

7 References

- Allison T, Ginter H, McCarthy G, Nobre AC, Puce A, Luby M, Spencer DD (1994) Face recognition in human extrastriate cortex. *J Neurophysiol* 71:821-825.
- Asaad WF, Rainer G, Miller EK (2000) Task-specific neural activity in the primate prefrontal cortex. *J Neurophysiol* 84:451-459.
- Baer PE, Fuhrer MJ (1982) Cognitive factors in the concurrent differential conditioning of eyelid and skin conductance responses. *Mem Cognit* 10:135-140.
- Bakin JS, Weinberger NM (1990) Classical conditioning induces CS-specific receptive field plasticity in the auditory cortex of the guinea pig. *Brain Res* 536:271-286.
- Bao S, Chan VT, Merzenich MM (2001) Cortical remodelling induced by activity of ventral tegmental dopamine neurons. *Nature* 412:79-83.
- Bechara A, Tranel D, Damasio H, Adolphs R, Rockland C, Damasio AR (1995) Double dissociation of conditioning and declarative knowledge relative to the amygdala and hippocampus in humans. *Science* 269:1115-1118.
- Beilock SL, Carr TH, MacMahon C, Starkes JL (2002) When paying attention becomes counterproductive: impact of divided versus skill-focused attention on novice and experienced performance of sensorimotor skills. *J Exp Psychol Appl* 8:6-16.
- Boucsein W (1992) *Electrodermal Activity*. New York: Plenum Press.
- Brainard DH (1997) The Psychophysics Toolbox. *Spatial Vision* 10:433-436.
- Buchel C, Dolan RJ (2000) Classical fear conditioning in functional neuroimaging. *Curr Opin Neurobiol* 10:219-223.
- Buchel C, Holmes AP, Rees G, Friston KJ (1998a) Characterizing stimulus-response functions using nonlinear regressors in parametric fMRI experiments. *Neuroimage* 8:140-148.
- Buchel C, Morris J, Dolan RJ, Friston KJ (1998b) Brain systems mediating aversive conditioning: an event-related fMRI study. *Neuron* 20:947-957.

- Buchel C, Dolan RJ, Armony JL, Friston KJ (1999) Amygdala-hippocampal involvement in human aversive trace conditioning revealed through event-related functional magnetic resonance imaging. *J Neurosci* 19:10869-10876.
- Carrillo M, Gabrieli J, Disterhoft J (2000) Selective effects of division of attention on discrimination conditioning. *Psychobiology* 28:293-302.
- Carter RM, Hofstotter C, Tsuchiya N, Koch C (2003) Working memory and fear conditioning. *Proc Natl Acad Sci U S A* 100:1399-1404.
- Carter RM, O'Doherty JP, Seymour B, Koch C, Dolan RJ (2006) Contingency awareness in human aversive conditioning involves the middle frontal gyrus. *Neuroimage* 29:1007-1012.
- Castner SA, Goldman-Rakic PS, Williams GV (2004) Animal models of working memory: insights for targeting cognitive dysfunction in schizophrenia. *Psychopharmacology (Berl)* 174:111-125.
- Chun MM, Phelps EA (1999) Memory deficits for implicit contextual information in amnesic subjects with hippocampal damage. *Nat Neurosci* 2:844-847.
- Clark RE, Squire LR (1998) Classical conditioning and brain systems: the role of awareness. *Science* 280:77-81.
- Clark RE, Squire LR (1999) Human eyeblink classical conditioning: Effects of manipulating awareness of the stimulus contingencies. *Psychol Sci* 10:14-18.
- Clark RE, Manns JR, Squire LR (2001) Trace and delay eyeblink conditioning: contrasting phenomena of declarative and nondeclarative memory. *Psychol Sci* 12:304-308.
- Clark RE, Manns JR, Squire LR (2002) Classical conditioning, awareness, and brain systems. *Trends Cogn Sci* 6:524-531.
- Cole LE (1939) A Comparison of Factors of Practice and Knowledge of Experimental Procedure in Conditioning the Eye-lid Response of Human Subjects. *J Gen Psychol* 20:349-373.
- Colloca L, Benedetti F (2005) Placebos and painkillers: is mind as real as matter? *Nat Rev Neurosci* 6:545-552.
- Compton DM, Griffith HR, McDaniel WF, Foster RA, Davis BK (1997) The flexible use of multiple cue relationships in spatial navigation: a comparison of water maze performance following

- hippocampal, medial septal, prefrontal cortex, or posterior parietal cortex lesions. *Neurobiol Learn Mem* 68:117-132.
- Connolly JB, Roberts IJ, Armstrong JD, Kaiser K, Forte M, Tully T, O'Kane CJ (1996) Associative learning disrupted by impaired Gs signaling in *Drosophila* mushroom bodies. *Science* 274:2104-2107.
- Cook SW, Harris RE (1937) The Verbal Conditioning of the Galvanic Skin Response. *J Exp Psychol* 21:202-210.
- Corlett PR, Aitken MR, Dickinson A, Shanks DR, Honey GD, Honey RA, Robbins TW, Bullmore ET, Fletcher PC (2004) Prediction error during retrospective revaluation of causal associations in humans: fMRI evidence in favor of an associative model of learning. *Neuron* 44:877-888.
- Critchley HD, Mathias CJ, Dolan RJ (2002) Fear conditioning in humans: the influence of awareness and autonomic arousal on functional neuroanatomy. *Neuron* 33:653-663.
- D'Esposito M, Aguirre GK, Zarahn E, Ballard D, Shin RK, Lease J (1998) Functional MRI studies of spatial and nonspatial working memory. *Cogn Brain Res* 7:1-13.
- Damasio AR, Tranel D, Damasio H (1991) Somatic Markers and the Guidance of Behaviour: Theory and Preliminary Testing. In: *Frontal Lobe Function and Dysfunction* (Levin HS, Eisenberg HM, Benton AL, eds), pp 217-229. New York: Oxford University Press.
- Dawson ME, Furedy JJ (1976) The role of awareness in human differential autonomic classical conditioning: the necessary-gate hypothesis. *Psychophysiology* 13:50-53.
- Degonda N, Mondadori CR, Bosshardt S, Schmidt CF, Boesiger P, Nitsch RM, Hock C, Henke K (2005) Implicit associative learning engages the hippocampus and interacts with explicit associative learning. *Neuron* 46:505-520.
- Deichmann R, Gottfried JA, Hutton C, Turner R (2003) Optimized EPI for fMRI studies of the orbitofrontal cortex. *Neuroimage* 19:430-441.
- Dyer AG, Neumeyer C, Chittka L (2005) Honeybee (*Apis mellifera*) vision can discriminate between and recognise images of human faces. *J Exp Biol* 208:4709-4714.
- Edeline JM, Pham P, Weinberger NM (1993) Rapid development of learning-induced receptive field plasticity in the auditory cortex. *Behav Neurosci* 107:539-551.

- Efron B, Tibshirani RJ (1998) *An Introduction to the Bootstrap*, 2 Edition. New York: Chapman and Hall.
- Eichenbaum H (1997) NEUROSCIENCE: How Does the Brain Organize Memories? *Science* 277:330-332.
- Eichenbaum H, Schoenbaum G, Young B, Bunsey M (1996) Functional organization of the hippocampal memory system. *Proc Natl Acad Sci U S A* 93:13500-13507.
- Fanselow MS (2000) Contextual fear, gestalt memories, and the hippocampus. *Behav Brain Res* 110:73-81.
- Fendt M, Fanselow MS (1999) The neuroanatomical and neurochemical basis of conditioned fear. *Neurosci Biobehav Rev* 23:743-760.
- Friston KJ, Holmes AP, Price CJ, Buchel C, Worsley KJ (1999) Multisubject fMRI studies and conjunction analyses. *Neuroimage* 10:385-396.
- Fritz J, Shamma S, Elhilali M, Klein D (2003) Rapid task-related plasticity of spectrotemporal receptive fields in primary auditory cortex. *Nat Neurosci* 6:1216-1223.
- Gallistel CR (1990) *The Organization of Learning*. Cambridge, MA: Bradford Books, MIT Press.
- Gauthier I, Tarr MJ (1997) Becoming a "Greeble" expert: exploring mechanisms for face recognition. *Vision Res* 37:1673-1682.
- Gauthier I, Skudlarski P, Gore JC, Anderson AW (2000) Expertise for cars and birds recruits brain areas involved in face recognition. *Nat Neurosci* 3:191-197.
- Gilboa A, Shalev AY, Laor L, Lester H, Louzoun Y, Chisin R, Bonne O (2004) Functional connectivity of the prefrontal cortex and the amygdala in posttraumatic stress disorder. *Biol Psychiatry* 55:263-272.
- Goldman-Rakic P (1987) Circuitry of primate prefrontal cortex and regulation of behaviour by representational memory. In: *Handbook of physiology* (Plum F, Mouncastle U, eds), pp 373-417. Washington, DC: The American Physiological Society.
- Goldstone RL (1998) Perceptual learning. *Annu Rev Psychol* 49:585-612.
- Grillon C (2002) Startle reactivity and anxiety disorders: aversive conditioning, context, and neurobiology. *Biol Psychiatry* 52:958-975.
- Haijiang Q, Saunders JA, Stone RW, Backus BT (2006) Demonstration of cue recruitment: Change in visual appearance by means of Pavlovian conditioning. *PNAS* 103:483-488.

- Han CJ, O'Tuathaigh CM, van Trigt L, Quinn JJ, Fanselow MS, Mongeau R, Koch C, Anderson DJ (2003) Trace but not delay fear conditioning requires attention and the anterior cingulate cortex. *Proc Natl Acad Sci U S A* 100:13087-13092.
- Haxby JV, Horwitz B, Ungerleider LG, Maisog JM, Pietrini P, Grady CL (1994) The functional organization of human extrastriate cortex: a PET-rCBF study of selective attention to faces and locations. *J Neurosci* 14:6336-6353.
- Henson RN, Shallice T, Gorno-Tempini ML, Dolan RJ (2002) Face repetition effects in implicit and explicit memory tests as measured by fMRI. *Cereb Cortex* 12:178-186.
- Hilgard ER, Campbell RK, Sears WN (1937) Conditioned discrimination: The effect of knowledge of stimulus relationships. *Am J Psychol* 51:498-506.
- Ishai A, Pessoa L, Bickle PC, Ungerleider LG (2004) Repetition suppression of faces is modulated by emotion. *PNAS* 101:9827-9832.
- Kanwisher N, McDermott J, Chun MM (1997) The fusiform face area: a module in human extrastriate cortex specialized for face perception. *J Neurosci* 17:4302-4311.
- Kaube H, Katsarava Z, Kaufer T, Diener HC, Ellrich J (2000) A new method to increase nociception specificity of the human blink reflex. *Clin Neurophysiol* 111:413-416.
- Khurana B, Carter RM, Watanabe K, Nijhawan R (2006) Flash-lag chimeras: The role of perceived alignment in the composite face effect. *Vision Res* 46:2757-2772.
- Kim JJ, Fanselow MS (1992) Modality-specific retrograde amnesia of fear. *Science* 256:675-677.
- Kisley MA, Gerstein GL (2001) Daily variation and appetitive conditioning-induced plasticity of auditory cortex receptive fields. *Eur J Neurosci* 13:1993-2003.
- Knight DC, Smith CN, Stein EA, Helmstetter FJ (1999) Functional MRI of human Pavlovian fear conditioning: patterns of activation as a function of learning. *Neuroreport* 10:3665-3670.
- Knight DC, Cheng DT, Smith CN, Stein EA, Helmstetter FJ (2004) Neural substrates mediating human delay and trace fear conditioning. *J Neurosci* 24:218-228.
- Knuttninen MG, Power JM, Preston AR, Disterhoft JF (2001) Awareness in classical differential eyeblink conditioning in young and aging humans. *Behav Neurosci* 115:747-757.

- Kocorowski LH, Helmstetter FJ (2001) Calcitonin gene-related peptide released within the amygdala is involved in Pavlovian auditory fear conditioning. *Neurobiol Learn Mem* 75:149-163.
- Kronforst-Collins MA, Disterhoft JF (1998) Lesions of the caudal area of rabbit medial prefrontal cortex impair trace eyeblink conditioning. *Neurobiol Learn Mem* 69:147-162.
- LaBar KS, Disterhoft JF (1998) Conditioning, awareness, and the hippocampus. *Hippocampus* 8:620-626.
- LaBar KS, Gatenby JC, Gore JC, LeDoux JE, Phelps EA (1998) Human amygdala activation during conditioned fear acquisition and extinction: a mixed-trial fMRI study. *Neuron* 20:937-945.
- Law E, Nuttley WM, van der Kooy D (2004) Contextual taste cues modulate olfactory learning in *C. elegans* by an occasion-setting mechanism. *Curr Biol* 14:1303-1308.
- LeDoux J (2003) The emotional brain, fear, and the amygdala. *Cell Mol Neurobiol* 23:727-738.
- Leung HC, Gore JC, Goldman-Rakic PS (2002) Sustained mnemonic response in the human middle frontal gyrus during on-line storage of spatial memoranda. *J Cogn Neurosci* 14:659-671.
- Lovibond PF, Shanks DR (2002) The role of awareness in Pavlovian conditioning: empirical evidence and theoretical implications. *J Exp Psychol Anim Behav Process* 28:3-26.
- Luria AR (1968) *The mind of a mnemonist; a little book about a vast memory* [by] A. R. Luria. Translated from the Russian by Lynn Solotaroff. With a foreword by Jerome S. Bruner. New York: Basic Books.
- Lykken DT (1972) Range correction applied to heart rate and to GSR data. *Psychophysiology* 9:373-379.
- Mackintosh NJ (1983) *Conditioning and Associative Learning*. Oxford, England: Clarendon Press.
- Manns JR, Clark RE, Squire LR (2000a) Awareness predicts the magnitude of single-cue trace eyeblink conditioning. *Hippocampus* 10:181-186.
- Manns JR, Clark RE, Squire LR (2000b) Parallel acquisition of awareness and trace eyeblink classical conditioning. *Learn Mem* 7:267-272.
- Manns JR, Clark RE, Squire LR (2002) Standard delay eyeblink classical conditioning is independent of awareness. *J Exp Psychol Anim Behav Process* 28:32-37.
- Maren S (2001) Neurobiology of Pavlovian fear conditioning. *Annu Rev Neurosci* 24:897-931.
- Maren S, Quirk GJ (2004) Neuronal signalling of fear memory. *Nat Rev Neurosci* 5:844-852.

- Maren S, Aharonov G, Fanselow MS (1997) Neurotoxic lesions of the dorsal hippocampus and Pavlovian fear conditioning in rats. *Behav Brain Res* 88:261-274.
- Mayer MJ, Ross LE (1969) Effects of stimulus complexity, interstimulus interval, and masking task conditions in differential eyelid conditioning. *J Exp Psychol* 81:469-474.
- McEchron MD, Bouwmeester H, Tseng W, Weiss C, Disterhoft JF (1998) Hippocampectomy disrupts auditory trace fear conditioning and contextual fear conditioning in the rat. *Hippocampus* 8:638-646.
- McIntosh AR, Gonzalez-Lima F (1998) Large-scale functional connectivity in associative learning: interrelations of the rat auditory, visual, and limbic systems. *J Neurophysiol* 80:3148-3162.
- McLaughlin J, Skaggs H, Churchwell J, Powell DA (2002) Medial prefrontal cortex and pavlovian conditioning: trace versus delay conditioning. *Behav Neurosci* 116:37-47.
- Medina JF, Christopher Repa J, Mauk MD, LeDoux JE (2002) Parallels between cerebellum- and amygdala-dependent conditioning. *Nat Rev Neurosci* 3:122-131.
- Milad MR, Rauch SL, Pitman RK, Quirk GJ (2006) Fear extinction in rats: Implications for human brain imaging and anxiety disorders. *Biol Psychol*.
- Morris JS, Ohman A, Dolan RJ (1998a) Conscious and unconscious emotional learning in the human amygdala. *Nature* 393:467-470.
- Morris JS, Friston KJ, Dolan RJ (1998b) Experience-dependent modulation of tonotopic neural responses in human auditory cortex. *Proc Biol Sci* 265:649-657.
- Morris JS, Ohman A, Dolan RJ (1999) A subcortical pathway to the right amygdala mediating "unseen" fear. *Proc Natl Acad Sci U S A* 96:1680-1685.
- Morris JS, Buchel C, Dolan RJ (2001) Parallel neural responses in amygdala subregions and sensory cortex during implicit fear conditioning. *Neuroimage* 13:1044-1052.
- Ohman A, Soares JJ (1998) Emotional conditioning to masked stimuli: expectancies for aversive outcomes following nonrecognized fear-relevant stimuli. *J Exp Psychol Gen* 127:69-82.
- Olsson A, Phelps EA (2004) Learned fear of "unseen" faces after Pavlovian, observational, and instructed fear. *Psychol Sci* 15:822-828.

- Pavlov IP (1906) The scientific investigation of the psychical faculties or processes in higher animals. *Science* 24:613-619.
- Pearce JM, Redhead ES, Aydin A (1997) Partial reinforcement in appetitive Pavlovian conditioning with rats. *Q J Exp Psychol B* 50:273-294.
- Pessoa L, Kastner S, Ungerleider LG (2003) Neuroimaging Studies of Attention: From Modulation of Sensory Processing to Top-Down Control. *J Neurosci* 23:3990-3998.
- Pessoa L, Gutierrez E, Bandettini P, Ungerleider L (2002) Neural correlates of visual working memory: fMRI amplitude predicts task performance. *Neuron* 35:975-987.
- Pessoa L, Japee S, Sturman D, Ungerleider LG (2006) Target visibility and visual awareness modulate amygdala responses to fearful faces. *Cereb Cortex* 16:366-375.
- Petrides M (2000) The role of the mid-dorsolateral prefrontal cortex in working memory. *Exp Brain Res* 133:44-54.
- Phillips RG, LeDoux JE (1992) Differential contribution of amygdala and hippocampus to cued and contextual fear conditioning. *Behav Neurosci* 106:274-285.
- Pochon JB, Levy R, Fossati P, Lehericy S, Poline JB, Pillon B, Le Bihan D, Dubois B (2002) The neural system that bridges reward and cognition in humans: an fMRI study. *Proc Natl Acad Sci U S A* 99:5669-5674.
- Poggio T, Fahle M, Edelman S (1992) Fast perceptual learning in visual hyperacuity. *Science* 256:1018-1021.
- Puce A, Allison T, Asgari M, Gore JC, McCarthy G (1996) Differential sensitivity of human visual cortex to faces, letterstrings, and textures: a functional magnetic resonance imaging study. *J Neurosci* 16:5205-5215.
- Quinn JJ, Oommen SS, Morrison GE, Fanselow MS (2002) Post-training excitotoxic lesions of the dorsal hippocampus attenuate forward trace, backward trace, and delay fear conditioning in a temporally specific manner. *Hippocampus* 12:495-504.
- Quirk GJ, Gehlert DR (2003) Inhibition of the amygdala: key to pathological states? *Ann N Y Acad Sci* 985:263-272.

- Quirk GJ, Armony JL, LeDoux JE (1997) Fear conditioning enhances different temporal components of tone-evoked spike trains in auditory cortex and lateral amygdala. *Neuron* 19:613-624.
- Quirk GJ, Likhtik E, Pelletier JG, Pare D (2003) Stimulation of medial prefrontal cortex decreases the responsiveness of central amygdala output neurons. *J Neurosci* 23:8800-8807.
- Rankin CH, Beck CD, Chiba CM (1990) *Caenorhabditis elegans*: a new model system for the study of learning and memory. *Behav Brain Res* 37:89-92.
- Rosenkranz JA, Grace AA (2001) Dopamine attenuates prefrontal cortical suppression of sensory inputs to the basolateral amygdala of rats. *J Neurosci* 21:4090-4103.
- Schendan HE, Searl MM, Melrose RJ, Stern CE (2003) An FMRI study of the role of the medial temporal lobe in implicit and explicit sequence learning. *Neuron* 37:1013-1025.
- Scoville WB, Milner B (1957) Loss of recent memory after bilateral hippocampal lesions. *J Neurol Neurosurg Psychiatry* 20:11-21.
- Seymour B, O'Doherty JP, Koltzenburg M, Wiech K, Frackowiak R, Friston K, Dolan R (2005) Opponent appetitive-aversive neural processes underlie predictive learning of pain relief. *Nat Neurosci* 8:1234-1240.
- Shamma SA (2004) Topographic organization is essential for pitch perception. *Proc Natl Acad Sci U S A* 101:1114-1115.
- Shellock FG (2000a) *Magnetic Resonance Procedures: Health Effects and Safety*. New York: CRC Press.
- Shellock FG (2000b) Radiofrequency energy-induced heating during MR procedures: a review. *J Magn Reson Imaging* 12:30-36.
- Shuler MG, Bear MF (2006) Reward timing in the primary visual cortex. *Science* 311:1606-1609.
- Slimko EM, McKinney S, Anderson DJ, Davidson N, Lester HA (2002) Selective electrical silencing of mammalian neurons in vitro by the use of invertebrate ligand-gated chloride channels. *J Neurosci* 22:7373-7379.
- Soares JJ, Ohman A (1993) Backward masking and skin conductance responses after conditioning to nonfeared but fear-relevant stimuli in fearful subjects. *Psychophysiology* 30:460-466.
- Sotres-Bayon F, Cain CK, Ledoux JE (2006) Brain Mechanisms of Fear Extinction: Historical Perspectives on the Contribution of Prefrontal Cortex. *Biol Psychiatry*.

- Squire LR, Kandel ER (1999) *From Mind to Molecules*. New York, New York: Scientific American Library, Freeman.
- Tarr MJ, Gauthier I (2000) FFA: a flexible fusiform area for subordinate-level visual processing automatized by expertise. *Nat Neurosci* 3:764-769.
- Thompson RF, Krupa DJ (1994) Organization of memory traces in the mammalian brain. *Annu Rev Neurosci* 17:519-549.
- Tully T (1998) Toward a molecular biology of memory: the light's coming on! *Nat Neurosci* 1:543-545.
- Tully T, Quinn WG (1985) Classical conditioning and retention in normal and mutant *Drosophila melanogaster*. *J Comp Physiol [A]* 157:263-277.
- Wallis JD, Anderson KC, Miller EK (2001) Single neurons in prefrontal cortex encode abstract rules. *Nature* 411:953-956.
- Watanabe T, Nanez JE, Koyama S, Mukai I, Liederman J, Sasaki Y (2002) Greater plasticity in lower-level than higher-level visual motion processing in a passive perceptual learning task. *Nat Neurosci* 5:1003-1009.
- Weible AP, McEchron MD, Disterhoft JF (2000) Cortical involvement in acquisition and extinction of trace eyeblink conditioning. *Behav Neurosci* 114:1058-1067.
- Weinberger NM (2004) Specific long-term memory traces in primary auditory cortex. *Nat Rev Neurosci* 5:279-290.
- Weiskrantz L, Warrington EK, Sanders MD, Marshall J (1974) Visual capacity in the hemianopic field following a restricted occipital ablation. *Brain* 97:709-728.
- Wen JY, Kumar N, Morrison G, Rambaldini G, Runciman S, Rousseau J, van der Kooy D (1997) Mutations that prevent associative learning in *C. elegans*. *Behav Neurosci* 111:354-368.
- Wiens S, Ohman A (2002) Unawareness is more than a chance event: comment on Lovibond and Shanks (2002). *J Exp Psychol Anim Behav Process* 28:27-31.
- Wilensky AE, Schafe GE, LeDoux JE (1999) Functional inactivation of the amygdala before but not after auditory fear conditioning prevents memory formation. *J Neurosci* 19:art. no.-RC48.
- Wunderlich K, Schneider KA, Kastner S (2005) Neural correlates of binocular rivalry in the human lateral geniculate nucleus. *Nat Neurosci* 8:1595-1602.

Yang TT, Gallen C, Schwartz B, Bloom FE, Ramachandran VS, Cobb S (1994) Sensory maps in the human brain. *Nature* 368:592-593.