE*
  Stroehle, A., Stoy, M., Wrase, J., Schwarzer, S., Schlagenhauf, F., Huss, M., Hein, J., Nedderhut, A., Neumann, B., Gregor, A., Juckel, G., Knutson, B., Lehmkuhl, et al
  2008; 39 (3): 966-972
- **Valence and salience contribute to nucleus accumbens activation** *NEUROIMAGE*
  Cooper, J. C., Knutson, B.
  2008; 39 (1): 538-547
- **Neural antecedents of financial decisions** *JOURNAL OF NEUROSCIENCE*
  Knutson, B., Bossaerts, P.
  2007; 27 (31): 8174-8177
- **Different neural systems adjust motor behavior in response to reward and punishment** *NEUROIMAGE*
  Wrase, J., Kahnt, T., Schiagenhauf, F., Beck, A., Cohen, M. X., Knutson, B., Heinz, A.
  2007; 36 (4): 1253-1262
- **Anticipation of monetary gain but not loss in healthy older adults** *NATURE NEUROSCIENCE*
  Samanez-Larkin, G. R., Gibbs, S. E., Khanna, K., Nielsen, L., Carstensen, L. L., Knutson, B.
  2007; 10 (6): 787-791
- **Affective influence on judgments and decisions: Moving towards core mechanisms** *REVIEW OF GENERAL PSYCHOLOGY*
  Winkielman, P., Knutson, B., Paulus, M., Trujillo, J. L.
  2007; 11 (2): 179-192
- **Linking nucleus accumbens dopamine and blood oxygenation** *PSYCHOPHARMACOLOGY*
  Knutson, B., Gibbs, S. E.
  2007; 191 (3): 813-822
- **Dysfunction of reward processing correlates with alcohol craving in detoxified alcoholics** *NEUROIMAGE*
  Wrase, J., Schlagenhauf, F., Kienast, T., Wuestenberg, T., Bermpohl, F., Kahnt, T., Beek, A., Stroehle, A., Juckel, G., Knutson, B., Heinz, A.
  2007; 35 (2): 787-794
- **Ventral striatal hyporesponsiveness during reward anticipation in attention-deficit/hyperactivity disorder** *BIOLOGICAL PSYCHIATRY*
  Scheres, A., Milham, M. P., Knutson, B., Castellanos, F. X.
  2007; 61 (5): 720-724
- **Neural predictors of purchases** *NEURON*
  Knutson, B., Rick, S., Wirnmer, G. E., Prelec, D., Loewenstein, G.
  2007; 53 (1): 147-156
- **Splitting the difference - How does the brain code reward episodes?** *Conference on Reward and Decision-Making in Corticobasal Ganglia Networks*
  Knutson, B., Wimmer, G. E.
  BLACKWELL PUBLISHING.2007: 54–69
- **The lure of the unknown** *NEURON*
  Knutson, B., Cooper, J. C.
  2006; 51 (3): 280-282
- **Dysfunction of ventral striatal reward prediction in schizophrenic patients treated with typical, not atypical, neuroleptics** *PSYCHOPHARMACOLOGY*
  Juckel, G., Schlagenhauf, F., Koslowski, M., Filonov, D., Wuestenberg, T., Villringer, A., Knutson, B., Kienast, T., Gallinat, J., Wrase, J., Heinz, A.
  2006; 187 (2): 222-228

- **Reward-motivated learning: Mesolimbic activation precedes memory formation** *NEURON*
  Adcock, R. A., Thangavel, A., Whitfield-Gabrieli, S., Knutson, B., Gabrieli, J. D.
  2006; 50 (3): 507-517
- **Cultural variation in affect valuation** *JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY*
  Tsai, J. L., Knutson, B., Fung, H. H.
  2006; 90 (2): 288-307
- **Dysfunction of ventral striatal reward prediction in schizophrenia** *NEUROIMAGE*
  Juckel, G., Schlagenhauf, F., Koslowski, M., Wustenberg, T., Villringer, A., Knutson, B., Wrase, J., Heinz, A.
  2006; 29 (2): 409-416
- **The neural basis of financial risk taking** *NEURON*
  Kuhnen, C. M., Knutson, B.
  2005; 47 (5): 763-770
- **Functional magnetic resonance imaging of reward prediction** *CURRENT OPINION IN NEUROLOGY*
  Knutson, B., Cooper, J. C.
  2005; 18 (4): 411-417
- **Neurally reconstructing expected utility** *GAMES AND ECONOMIC BEHAVIOR*
  Knutson, B., Peterson, R.
  2005; 52 (2): 305-315
- **Distributed neural representation of expected value** *JOURNAL OF NEUROSCIENCE*
  Knutson, B., Taylor, J., Kaufman, M., Peterson, R., Glover, G.
  2005; 25 (19): 4806-4812
- **Remembrance of rewards past** *NEURON*
  Knutson, B., Adcock, R. A.
  2005; 45 (3): 331-332
- **Sweet revenge?** *SCIENCE*
  Knutson, B.
  2004; 305 (5688): 1246-1247
- **Amphetamine modulates human incentive processing** *NEURON*
  Knutson, B., Bjork, J. M., Fong, G. W., Hommer, D., Mattay, V. S., Weinberger, D. R.
  2004; 43 (2): 261-269
- **Amphetamine modulates human incentive processing** *NEURON*
  Knutson, B., Bjork, J. M., Fong, G. W., Hommer, D., Mattay, V. S., Weinberger, D. R.
  2004; 43 (2): 261-269
- **Voxel-based homogeneity probability maps of grapy matter in groups: assessing the reliability of functional effects** *NEUROIMAGE*
  Momenan, R., Rawlings, R., Fong, G., Knutson, B., Hommer, D.
  2004; 21 (3): 965-972
- **Incentive-elicited brain activation in adolescents: Similarities and differences from young adults** *JOURNAL OF NEUROSCIENCE*
  Bjork, J. M., Knutson, B., Fong, G. W., Caggiano, D. M., Bennett, S. M., Hommer, D. W.
  2004; 24 (8): 1793-1802
- **Facial EMG discriminates gain and loss anticipation and outcome in a monetary incentive delay task** *44th Annual Meeting of the Society-for-Psychophysiological-Research*
  NIELSEN, L., Knutson, B., Kaufman, M., Weinstein, L., Carstensen, L. L.
  WILEY-BLACKWELL.2004: S80–S80
- **A region of mesial prefrontal cortex tracks monetarily rewarding outcomes: characterization with rapid event-related fMRI** *NEUROIMAGE*
  Knutson, B., Fong, G. W., Bennett, S. M., Adams, C. M., Homme, D.
  2003; 18 (2): 263-272

- **Amygdalar recruitment during anticipation of monetary rewards - An event-related fMRI study** *Conference on the Amygdala in Brain Function*
  Hommer, D. W., Knutson, B., Fong, G. W., Bennett, S., Adams, C. M., Varner, J. L.
  NEW YORK ACAD SCIENCES.2003: 476–478
- **Ultrasonic Vocalizations as indices of affective states in rats** *PSYCHOLOGICAL BULLETIN*
  Knutson, B., Burgdorf, J., Panksepp, J.
  2002; 128 (6): 961-977
- **Volition to action - An event-related fMRI study** *NEUROIMAGE*
  Winterer, G., Adams, C. M., Jones, D. W., Knutson, B.
  2002; 17 (2): 851-858
- **The role of brain emotional systems in addictions: a neuro-evolutionary perspective and new 'self-report' animal model** *ADDICTION*
  Panksepp, J., Knutson, B., Burgdorf, J.
  2002; 97 (4): 459-469
- **Dissociation of reward anticipation and outcome with event-related fMRI** *NEUROREPORT*
  Knutson, B., Fong, G. W., Adams, C. M., Varner, J. L., Hommer, D.
  2001; 12 (17): 3683-3687
- **Negative association of neuroticism with brain volume ratio in healthy humans** *BIOLOGICAL PSYCHIATRY*
  Knutson, B., Momenan, R., RAWLINGS, R. R., Fong, G. W., Hommer, D.
  2001; 50 (9): 685-690
- **Anticipation of increasing monetary reward selectively recruits nucleus accumbens** *JOURNAL OF NEUROSCIENCE*
  Knutson, B., Adams, C. M., Fong, G. W., Hommer, D.
  2001; 21 (16)
- **Nucleus accumbens amphetamine microinjections unconditionally elicit 50-kHz ultrasonic vocalizations in rats** *BEHAVIORAL NEUROSCIENCE*
  Burgdorf, J., Knutson, B., Panksepp, J., Ikemoto, S.
  2001; 115 (4): 940-944
- **Evaluation of rat ultrasonic vocalizations as predictors of the conditioned aversive effects of drugs** *PSYCHOPHARMACOLOGY*
  Burgdorf, J., Knutson, B., Panksepp, J., Shippenberg, T. S.
  2001; 155 (1): 35-42
- **FMRI visualization of brain activity during a monetary incentive delay task** *NEUROIMAGE*
  Knutson, B., Westdorp, A., Kaiser, E., Hommer, D.
  2000; 12 (1): 20-27
- **Anticipation of rewarding electrical brain stimulation evokes ultrasonic vocalization in rats** *BEHAVIORAL NEUROSCIENCE*
  Burgdorf, J., Knutson, B., Panksepp, J.
  2000; 114 (2): 320-327
- **High-frequency ultrasonic vocalizations index conditioned pharmacological reward in rats** *PHYSIOLOGY & BEHAVIOR*
  Knutson, B., Burgdorf, J., Panksepp, J.
  1999; 66 (4): 639-643
- **Anticipation of play elicits high-frequency ultrasonic vocalizations in young rats** *JOURNAL OF COMPARATIVE PSYCHOLOGY*
  Knutson, B., Burgdorf, J., Panksepp, J.
  1998; 112 (1): 65-73
- **Selective alteration of personality and social behavior by serotonergic intervention** *149th Annual Meeting of the American-Psychiatric-Association*
  Knutson, B., Wolkowitz, O. M., Cole, S. W., Chan, T., Moore, E. A., Johnson, R. C., Terpstra, J., Turner, R. A., Reus, V. I.
  AMER PSYCHIATRIC PUBLISHING, INC.1998: 373–79
- **Effects of serotonin depletion on the play of juvenile rats** *Conference of the New-York-Academy-of-Sciences on the Integrative Neurobiology of Affiliation*

Knutson, B., Panksepp, J.
NEW YORK ACAD SCIENCES.1997: 475–477

- **Serotonergic intervention increases affiliative behavior in humans** *Conference of the New-York-Academy-of-Sciences on the Integrative Neurobiology of Affiliation*
  Knutson, B., Cole, S., Wolkowitz, O., Reus, V., Chan, T., Moore, E.
  NEW YORK ACAD SCIENCES.1997: 492–493
- **Facial expressions of emotion influence interpersonal trait inferences** *JOURNAL OF NONVERBAL BEHAVIOR*
  Knutson, B.
  1996; 20 (3): 165-182
- **Effects of fluoxetine on play dominance in juvenile rats** *AGGRESSIVE BEHAVIOR*
  Knutson, B., Panksepp, J., Pruitt, D.
  1996; 22 (4): 297-307
- **ON THE BRAIN AND PERSONALITY SUBSTRATES OF PSYCHOPATHY** *BEHAVIORAL AND BRAIN SCIENCES*
  Panksepp, J., Knutson, B., Bird, L.
  1995; 18 (3): 568-570