

CURRICULUM VITAE

Joseph E. LeDoux, Ph.D.

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Education: Louisiana State University
Baton Rouge, LA 1968-1971
B.S. 1971

Louisiana State University
Baton Rouge, LA 1972-1974
M.S. 1974

State University of NY
Stony Brook, NY 1974-1977
Ph.D. 1977

Professional Appointments: Center for Neural Science and
Department of Psychology
New York University
*1989-1991, *Associate Professor*
*1991-1996, *Professor*
*1996-present, *Henry and Lucy Moses Professor of Science*
*2005-present, *University Professor*

Nathan Kline Institute
2007-present, *Director of Emotional Brain Institute*

Cornell University Medical College
Department of Neurology
*1986 - 1989, *Associate Professor*
*1980 - 1986, *Assistant Professor*
*1979 - 1980, *Instructor*
*1977 - 1979, *NIH Postdoctoral Fellow*

Professional Societies:

Society for Neuroscience
International Brain Research Organization
American Association for the Advancement of Science
New York Academy of Sciences

Editorial Boards:

Behavioral Brain Research
Cognitive Systems Research
Learning and Memory
Brain and Mind
Neurobiology of Learning and Memory
Neuro-Psychoanalysis
Emotion Review
Neuron

Foundation and Organizational Boards:

Foundation for Human Potential
Anxiety Disorders Association of America
Aspen Brain Forum
Neuroscience Research Program

Named Lectureships:

Lokus Lecture in Physiological Psychology, U. Washington, (1996)
Solowey Award Lecture in Neuroscience, NIH (1997)
Dana Alliance/Smithsonian Lecture (1997)
Neal Miller Lecture, American Psychological Association (1997)
Donders Lecture, Max Planck Institute, Nimegin, Netherlands (1998)
Charles Fisher Lecture, NY Psychoanalytic (1998)
Society for Neuroscience Presidential Lecture (1999)
Distinguished Lecturer, Cornell University (2000)
Elliot Lecture, University of Pennsylvania (2000)
Litman Lecture, University of Colorado (2000)
Flynn Lecture, Yale University (2001)
Secret Life of the Brain Lecture, Smithsonian (2001)
American Psychopathological Association, Hoch Lecture (2001)
Henry and Lucy Moses Lecture, NYU (2002)
Distinguished Lecturer, American Psychological Association (2002)
Schwarz Lecture, SUNY Stony Brook (2002)
Herbert Spencer Lecture, Oxford (2002)
Grass Lecture, Emory University (2004)
Keynote Address, Biological Psychiatry (2004)
Barrett Neuroscience Lecture, University of Michigan (2004)
Kline Lecture, University of Cincinnati (2007)
University Professorship Inaugural Lecture, NYU (2007)

Woolsey Lecture, University of Wisconsin (2008)
Hebb Lecture, American Psychological Association, 2008
Santiago Grisolia Lecture, Valencia Spain (2009)
Distinguished Scientific Contributions Lecture, American
Psychological Association (2010)

**Honors and
Awards:**

Merit Award, NIMH (1989)
Research Scientist Development Award (KO2), NIMH (1994)
Jean Louis Signoret Prize, Foundation IPSEN, Paris (1999)
Margaret and Louis Sokol Faculty Award in the Sciences, NYU (1998)
Research Scientist Development Award (KO2), NIMH (1999)
Merit Award, NIMH (1999)
Hoch Award, American Psychopathological Association (2001)
Research Scientist Award (K05), NIMH (2003)
Fellow of the New York Academy of Sciences (2005)
Fyssen Foundation 2005 International Prize (2006)
Fellow of the American Academy of Arts and Sciences (2006)
D. O. Hebb Award, American Psychological Association (2008)
Santiago Grisolia Prize, Valencia Spain (2009)
Distinguished Scientific Contributions to Psychology, American
Psychological Association (2010)

Extramural Research Grants:
Currently Active Grants

- 1985-2014 Neural Pathways Underlying Emotional Conditioning, NIMH (J.E. LeDoux, PI)
- 1991-2011 Synaptic Transmission in Fear Conditioning Circuits, NIMH (J.E. LeDoux, PI)
- 1999-2010 Center for the Neural Systems of Fear and Anxiety, NIMH Conte Center (J.E. LeDoux, PI)
- 2007-2011 Affect, Learning and Decision Making, McDonnell Grant (E. Phelps, PI)
- 2009-2012 Serial vs. Parallel Processing in the Amygdala. NSF (J.E. LeDoux, PI)
- 2010-2015 Neural Mechanisms of Avoidance: Implications for Addiction, NIDA (J.E. LeDoux, PI)

Previous Grants

- 1977-1979 Parietal Lobe Disorders (NIH Postdoctoral Fellowship)
- 1979-1982 Language Processing and Its Disorders (NINCDS, J.E. LeDoux, PI)
- 1984-1987 Sensory Control of Blood Pressure (American Heart Assoc., J.E. LeDoux, PI)
- 1986-1991 Neural Pathways Mediating Interactions between the Auton. Nerv. Sys. and Behavior, Project IIB in The Neurogenic Hypertension Program Project (NHLBI, D.J. Reis, Program Director)
- 1986-1991 Established Investigator Award (American Heart Association Career Development Grant)
- 1987-1990 Sensory Control of Blood Pressure: Cellular Mechanisms (New York Heart Assoc., Anton Monell Award, J.E. LeDoux, PI)
- 1992-1995 Neural Mechanisms of Contextual Fear, Conditioning, NSF (J.E. LeDoux, PI)
- 1993-2003 Mechanisms of Emotional Memory, NIMH RSDA Award (J.E. LeDoux, PI)
- 2001-2004 Towards an Understanding of Reconsolidation, Human Scientific Frontiers (J.E. LeDoux, PI)
- 2001-2006 Does Reconsolidation Recapitulate Consolidation, Volkswagen Foundation (J.E. LeDoux, PI)
- 2002-2006 fMRI Localization of Psychotic Symptoms in Schizophrenia, NIMH (D. Silbersweig, PI)
- 2004-2007 Extinction and Active Coping Fear: Translation from Animal Models to Human Function, NIMH (J.E. LeDoux, Co-PI)
- 2003-2008 Mechanisms of Emotional Memory, NIMH Research Scientist Award (J.E. LeDoux, PI)
- 2004-2008 US-France Cooperative Research: The Anatomy of Fear-Networks in the Lateral Amygdala, NSF (J.E. LeDoux, PI)

Peer Reviewed Research Papers

1. Thompson R, Chetta M, LeDoux JE (1974) Brightness discrimination loss after lesion of the corpus striatum in the white rat. *Bull Psychon Soc* 3:293-295.
2. Thompson R, LeDoux JE (1974) Common brain regions essential for the expression of learned and instinctive visual habits in the albino rat. *Bull Psychon Soc* 4:78-80.
3. Thompson R, LeDoux JE (1975) A stereotaxic map of the brainstem areas critical for locomotor responses in a novel environment. *Bull Psychon Soc* 6:327-328.
4. Thompson R, LeDoux JE (1976) Stereotaxic mapping of brainstem areas critical for the expression of the rodent's preference for the dark. *Bull Psychon Soc* 8:472-474.
5. LeDoux JE, Risse GL, Springer SP, Wilson DH, Gazzaniga MS (1977) Cognition and commissurotomy. *Brain* 100 Pt 1:87-104.
6. LeDoux JE, Wilson DH, Gazzaniga MS (1977) Manipulo-spatial aspects of cerebral lateralization: clues to the origin of lateralization. *Neuropsychologia* 15:743-750.
7. Gazzaniga MS, LeDoux JE, Wilson DH (1977) Language, praxis, and the right hemisphere: clues to some mechanisms of consciousness. *Neurology* 27:1144-1147.
8. LeDoux JE, Wilson DH, Gazzaniga MS (1977) A divided mind: observations on the conscious properties of the separated hemispheres. *Ann Neurol* 2:417-421.
9. Risse GL, LeDoux JE, Springer SP, Wilson DH, Gazzaniga MS (1978) The anterior commissure in man: functional variation in a multisensory system. *Neuropsychologia* 16:23-31.
10. LeDoux JE, Wilson DH, Gazzaniga MS (1978) Block design performance following callosal sectioning. Observations on functional recovery. *Arch Neurol* 35:506-508.
11. Gazzaniga MS, Volpe BT, Smylie CS, Wilson DH, LeDoux JE (1979) Plasticity in speech organization following commissurotomy. *Brain* 102:805-815.
12. Volpe BT, LeDoux JE, Gazzaniga MS (1979) Spatially oriented movements in the absence of proprioception. *Neurology* 29:1309-1313.
13. Volpe BT, LeDoux JE, Gazzaniga MS (1979) Information processing of visual stimuli in an "extinguished" field. *Nature* 282:722-724.
14. LeDoux JE, Smylie CS, Ruff R, Gazzaniga MS (1980) Left hemisphere visual processes in a case of right hemisphere symptomatology. Implications for theories of cerebral lateralization. *Arch Neurol* 37:157-159.

15. LeDoux JE, Tucker LW, Del Bo A, Harshfield G, Green L, Talman WT, Reis DJ (1980) A hierarchical organization of blood pressure during natural behaviour in rat and the effects of central catecholamine neurons thereon. *Clin Sci (Lond)* 59 Suppl 6:271s-273s.
16. del Bo A, LeDoux JE, Tucker LW, Harshkfield GA, Reis DJ (1982) Arterial pressure and heart rate changes during natural sleep in rat. *Physiol Behav* 28:425-429.
17. LeDoux JE, Del Bo A, Tucker LW, Harshfield G, Talman WT, Reis DJ (1982) Hierarchic organization of blood pressure responses during the expression of natural behaviors in rat: mediation by sympathetic nerves. *Exp Neurol* 78:121-133.
18. LeDoux JE, Sakaguchi A, Reis DJ (1982) Behaviorally selective cardiovascular hyperreactivity in spontaneously hypertensive rats. Evidence for hypoemotionality and enhanced appetitive motivation. *Hypertension* 4:853-863.
19. LeDoux JE, Sakaguchi A, Reis DJ (1983) Alpha-methylDOPA dissociates hypertension, cardiovascular reactivity and emotional behavior in spontaneously hypertensive rats. *Brain Res* 259:69-76.
20. Sakaguchi A, LeDoux JE, Reis DJ (1983) Sympathetic nerves and adrenal medulla: contributions to cardiovascular-conditioned emotional responses in spontaneously hypertensive rats. *Hypertension* 5:728-738.
21. LeDoux JE, Sakaguchi A, Reis DJ (1983) Strain differences in fear between spontaneously hypertensive and normotensive rats. *Brain Res* 277:137-143.
22. Thompson ME, LeDoux JE, Iadecola C, Tucker LW, Reis DJ (1983) Select increases in local cerebral blood flow during environmental stimulation in conscious rat. *J Cerebral Blood Flow and Metabolism* 3:S256-S257.
23. LeDoux JE, Thompson ME, Iadecola C, Tucker LW, Reis DJ (1983) Local cerebral blood flow increases during auditory and emotional processing in the conscious rat. *Science* 221:576-578.
24. LeDoux JE, Blum C, Hirst W (1983) Inferential processing of context: studies of cognitively impaired subjects. *Brain Lang* 19:216-224.
25. Sakaguchi A, LeDoux JE, Sved AF, Reis DJ (1984) Strain difference in fear between spontaneously hypertensive and normotensive rats is mediated by adrenal cortical hormones. *Neurosci Lett* 46:59-64.
26. LeDoux JE, Sakaguchi A, Reis DJ (1984) Subcortical efferent projections of the medial geniculate nucleus mediate emotional responses conditioned to acoustic stimuli. *J Neurosci* 4:683-698.
27. LeDoux JE, Ruggiero DA, Reis DJ (1985) Projections to the subcortical forebrain from anatomically defined regions of the medial geniculate body in the rat. *J Comp*

Neurol 242:182-213.

28. LeDoux JE, Sakaguchi A, Iwata J, Reis DJ (1986) Interruption of projections from the medial geniculate body to an archi-neostriatal field disrupts the classical conditioning of emotional responses to acoustic stimuli. *Neuroscience* 17:615-627.
29. Iwata J, LeDoux JE, Reis DJ (1986) Destruction of intrinsic neurons in the lateral hypothalamus disrupts the classical conditioning of autonomic but not behavioral emotional responses in the rat. *Brain Res* 368:161-166.
30. Iwata J, LeDoux JE, Meeley MP, Arneric S, Reis DJ (1986) Intrinsic neurons in the amygdaloid field projected to by the medial geniculate body mediate emotional responses conditioned to acoustic stimuli. *Brain Res* 383:195-214.
31. LeDoux JE, Iwata J, Pearl D, Reis DJ (1986) Disruption of auditory but not visual learning by destruction of intrinsic neurons in the rat medial geniculate body. *Brain Res* 371:395-399.
32. Iwata J, Chida K, LeDoux JE (1987) Cardiovascular responses elicited by stimulation of neurons in the central amygdaloid nucleus in awake but not anesthetized rats resemble conditioned emotional responses. *Brain Res* 418:183-188.
33. LeDoux JE, Ruggiero DA, Forest R, Stornetta R, Reis DJ (1987) Topographic organization of convergent projections to the thalamus from the inferior colliculus and spinal cord in the rat. *J Comp Neurol* 264:123-146.
34. Iwata J, LeDoux JE (1988) Dissociation of associative and nonassociative concomitants of classical fear conditioning in the freely behaving rat. *Behav Neurosci* 102:66-76.
35. LeDoux JE, Iwata J, Cicchetti P, Reis DJ (1988) Different projections of the central amygdaloid nucleus mediate autonomic and behavioral correlates of conditioned fear. *J Neurosci* 8:2517-2529.
36. LeDoux JE, Xagoraris A, Romanski L (1989) Indelibility of subcortical emotional memories. *J Cognitive Neurosci* 1:238-243.
37. LeDoux JE, Farb C, Ruggiero DA (1990) Topographic organization of neurons in the acoustic thalamus that project to the amygdala. *J Neurosci* 10:1043-1054.
38. Clugnet MC, LeDoux JE, Morrison SF (1990) Unit responses evoked in the amygdala and striatum by electrical stimulation of the medial geniculate body. *J Neurosci* 10:1055-1061.
39. LeDoux JE, Cicchetti P, Xagoraris A, Romanski LM (1990) The lateral amygdaloid nucleus: sensory interface of the amygdala in fear conditioning. *J Neurosci* 10:1062-1069.

40. Clugnet MC, LeDoux JE (1990) Synaptic plasticity in fear conditioning circuits: induction of LTP in the lateral nucleus of the amygdala by stimulation of the medial geniculate body. *J Neurosci* 10:2818-2824.
41. LeDoux JE, Farb CR, Milner TA (1991) Ultrastructure and synaptic associations of auditory thalamo-amygdala projections in the rat. *Exp Brain Res* 85:577-586.
42. LeDoux JE, Farb CR (1991) Neurons of the acoustic thalamus that project to the amygdala contain glutamate. *Neurosci Lett* 134:145-149.
43. LeDoux JE, Farb CR, Romanski LM (1991) Overlapping projections to the amygdala and striatum from auditory processing areas of the thalamus and cortex. *Neurosci Lett* 134:139-144.
44. Phillips RG, LeDoux JE (1992) Differential contribution of amygdala and hippocampus to cued and contextual fear conditioning. *Behav Neurosci* 106:274-285.
45. Bordi F, LeDoux JE (1992) Sensory tuning beyond the sensory system: an initial analysis of auditory response properties of neurons in the lateral amygdaloid nucleus and overlying areas of the striatum. *J Neurosci* 12:2493-2503.
46. Romanski LM, LeDoux JE (1992) Bilateral destruction of neocortical and perirhinal projection targets of the acoustic thalamus does not disrupt auditory fear conditioning. *Neurosci Lett* 142:228-232.
47. Romanski LM, LeDoux JE (1992) Equipotentiality of thalamo-amygdala and thalamo-cortico-amygdala circuits in auditory fear conditioning. *J Neurosci* 12:4501-4509.
48. Farb C, Aoki C, Milner T, Kaneko T, LeDoux JE (1992) Glutamate immunoreactive terminals in the lateral amygdaloid nucleus: a possible substrate for emotional memory. *Brain Res* 593:145-158.
49. Stefanacci L, Farb CR, Pitkanen A, Go G, LeDoux JE, Amaral DG (1992) Projections from the lateral nucleus to the basal nucleus of the amygdala: a light and electron microscopic PHA-L study in the rat. *J Comp Neurol* 323:586-601.
50. Bordi F, LeDoux JE, Clugnet MC, Pavlides C (1993) Single-unit activity in the lateral nucleus of the amygdala and overlying areas of the striatum in freely behaving rats: rates, discharge patterns, and responses to acoustic stimuli. *Behav Neurosci* 107:757-769.
51. Romanski LM, Clugnet MC, Bordi F, LeDoux JE (1993) Somatosensory and auditory convergence in the lateral nucleus of the amygdala. *Behav Neurosci* 107:444-450.

52. Romanski LM, LeDoux JE (1993) Organization of rodent auditory cortex: anterograde transport of PHA-L from MGv to temporal neocortex. *Cereb Cortex* 3:499-514.
53. Romanski LM, LeDoux JE (1993) Information cascade from primary auditory cortex to the amygdala: corticocortical and corticoamygdaloid projections of temporal cortex in the rat. *Cereb Cortex* 3:515-532.
54. Morgan MA, Romanski LM, LeDoux JE (1993) Extinction of emotional learning: contribution of medial prefrontal cortex. *Neurosci Lett* 163:109-113.
55. Bordi F, LeDoux JE (1994) Response properties of single units in areas of rat auditory thalamus that project to the amygdala. I. Acoustic discharge patterns and frequency receptive fields. *Exp Brain Res* 98:261-274.
56. Bordi F, LeDoux JE (1994) Response properties of single units in areas of rat auditory thalamus that project to the amygdala. II. Cells receiving convergent auditory and somatosensory inputs and cells antidromically activated by amygdala stimulation. *Exp Brain Res* 98:275-286.
57. Phillips RG, LeDoux JE (1994) Lesions of the dorsal hippocampal formation interfere with background but not foreground contextual fear conditioning. *Learn Mem* 1:34-44.
58. Corodimas KP, LeDoux JE, Gold PW, Schulkin J (1994) Corticosterone potentiation of conditioned fear in rats. *Ann N Y Acad Sci* 746:392-393.
59. Sparks PD, LeDoux JE (1995) Septal lesions potentiate freezing behavior to contextual but not to phasic conditioned stimuli in rats. *Behav Neurosci* 109:184-188.
60. Morgan MA, LeDoux JE (1995) Differential contribution of dorsal and ventral medial prefrontal cortex to the acquisition and extinction of conditioned fear in rats. *Behav Neurosci* 109:681-688.
61. Phillips RG, LeDoux JE (1995) Lesions of the fornix but not the entorhinal or perirhinal cortex interfere with contextual fear conditioning. *J Neurosci* 15:5308-5315.
62. Corodimas KP, LeDoux JE (1995) Disruptive effects of posttraining perirhinal cortex lesions on conditioned fear: contributions of contextual cues. *Behav Neurosci* 109:613-619.
63. Li XF, Phillips R, LeDoux JE (1995) NMDA and non-NMDA receptors contribute to synaptic transmission between the medial geniculate body and the lateral nucleus of the amygdala. *Exp Brain Res* 105:87-100.
64. Farb CR, Aoki C, LeDoux JE (1995) Differential localization of NMDA and AMPA

- receptor subunits in the lateral and basal nuclei of the amygdala: a light and electron microscopic study. *J Comp Neurol* 362:86-108.
65. Pitkanen A, Stefanacci L, Farb CR, Go GG, LeDoux JE, Amaral DG (1995) Intrinsic connections of the rat amygdaloid complex: projections originating in the lateral nucleus. *J Comp Neurol* 356:288-310.
 66. Savander V, Go CG, LeDoux JE, Pitkanen A (1995) Intrinsic connections of the rat amygdaloid complex: projections originating in the basal nucleus. *J Comp Neurol* 361:345-368.
 67. LaBar KS, LeDoux JE, Spencer DD, Phelps EA (1995) Impaired fear conditioning following unilateral temporal lobectomy in humans. *J Neurosci* 15:6846-6855.
 68. Armony JL, Servan-Schreiber D, Cohen JD, LeDoux JE (1995) An anatomically constrained neural network model of fear conditioning. *Behav Neurosci* 109:246-257.
 69. Hugdahl K, Berardi A, Thompson WL, Kosslyn SM, Macy R, Baker DP, Alpert NM, LeDoux JE (1995) Brain mechanisms in human classical conditioning: a PET blood flow study. *Neuroreport* 6:1723-1728.
 70. Rogan MT, LeDoux JE (1995) LTP is accompanied by commensurate enhancement of auditory-evoked responses in a fear conditioning circuit. *Neuron* 15:127-136.
 71. Quirk GJ, Reppas CB, LeDoux JE (1995) Fear conditioning enhances short-latency auditory responses of lateral amygdala neurons: parallel recordings in the freely behaving rat. *Neuron* 15:1029-1039.
 72. LaBar KS, LeDoux JE (1996) Partial disruption of fear conditioning in rats with unilateral amygdala damage: correspondence with unilateral temporal lobectomy in humans. *Behav Neurosci* 110:991-997.
 73. Melia KR, Ryabinin AE, Corodimas KP, Wilson MC, LeDoux JE (1996) Hippocampal-dependent learning and experience-dependent activation of the hippocampus are preferentially disrupted by ethanol. *Neuroscience* 74:313-322.
 74. Savander V, Go CG, LeDoux JE, Pitkanen A (1996) Intrinsic connections of the rat amygdaloid complex: projections originating in the accessory basal nucleus. *J Comp Neurol* 374:291-313.
 75. Savander V, LeDoux JE, Pitkanen A (1996) Topographic projections from the periamygdaloid cortex to select subregions of the lateral nucleus of the amygdala in the rat. *Neurosci Lett* 211:167-170.
 76. Li XF, Armony JL, LeDoux JE (1996) GABAA and GABAB receptors differentially regulate synaptic transmission in the auditory thalamo-amygdala pathway: an in vivo microiontophoretic study and a model. *Synapse* 24:115-124.

77. Savander V, LeDoux JE, Pitkanen A (1997) Interamygdaloid projections of the basal and accessory basal nuclei of the rat amygdaloid complex. *Neuroscience* 76:725-735.
78. Savander V, Miettinen R, LeDoux JE, Pitkanen A (1997) Lateral nucleus of the rat amygdala is reciprocally connected with basal and accessory basal nuclei: a light and electron microscopic study. *Neuroscience* 77:767-781.
79. Li XF, Stutzmann GE, LeDoux JE (1996) Convergent but temporally separated inputs to lateral amygdala neurons from the auditory thalamus and auditory cortex use different postsynaptic receptors: in vivo intracellular and extracellular recordings in fear conditioning pathways. *Learn Mem* 3:229-242.
80. Armony JL, Servan-Schreiber D, Romanski LM, Cohen JD, LeDoux JE (1997) Stimulus generalization of fear responses: effects of auditory cortex lesions in a computational model and in rats. *Cereb Cortex* 7:157-165.
81. Muller J, Corodimas KP, Fridel Z, LeDoux JE (1997) Functional inactivation of the lateral and basal nuclei of the amygdala by muscimol infusion prevents fear conditioning to an explicit conditioned stimulus and to contextual stimuli. *Behav Neurosci* 111:683-691.
82. Farb CR, LeDoux JE (1997) NMDA and AMPA receptors in the lateral nucleus of the amygdala are postsynaptic to auditory thalamic afferents. *Synapse* 27:106-121.
83. 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.
84. Rogan MT, Staubli UV, LeDoux JE (1997) AMPA receptor facilitation accelerates fear learning without altering the level of conditioned fear acquired. *J Neurosci* 17:5928-5935.
85. Rogan MT, Staubli UV, LeDoux JE (1997) Fear conditioning induces associative long-term potentiation in the amygdala. *Nature* 390:604-607.
86. Armony JL, Quirk GJ, LeDoux JE (1998) Differential effects of amygdala lesions on early and late plastic components of auditory cortex spike trains during fear conditioning. *J Neurosci* 18:2592-2601.
87. 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.
88. Stutzmann GE, McEwen BS, LeDoux JE (1998) Serotonin modulation of sensory inputs to the lateral amygdala: dependency on corticosterone. *J Neurosci* 18:9529-9538.

89. Farb CR, LeDoux JE (1999) Afferents from rat temporal cortex synapse on lateral amygdala neurons that express NMDA and AMPA receptors. *Synapse* 33:218-229.
90. Nader K, LeDoux JE (1999) The dopaminergic modulation of fear: quinpirole impairs the recall of emotional memories in rats. *Behav Neurosci* 113:152-165.
91. Weisskopf MG, LeDoux JE (1999) Distinct populations of NMDA receptors at subcortical and cortical inputs to principal cells of the lateral amygdala. *J Neurophysiol* 81:930-934.
92. Stutzmann GE, LeDoux JE (1999) GABAergic antagonists block the inhibitory effects of serotonin in the lateral amygdala: a mechanism for modulation of sensory inputs related to fear conditioning. *J Neurosci* 19:RC8.
93. Schafe GE, Nadel NV, Sullivan GM, Harris A, LeDoux JE (1999) Memory consolidation for contextual and auditory fear conditioning is dependent on protein synthesis, PKA, and MAP kinase. *Learn Mem* 6:97-110.
94. Conrad CD, LeDoux JE, Magarinos AM, McEwen BS (1999) Repeated restraint stress facilitates fear conditioning independently of causing hippocampal CA3 dendritic atrophy. *Behav Neurosci* 113:902-913.
95. Weisskopf MG, Bauer EP, LeDoux JE (1999) L-type voltage-gated calcium channels mediate NMDA-independent associative long-term potentiation at thalamic input synapses to the amygdala. *J Neurosci* 19:10512-10519.
96. Amorapanth P, Nader K, LeDoux JE (1999) Lesions of periaqueductal gray dissociate-conditioned freezing from conditioned suppression behavior in rats. *Learn Mem* 6:491-499.
97. Morgan MA, LeDoux JE (1999) Contribution of ventrolateral prefrontal cortex to the acquisition and extinction of conditioned fear in rats. *Neurobiol Learn Mem* 72:244-251.
98. Doron NN, LeDoux JE (1999) Organization of projections to the lateral amygdala from auditory and visual areas of the thalamus in the rat. *J Comp Neurol* 412:383-409.
99. 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:RC48.
100. Nader K, LeDoux JE (1999) Inhibition of the mesoamygdala dopaminergic pathway impairs the retrieval of conditioned fear associations. *Behav Neurosci* 113:891-901.
101. Schafe GE, LeDoux JE (2000) Memory consolidation of auditory pavlovian fear conditioning requires protein synthesis and protein kinase A in the amygdala. *J*

Neurosci 20:RC96.

102. Amorapanth P, LeDoux JE, Nader K (2000) Different lateral amygdala outputs mediate reactions and actions elicited by a fear-arousing stimulus. *Nat Neurosci* 3:74-79.
103. Nader K, Schafe GE, LeDoux JE (2000) Fear memories require protein synthesis in the amygdala for reconsolidation after retrieval. *Nature* 406:722-726.
104. Doron NN, LeDoux JE (2000) Cells in the posterior thalamus project to both amygdala and temporal cortex: a quantitative retrograde double-labeling study in the rat. *J Comp Neurol* 425:257-274.
105. Schafe GE, Fitts DA, Thiele TE, LeDoux JE, Bernstein IL (2000) The induction of c-Fos in the NTS after taste aversion learning is not correlated with measures of conditioned fear. *Behav Neurosci* 114:99-106.
106. Wilensky AE, Schafe GE, LeDoux JE (2000) The amygdala modulates memory consolidation of fear-motivated inhibitory avoidance learning but not classical fear conditioning. *J Neurosci* 20:7059-7066.
107. Woodson W, Farb CR, LeDoux JE (2000) Afferents from the auditory thalamus synapse on inhibitory interneurons in the lateral nucleus of the amygdala. *Synapse* 38:124-137.
108. Schafe GE, Atkins CM, Swank MW, Bauer EP, Sweatt JD, LeDoux JE (2000) Activation of ERK/MAP kinase in the amygdala is required for memory consolidation of pavlovian fear conditioning. *J Neurosci* 20:8177-8187.
109. Nader K, Majidishad P, Amorapanth P, LeDoux JE (2001) Damage to the lateral and central, but not other, amygdaloid nuclei prevents the acquisition of auditory fear conditioning. *Learn Mem* 8:156-163.
110. Bauer EP, LeDoux JE, Nader K (2001) Fear conditioning and LTP in the lateral amygdala are sensitive to the same stimulus contingencies. *Nat Neurosci* 4:687-688.
111. Repa JC, Muller J, Apergis J, Desrochers TM, Zhou Y, LeDoux JE (2001) Two different lateral amygdala cell populations contribute to the initiation and storage of memory. *Nat Neurosci* 4:724-731.
112. Yaniv D, Schafe GE, LeDoux JE, Richter-Levin G (2001) A gradient of plasticity in the amygdala revealed by cortical and subcortical stimulation, in vivo. *Neuroscience* 106:613-620.
113. Rodrigues SM, Schafe GE, LeDoux JE (2001) Intra-amygdala blockade of the NR2B subunit of the NMDA receptor disrupts the acquisition but not the expression of fear conditioning. *J Neurosci* 21:6889-6896.

114. Peper M, Karcher S, Wohlfarth R, Reinshagen G, LeDoux JE (2001) Aversive learning in patients with unilateral lesions of the amygdala and hippocampus. *Biol Psychol* 58:1-23.
115. Rodrigues SM, Bauer EP, Farb CR, Schafe GE, LeDoux JE (2002) The group I metabotropic glutamate receptor mGluR5 is required for fear memory formation and long-term potentiation in the lateral amygdala. *J Neurosci* 22:5219-5229.
116. Bauer EP, Schafe GE, LeDoux JE (2002) NMDA receptors and L-type voltage-gated calcium channels contribute to long-term potentiation and different components of fear memory formation in the lateral amygdala. *J Neurosci* 22:5239-5249.
117. Moita MA, Lamprecht R, Nader K, LeDoux JE (2002) A-kinase anchoring proteins in amygdala are involved in auditory fear memory. *Nat Neurosci* 5:837-838.
118. Debiec J, LeDoux JE, Nader K (2002) Cellular and systems reconsolidation in the hippocampus. *Neuron* 36:527-538.
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