# **CURRICULUM VITAE**

## Warren H. Meck

# Personal

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1974-1976 The Pennsylvania State University (Biology)	
B.A. 1976-1978 University of California, San Diego (Psychology/Neuroscience	e)
Ph.D. 1978-1982 Brown University (Psychology)	

## **Professional Experience**

1982-1984	Research Scientist Department of Psychology	Brown University Providence, RI 02912
1984-1985	Assistant Professor Department of Psychology	Brown University Providence, RI 02912
1985-1990	Assistant Professor Department of Psychology	Columbia University New York, NY 10027
1990-1994	Associate Professor Department of Psychology	Columbia University New York, NY 10027
1990 (Summer)	Visiting Lecturer Neurobiologie Moleculaire Departement des Biotechnologies	Institut Pasteur 25, rue du Docteur Roux Paris, France 75015
1990 (Fall)	Visiting Scientist Department of Brain & Cognitive Sciences	Massachusetts Institute of Technology Cambridge, MA 02139
1991 (Spring)	Visiting Professor Department of Psychology	The Johns Hopkins University Baltimore, MD 21218
1993 (Summer)	Visiting Lecturer Service de Neurologie et Neuropsychologie	Hôpital de la Salpêtrière – INSERM U289 Paris, France
1994-2001	Associate Professor Department of Psychology: Experimental	Duke University Durham, NC 27708
2001-2006	Professor Department of Psychological & Brain Sciences Adjunct Professor – Integrated Toxicology Program	Duke University Durham, NC 27708
2002-2003	Visiting Scholar – Columbia University/NYSPI Temporal Cognition Unit – Biopsychology Division	New York State Psychiatric Institute New York, NY 10032
2003 (Spring)	CNRS Associate Researcher Unite de Neurosciences Cognitives et Imagerie Cérébrale	Hôpital de la Salpêtrière LENA - CNRS UPR640 UPMC F-75651 Paris Cedex 13
2006-present	Professor Department of Psychology and Neuroscience	Duke University Durham, NC 27708

#### **Honors and Awards**

Sigma Xi (1982) – Brown University Chapter. James McKeen Cattell Dissertation Award (1982) - presented by The New York Academy of Sciences. Alfred P. Sloan Foundation Research Fellowship in Neuroscience (1988 - 1990). FIRST Award (1988) - NINCDS: Fundamental Neurosciences Program. Special Reviewer (1993) – Psychobiology and Behavior Committee, NIMH. Panel Member (1993) – Neurobiology of Cognition and Behavior Committee, NINDS/NIH. Panel Member (1995 - 1999) - Basic Behavioral Sciences Services Research Subcommittee, NIDA. Early Career Recognition Award (1994) - presented by the Eastern Psychological Association. Fellow of the American Psychological Association (elected 1996). Sponsor – Wellcome Trust Advanced Training Fellowship (1995-1998): Melissa Bateson, University of Oxford, UK. Sponsor – National Research Service Award Fellowships (1997-2000): Sean Hinton & Matthew Matell, Duke University. Investigator (1996 - present) – Mental Health Clinical Research Center, Department of Psychiatry, UNC, Chapel Hill. Behavioral and Cognitive Neuroscience Core: Neurobiology of Psychotic Disorders - Basic Science Section. James S. McDonnell Fellowship (1997) – Summer Institute in Cognitive Neuroscience, Dartmouth College, Hanover, NH. Fellow of the American Psychological Society (elected 1998). Visiting Scientist (1999) – Max Planck Institute of Cognitive Neuroscience, Leipzig, Germany. Invited Plenary Lecturer (1999) – XXVI International Ethological Conference, August 2-9, Bangalore, India. Panel Member (1998-1999) - Cognitive Neuroscience Program, Special Emphasis Panel, NIMH. Chair (2000) - Behavioral Neuroscience Program (BBBP-5) - Special Emphasis Panel, NIH. Project Advisor (1999-2002) - NSF supported "Exploring Time" exhibit, Science Museum of Minnesota, St. Paul, MN. Project Advisor (1998) - "What Makes Us Tick?", a British Broadcasting Company documentary. Aired in the UK on 1/9/99 and in the US on The Learning Channel and the Discovery Channel as "The Body Clock" on 8/6/99 and 8/8/99. James McKeen Cattell Sabbatical Fellowship (2002-2003). CNRS Associate "Rouge" Research Scientist Fellowship - UPR 640, Paris, France (2003). Chair, Awards Committee (2003-2004) - American Psychological Association, Division 6 - Behavioral Neuroscience and Comparative Psychology. Participating Faculty (2003) - Functional Magnetic Resonance Imaging" An Introductory Course, Medical College of Wisconsin, October 23-25, 2003. Invited Plenary Lecturer (2007) - PROUST: Specific Support Action symposium on "The dimension of time and gene functioning: Focus on the nervous system" sponsored by the Department of Neuroscience, Karolinska Institutet and the Royal Swedish Academy of Sciences - Kristineberg Marine Research Station, Fiskebackskil, Sweden, June 7-12, 2007. Organizing Committee (2008) - Inaugural "Multidisciplinary Workshop on Nutrition, Brain Development and Aging: Genetics, Epigenetics and Behavior" to celebrate the opening of the Nutrition Research Institute at Kannapolis, NC as part of the School of Public Health, University of North Carolina, Chapel Hill and the School of Medicine, Duke University - May 12-14, 2008. Invited Lecturer (2008) - International Neuropsychology Symposium - "The Neural Mechanisms of Time", Puerto de la Cruz, Tenerife (Canary Islands) – Spain, June 24-28, 2008. Invited Plenary Lecturer (2008) - PROUST: Specific Support Action symposium on "Genes at work on time" sponsored by Univ. of Verona and the "Temporal Dimension in Functional Genomics Initiative", International Training Centre of the International Labour Organization - Turin, Italy, October 15-17, 2008. Invited Lecturer (2009) – Seminar series sponsored by the National Cheng-Chi University, National Taiwan University, National Yang-Ming University, and the National Science Council of Taiwan – March 3-12, 2009. Working Group Member (2009-2012) - European Union Committee of Senior Officials for Scientific and Technical (COST) action program – Time In MEntaL activitY (TIMELY): Theoretical, behavioral, bioimaging, and clinical perspectives (TIMELY) http://www.timely-cost.eu/ Anonymous Nominator (2009) - MacArthur Fellows Program/"Genius Grant" administered by the John D. and Catherine T. MacArthur Foundation. Awards Committee Member (2010) - American Psychological Association, Division 6 - Behavioral Neuroscience and Comparative Psychology.

International Lectureship (2010) – Centre for Advanced Research on Logic and Sensibility – Global Centers of Excellence Program, Keio University, Tokyo, Japan.

## Media Citations (1994-present)

Numerous short news pieces have appeared in the last 18 years dealing with my research on interval timing and the beneficial effects of prenatal choline supplementation on brain and behavior. Many of these were Associated Press stories that were widely published in newspapers across the US. Others included unique pieces published in the local newspapers (e.g., *Durham Herald Sun* and *Raleigh News & Observer*). The most prominent pieces are noted below.

Poole, R. K. (1994). Eve's rib: Searching for the biological root of sex differences. Saint Martin's Press, New York, NY.

"Brain watch," Hippocrates, April 1996, p. 15.

"Biological clocks," GEO (Korean ed.), May, 1996, pp. 168-170.

"Internal clocks in the striatum," GEO Neurobiologie (German ed.), Sept./Oct., 1996.

"The clocks that time us," Journal of the Swedish Medical Association, February 23, 1996.

"Memory of time may be factor in Parkinson's," Columbia University Record, April 5, 1996, 21.

Friend, T. (1996, February 18). Body's timing mechanism discovered. USA Today.

George, K. H. (1996, February 16). Study: Brain's motor center keeps time, too. Duke Dialogue, p. 4, 7.

Highfield, R. (1996, February 21). Working out how time files. London Daily Telegraph, p. 240.

Martin, N. (1996). Ticking inside your head. British Psychophysiology Society: B.P.P.S. Quarterly, 28.

Morell, V. (1996). Setting a biological stopwatch. Science, 271, 905-906.

Poncin, J. (1996, April 14). Le chrono du cerveau. Le Souir, p. 14.

Radford, T. (1996, February 13). Interval clock clue to red light rage. The Guardian, p. 23.

Travis, J. (1996). Biological stopwatch found in the brain. Science News, 149, 101.

"Body's Timing Mechanism Discovered," Saturday Night Live - National Broadcasting Corporation (February 17, 1996), Weekend Update segment with Norm MacDonald.

"The Hunt for the Internal Clock," program presented by the Australian Broadcasting Corporation, April, 1996.

Dehaene, S. (1997). The number sense. Oxford University Press, Oxford, UK.

George, K.H. (1997). Time on the brain. Duke Research 1996-1997 (Medical News). p. 35.

McCrone, J. (1997). When a second lasts forever. New Scientist, November, pp. 23-27.

"The brain's internal stopwatch," The London Times, (1998, March 31).

"Temporal perception and its possible neural/brain mechanisms," International Herald Tribune, (1998, April 4).

[Advisory Report], National Academy of Sciences: Food and Nutrition Board: Institute of Medicine. Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, panthotenic acid, biotin, and choline. *National Academy Press*, Washington, D.C. (1998).

"Extra choline during pregnancy enhances memory in offspring," *Duke University Medical Center News Release*, (http://www.sciencedaily.com/releases/1998/04/980409080807.htm), April 9, 1998.

Blakeslee, S. (1998, March 24). Running late? Researchers blame aging brain. *The New York Times: Science Times*, pp. B13, B16.

Blusztajn, J.K. (1998). Choline, a vital amine," Science, 281, 794-795.

McCrone, J. (1999). Going inside: A tour round a single moment of consciousness. Farber & Farber, London, UK.

"Human interval timing," *Preliminary fMRI studies: Center for Advanced Magnetic Resonance Development* (CAMRD), Duke University Medical Center, Department of Radiology. (Please see web sites updated March 3, 1999:

http://camrd4.mc.duke.edu/ and http://camrd4.mc.duke.edu/project%20pages/fMRI%20projects).

*"The Body Clock: What Makes Us Tick?"* a *British Broadcasting Company* (BBC) documentary filmed on location at Duke University, Columbia University, Rockefeller University, and Northwestern University – directed by Alison Baum. Film aired in the UK on January 9, 1999, appeared on August 6th & 8th on the Discovery Channel in the US, and in August of 2000 in Japan (dubbed in Japanese).

Chelius, C. (2000). Timing is everything: The body's internal clock. *The Duke Mind*, *1*, 6-8.
Hauser, M.D. (2000). *Wild minds: What animals really think*. Henry Holt & Company, p. 275.
"Developmental effects of choline: Food for thought," (2000). *American Psychological Association* web site: http://www.apa.org/psa/janfeb97/sb.html.

*"Exploring Time"* exhibit (2001), *Science Museum of Minnesota*, St. Paul, supported by the National Science Foundation. Project advisor for interval timing and time perception in humans.

Interactive Metronome Project: "*It's all a matter of timing*." (2001). Please see linked web sites: (www.interactivemetronome.com, http://interactivemetronome.com/timing1.htm,

http://interactivemetronome.com/brain4.html, and http://www.voyager.net/tcams/meck.htm).

Goldstein, J.S. (2001). *War and gender: How gender shapes the war system and vice versa*. Cambridge University Press, Cambridge, UK. http://www.warandgender.com/

McKinney, M. (2001). Harder for seniors to keep track of time: Study. *Reuters Health*, Thursday, November 29, 2001. http://dailynews.yahoo.com/h/nm/20011129/hl/senior 1.html

Raloff, J. (2001). Brain food: Choline enters the nutritional limelight. Science News, 160, 282-284.

Raloff, J. (2002). New research uncovers nutrient's role what choline does for the brain and the body. *Consumers' Research Magazine*, January 10, 2002.

Wright, K. (2002). "The time of our lives". Scientific American - Single Topic Issue on "Time", September 2002.

Baron-Cohen, S. (2003). The essential difference: The truth about the male and female brain. Basic Books, p. 101.

- Cheng, K. (2004). Review of "Functional and Neural Mechanisms of Interval Timing", W.H. Meck (ed). What makes us tick: clocks in the brain. Animal Cognition, 7, 267-268.
- Grondin, S. (2004). Review of "Functional and Neural Mechanisms of Interval Timing", W.H. Meck (ed). Quarterly Review of Biology, 79,112-113.
- Nichelli, P. (2004). Review of "Functional and Neural Mechanisms of Interval Timing", W.H. Meck (ed). Annals of Neurology, 56, 167-168.
- Paulus, R. (2004). Review of "Functional and Neural Mechanisms of Interval Timing", W.H. Meck (ed). Contemporary Topics in Laboratory Animal Science, 43, 22-23.

Bilger, B. (2005). The Egg Men: What it takes to be a short-order cook in Las Vegas. *The New Yorker, September* 5<sup>th</sup>, 110-119.

- Meredith, D. (2005). What makes the brain tick, tick, tick... *Office of News & Communications*, Duke University, October 28<sup>th</sup>. http://www.dukenews.duke.edu/2005/10/Meck&BuhusiNatNeuro.html
- Salomon, R. M. (2005). Review of "Functional and Neural Mechanisms of Interval Timing". W.H. Meck (ed). *The Journal of Clinical Psychiatry*, 66, 1078-1079.
- A Brief History of Time: It's All in Your Mind http://www.yazakpro.com/interesting/time/timehistory.htm
- Tu, T. (2005). Scientists propose theory of time perception. *The Chronicle*, Duke University, November 16<sup>th</sup>. http://www.chronicle.duke.edu/vnews/display.v/ART/2005/11/16/437b1ddfcec72
- http://www.msnbc.msn.com/id/9853910
- http://www.vidyya.com/vol7/v7i287 7.htm
- http://www.techno-science.net/?onglet=news&news=1956
- http://www.livescience.com/humanbiology/051028 brain time.html
- http://www.upi.com/NewsTrack/view.php?StoryID=20051028-101708-4724r
- http://news.yahoo.com/s/space/20051028/sc space/thehumanbrainseenasmasteroftime

http://www.rednova.com/news/science/287819/what makes the brain tick tick /

Aziz, D. (2006). Disclosing time. The Duke Mind, 2, 9-11.

Bhattacharjee, Y. (2006). Neuroscience: A timely debate about the brain. Science, 311, 596-598.

Burdick, A. (2006). The future of time: The mind in overdrive. Discover, 27, 12-14.

Frontiers - BBC Radio 4 programme: "Time Perception (featured guest) - May 17, 2006.

http://www.bbc.co.uk/radio4/science/frontiers 20060517.shtml

- Semeniuk, I. (2006). Time stretchers. *New Scientist Podcast, 03-February-2006* <u>http://www.newscientist.com/podcast.ns</u> Thoma, M. (2006). True time management. *Economist's View*, March 30<sup>th</sup> –
- http://economistsview.typepad.com/economistsview/2006/03/true\_time\_manag.html

Williams, C. (2006). The 25-hour day: Teaching your brain to stretch time. New Scientist, 189, 34-37.

"Time" (2006) – *British Broadcasting Company - Annabel Gillings (Producer)*, documentary series filmed on location at Duke University with Mishio Kaku as moderator. <u>http://en.wikipedia.org/wiki/Time (TV series</u>)

Science - http://sciencenow.sciencemag.org/cgi/content/full/2007/201/3

Newsday - http://www.newsday.com/news/health/ny-hstime015074978feb01,0,2568458.story

Scientific American – http://www.sciam.com/article.cfm?articleid=8E2F48DF-E7F2-99DF-3A3C885FD7325BF3

"Exploring Time" – Documentary produced by Red Hill Studios in collaboration with the National Science Foundation with portions filmed at Duke University. Premiered March 18, 2007 (9:00 –11:00 pm EST) on the Discovery Science channel. Wallisch, V.P. (2007). Wie die Zeit in den Kopf kommt. *Gehirn & Geist*, 10, 14-20.

Triangle BioSystems, Inc. (2008). *TBSI News and Announcements* – 8/8/08. <u>http://www.tbsi.biz/Industry/News.aspx</u> Wallisch, P. (2008). An odd sense of timing. *Scientific American Mind*, February/March, 37-43.

- Zimmer, C. (2008). The brain: How your brain can control time. *Discover*, August 20-22, 2008.
- http://discovermagazine.com/2008/aug/11-how-your-brain-can-control-time

Zinkant, K. (2008). Time knowledge: The 25-hour day. Die Zeit, February 2008.

http://www.zeit.de/zeit-wissen/2008/02/Zeit?page=all

Zinkant, K. (2008). Interview with W.H. Meck in an article on time perception published in the bimonthly science magazine section of *Die Zeit* and in *Spiegel* online (Berlin, Germany).

http://artschoolvets.com/blog/skism/2008/02/15/zum-thema-zeit-2-2/

http://www.spiegel.de/dertag/pda/avantgo/artikel/0,1958,533315,00.html

Editor's Select: Cold Spring Harbor Press – January 2009 <u>http://www.cshlpress.com/email\_news/enews.html</u> Lamoureux, J.A., Meck, W.H., & Williams, C.L. (2008). Availability of prenatal dietary choline alters the context sensitivity of Pavlovian conditioning in adult rats. *Learning & Memory*, **15**, 866-875.

- Afsarmanesh, N. (2009). World Science Festival: Time, the familiar stranger. In the Field: The *Nature* reporters' blog from conferences and events. <u>http://blogs.nature.com/news/blog/2009/06/world\_science\_festival\_time\_th.html#more</u>
- Ayan, S. (2009). Impressionen vom "World Science Festival". BrainLogs. <u>http://www.brainlogs.de/blogs/blog/nette-an-</u> steve/2009-06-16/impressionen-vom-world-science-festival
- World Science Festival (2009). The Psychology of Time. DISCOVER Science, Technology, and the Future Discoblog <a href="http://blogs.discovermagazine.com/discoblog/2009/06/15/world-science-festival-the-psychology-of-time/">http://blogs.discovermagazine.com/discoblog/2009/06/15/world-science-festival-the-psychology-of-time/</a>

Gleiser, M. (2010). The doors of time perception. *National Public Radio – Science and Culture Blog*, January 31, 2010. http://www.npr.org/blogs/13.7/2010/01/the doors of time perception.html

Krulwich, R. (2010). Interview with Warren Meck on the topic of "Why does time fly by as you get older?" for *National Public Radio – All Things Considered –* Robert Siegel (host), February 1, 2010.

http://www.npr.org/templates/story/story.php?storyId=122322542

- MemeuFacture (2010). Can you stretch the time with the mind? June 14, 2010. <u>http://memeufacture.com/s-science/can-you-stretch-the-time-with-the-mind/</u>
- Newitz, A. (2010). How do you really know what time it is? The neuroscience of time. *io9.com Mad Science blog*, http://io9.com/5646561/how-do-you-really-know-what-time-it-is
- Banks, S. (2011). Gone in the blink of an eye. *Los Angeles Times*, January 1, 2011. http://articles.latimes.com/2011/jan/01/local/la-me-banks-20110101
- Starbard, M. (2011). Love in slow motion. *National Public Radio: The Picture Show*, Valentine's Day, February 14, 2011. http://www.npr.org/blogs/pictureshow/2011/02/14/133756997/love-in-slow-motion
- Bilger, B. (2011). The Possibilian. *The New Yorker*, April 25, 2011. http://www.newyorker.com/reporting/2011/04/25/110425fa fact bilger
- Geddes, L. (2011). About time: Does it really fly when you're having fun?' New Scientist, October 11, 2011. http://www.newscientist.com/special/about-time
- Skomorowska, A, (2011). Time and the brain. *Lapidarium notes*. October 3, 2011. http://aminotes.tumblr.com/post/10978595185/time-and-the-brain-eagleman-time-is-not-just-as

## Membership

American Psychological Association Association for Psychological Science Cognitive Neuroscience Society Eastern Psychological Association International Brain Research Organization International Society for Developmental Psychobiology Organization for Human Brain Mapping Psychonomic Society Society for Neuroscience The New York Academy of Sciences

# **Research Support**

1984-1985	Acting Principal Investigator, " <u>Pharmacological Effects on Timing Behavior</u> ," National Institute of Mental Health grant, \$60,000 direct costs.
1985-1987	Principal Investigator, <u>Biomedical Research Support</u> , National Institutes of Health grant awarded to Columbia University, \$70,000 direct costs.
1988-1993	Principal Investigator, " <u>Brain Mechanisms, Timing, and Temporal Memory</u> ," National Institute of Neurological and Communicative Disorders and Stroke grant awarded to Columbia University, \$528,446 total costs.
1988-1990	Principal Investigator, <u>Sloan Research Fellowship in Neuroscience</u> , research grant awarded to Columbia University, \$25,000 direct costs.
1991-2005	Principal Investigator, Project # 3: "Perinatal Choline Supplementation, Memory, and Aging," National Institute of Aging Program Project " <u>Aging of Brain: Effects of Perinatal Choline Exposure</u> " grant awarded to Duke University, \$2,561,540 total costs.
1997-1998	Principal Investigator, Anonymous donation for the support of " <u>Cognitive Neuroscience &amp; Aging of</u> Brain: Effects of Perinatal Choline Exposure" \$60,000 total costs.
1997-2001	Principal Investigator, " <u>Functional and Neural Mechanisms of Interval Timing in Rats and Humans</u> ," National Institute of Mental Health, \$883,628 total costs awarded to Duke University.
1996-1998	Sponsor for Melissa Bateson, " <u>Psychological and Neural Mechanisms of Information Processing in the Foraging Starling</u> ", Wellcome Trust (UK), \$130,000 total costs subcontracted to Duke University from Oxford University.
1997-1999	Co-PI/Consultant with Sean Hinton, "Dopaminergic Mechanisms of Interval Timing Assessed Using <u>fMRI</u> ," National Institute of Drug Abuse – \$100,000 total direct costs awarded to Duke University.
1997-2000	Sponsor/PI for Matthew Matell, " <u>Timing Behavior: Ensemble Recording and Stimulants</u> ," National Institute of Drug Abuse – \$50,000 total direct costs awarded to Duke University.
1998-2002	Principal Investigator, " <u>Mechanisms of Behavior – REU Program in Biological Sciences</u> ," National Science Foundation – \$337,136 total costs awarded to Duke University.
1998-2001	Consultant/Contributor with Gregory McCarthy, " <u>Undergraduate Laboratory Courses in Cognitive</u> <u>Neuroscience</u> ," Howard Hughes Medical Institute (Dr. Charles Putnam, PI) – \$515,100 out of the \$1,400,000 total costs awarded to Duke University.
2001-2006	Co-PI with Dr. Catalin Buhusi, " <u>Attentional Processing of Temporal Information</u> ," National Institute of Mental Health - \$962,500 total costs awarded to Duke University.
2005-2010	Principal Investigator, Project # 3: " <u>Prenatal Choline Availability: Impact on Age-Related</u> <u>Deficits in Sleep and Memory</u> ", National Institute of Aging Program Project " <u>Aging of Brain: Effects</u> <u>of Perinatal Choline Exposure</u> " grant awarded to Duke University, \$1,188,567 total costs.
2005-2010	Principal Investigator, "Mechanisms of Behavior – REU Program in Biological Sciences," National Science Foundation – \$450,000 total costs awarded to Duke University.
2006-2011	Co-PI with Dr. Catalin Buhusi, " <u>Neural Representation of Temporal Information</u> ," NIMH \$1,775,000 total costs awarded to Medical University of South Carolina and Duke University.
2009-2012	Principal Investigator, " <u>Mechanisms of Behavior – REU Program in Biological Sciences,</u> " National Science Foundation – \$353,636 total costs awarded to Duke University.

2010-2014	Principal Investigator, " <u>Developmental Neuroscience of Time and Number</u> " National Institute of Child Health and Human Development – \$7,700,000 total costs to be awarded to Duke University (pending).
2012-2016	Principal Investigator, "Impact of Social Defeat Stress on Sleep Electrophysiology," National Institute of Mental Health – \$1,536,041 total costs to be awarded to Duke University (pending).
2012-2017	Principal Investigator, " <u>Prenatal Choline Effects on Brain Oscillations and Memory Consolidation</u> ," National Institute of Aging – \$1,922,489 total costs to be awarded to Duke University (pending).

## **Publications**

#### **Journal Articles:**

- Fantino, E., Dunn, R., & Meck, W. (1979). Percentage reinforcement and choice. *Journal of the Experimental Analysis* of Behavior, 32, 335-340.
- 2) Meck, W. H., & Church, R. M. (1982). Abstraction of temporal attributes. *Journal of Experimental Psychology: Animal Behavior Processes*, **8**, 226-243.
- Meck, W. H., & Church, R. M. (1982). Discrimination of fixed intertrial intervals in cross-modal transfer of duration. Bulletin of the Psychonomic Society, 19, 234-236.
- 4) Meck, W. H. (1983). Selective adjustment of the speed of internal clock and memory processes. *Journal of Experimental Psychology: Animal Behavior Processes*, 9, 171-201.
- 5) Meck, W. H., & Church, R. M. (1983). A mode control model of counting and timing processes. *Journal of Experimental Psychology: Animal Behavior Processes*, 9, 320-334.
- 6) Meck, W. H., & Church, R. M. (1984). Simultaneous temporal processing. *Journal of Experimental Psychology: Animal Behavior Processes*, **10**, 1-29.
- 7) Meck, W. H., Church, R. M., & Olton, D. S. (1984). Hippocampus, time, and memory. *Behavioral Neuroscience*, **98**, 3-22.
- 8) Meck, W. H., Komeily-Zadeh, F. N., & Church, R. M. (1984). Two-step acquisition: Modification of an internal clock's criterion. *Journal of Experimental Psychology: Animal Behavior Processes*, **10**, 297-306.
- 9) Meck, W. H. (1985). Postreinforcement signal processing. *Journal of Experimental Psychology: Animal Behavior Processes*, **11**, 52-70.
- 10) Meck, W. H., Church, R. M., & Gibbon, J. (1985). Temporal integration in duration and number discrimination. *Journal* of Experimental Psychology: Animal Behavior Processes, 11, 591-597.
- 11) Meck, W. H. (1986). Affinity for the dopamine D<sub>2</sub> receptor predicts neuroleptic potency in decreasing the speed of an internal clock. *Pharmacology Biochemistry & Behavior*, **25**, 1185-1189.
- 12) Meck, W. H., Church, R. M., & Wenk, G. L. (1986). Arginine vasopressin inoculates against age-related increases in sodium-dependent high affinity choline uptake and discrepancies in the content of temporal memory. *European Journal of Pharmacology*, 130, 327-331.
- **13)** Meck, W. H. (1987). Vasopressin metabolite neuropeptide facilitates simultaneous temporal processing. *Behavioural Brain Research*, **23**, 147-157.
- 14) Meck, W. H., & Church, R. M. (1987). Cholinergic modulation of the content of temporal memory. *Behavioral Neuroscience*, 101, 457-464.
- **15)** Meck, W. H., & Church, R. M. (1987). Nutrients that modify the speed of internal clock and memory storage processes. *Behavioral Neuroscience*, **101**, 465-475.
- 16) Meck, W. H., Church, R. M., Wenk, G. L., & Olton, D. S. (1987). Nucleus basalis magnocellularis and medial septal area lesions differentially impair temporal memory. *Journal of Neuroscience*, 7, 3505-3511.
- 17) Olton, D. S., Meck, W. H., & Church, R. M. (1987). Separation of hippocampal and amygdaloid involvement in temporal memory dysfunctions. *Brain Research*, **404**, 180-188.
- **18)** Meck, W. H. (1988). Hippocampal function is required for feedback control of an internal clock's criterion. *Behavioral Neuroscience*, **102**, 54-60.
- **19)** Meck, W. H., Smith, R. A., & Williams, C. L. (1988). Pre- and postnatal choline supplementation produces long-term facilitation of spatial memory. *Developmental Psychobiology*, **21**, 339-353.
- 20) Olton, D. S., Wenk, G. L., Church, R. M., & Meck, W. H. (1988). Attention and the frontal cortex as examined by simultaneous temporal processing. *Neuropsychologia*, 26, 307-318.

- Meck, W. H., Smith, R. A., & Williams, C. L. (1989). Organizational changes in cholinergic activity and enhanced visuospatial memory as a function of choline administered prenatally or postnatally or both. *Behavioral Neuroscience*, 103, 1234-1241.
- 22) Dallal, N. L., & Meck, W. H. (1990). Hierarchical structures: Chunking by food type facilitates spatial memory. *Journal of Experimental Psychology: Animal Behavior Processes*, 16, 69-84.
- 23) Williams, C. L., Barnett, A. M., & Meck, W. H. (1990). Organizational effects of early gonadal secretions on sexual differentiation in spatial memory. *Behavioral Neuroscience*, 104, 84-97.
- 24) Church, R. M., Miller, K. D., Meck, W. H., & Gibbon, J. (1991). Symmetrical and asymmetrical sources of variance in temporal generalization. *Animal Learning & Behavior*, **19**, 207-214.
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- 139) MacDonald, C. J., Cheng, R. K., & Meck, W. H. (2012). Acquisition of "Start" and "Stop" response thresholds in peakinterval timing is differentially sensitive to protein synthesis inhibition in the dorsal and ventral striatum. *Frontiers in Integrative Neuroscience*, 6:10. doi: 10.3389/fnint.2012.00010. Invited contribution to research topic on "*Interval timing and time-based decision making*" W.H. Meck, V. Doyère, & A. Gruart (eds.).
- 140) MacDonald, C. J., & Meck, W. H., & Cheng, R. K. (2012). Potential role of protein synthesis in the formation of temporal memory. Invited contribution to special issue on "A tribute to the contributions of Anthony A. Wright" – J.S. Katz & J.D. Crystal & (eds.), in preparation.
- 141) MacDonald, C. J., Meck, W. H., & Simon, S. A. (2012). Distinct neural ensembles in rat gustatory cortex encode for water, osmotic pressure and the intensity of NaCl. *Journal of Physiology*, in press.
- Meck, W. H., Cheng, R. K., MacDonald, C. J., Gainetdinov, R. R., Caron, M. G., & Çevik, M. Ö. (2012). Gene-dose dependent effects of methamphetamine on interval timing in dopamine-transporter knockout mice. *Neuropharmacology*, 62, 1221-1229. Invited contribution to special issue on "*Schizophrenia*" D. Lodge, P. Harrison, T. Robbins, & D. Schoepp (eds.).
- 143) Meck, W. H., Jones III, J. P., & Williams, C. L. (2012). Prenatal choline availability alters both increments and decrements in attention to conditioned stimuli in young and older adult rats. *European Journal of Neuroscience*, under revision.
- 144) Meck, W. H., & Williams, C. L. (2012). Differential effects of pre- and postnatal choline supplementation on the long-term facilitation of hippocampal-dependent spatial memory. *Hippocampus*, under revision.
- 145) Meck, W. H., & Williams, C. L. (2012). Novel inversions in the presentation of numerical stimuli provide evidence for spontaneous subtraction. *Cognition*, under revision.
- 146) Meck, W. H., & Williams, C. L. (2012). Organizational effects of perinatal choline supplementation on spatial exploration as a function of sex, time of day, and aging, *Neurobiology of Aging*, under revision.
- 147) Merchant, H., Harrington, D. L., & Meck, W. H. (2013). Neural basis of time estimation. *Annual Review of Neuroscience*, 26, xxx-yyy. in preparation.
- 148) Pronin, E., & Meck, W. H. (2014). It's not just what you think: Thought speed and the flow of time. *Annual Review of Psychology*, 65, xxx-yyy. in preparation.

#### **Book Chapters:**

- 149) Church, R. M., & Meck, W. H. (1984). Acquisition and cross-modal transfer of classification rules for temporal intervals. In M.L. Commons, R.J. Herrnstein, & A.R. Wagner (Eds.), *Quantitative analyses of behavior: Discrimination processes* (Vol. 4) (pp. 75-97). Cambridge, MA: Ballinger.
- **150)** Church, R. M., & Meck, W. H. (1984). The numerical attribute of stimuli. In H.L. Roitblat, T.G. Bever, & H.S. Terrace (Eds.), *Animal cognition* (pp. 445-464). Hillsdale, NJ: Erlbaum.
- 151) Gibbon, J., Church, R. M., & Meck, W. H. (1984). Scalar timing in memory. In J. Gibbon, & L. Allan (Eds.), Annals of The New York Academy of Sciences: *Timing and time perception*, (Vol. 423, pp. 52-77). New York, NY: NYAS.
- 152) Meck, W. H. (1984). Attentional bias between modalities: Effect on the internal clock, memory, and decision stages used in animal time discrimination. In J. Gibbon, & L. Allan (Eds.), Annals of The New York Academy of Sciences: *Timing and time perception* (Vol. 423, pp. 528-541). New York, NY: NYAS.
- 153) Meck, W. H., & Church, R. M. (1985). Arginine vasopressin inoculates against age-related changes in temporal memory. In D.S. Olton, E. Gamzu, & S. Corkin (Eds.), Annals of The New York Academy of Sciences: *Memory dysfunctions: An integration of animal and human research from preclinical and clinical perspectives*. (Vol. 444, pp. 453-456). New York, NY: The New York Academy of Sciences.
- 154) Church, R. M., & Meck, W. H. (1988). Biological basis of the remembered time of reinforcement. In M.L. Commons, R.M. Church, J.R. Stellar, & A.R. Wagner (Eds.), *Quantitative analyses of behavior: Biological determinants of reinforcement*. (Vol. 7), (pp.103-119). Hillsdale, NJ: Erlbaum.
- **155)** Meck, W. H. (1988). Internal clock and reward pathways share physiologically similar information-processing stages. In M.L. Commons, R.M. Church, J.R. Stellar, & A.R. Wagner (Eds.), *Quantitative analyses of behavior: Biological determinants of reinforcement*. (Vol. 7), (pp. 121-138). Hillsdale, NJ: Erlbaum.
- **156)** Loy, R., Heyer, D., Williams, C. L., & Meck, W. H. (1992). Choline-induced spatial memory facilitation correlates with altered distribution and morphology of septal neurons. In T.C. Napier, I. Hanin, & P. Kalivas (Eds.), *Basal forebrain: Anatomy to function*, New York: Plenum.
- 157) Rakitin, B. C., Dallal, N. L., & Meck, W. H. (1992). Spatial memory structure and capacity: Influences on problemsolving and memory-coding strategies. In W.K. Honig & J.G. Fetterman (Eds.), *Cognitive aspects of stimulus control.* (pp. 155-183). Hillsdale, NJ: Erlbaum.

- 158) Broadbent, H. A., Rakitin, B. C., Church, R. M., & Meck, W. H. (1993). Quantitative relationships between timing and counting. In S. Boysen & E. J. Capaldi (Eds.), *The development of numerical competence: Animal and human models*. (pp. 171-187). Hillsdale, NJ: Erlbaum.
- 159) Williams. C. L., & Meck, W. H. (1993). Organizational effects of gonadal hormones induce qualitative differences in visuospatial navigation. In M. Haug, R. Whalen, C. Aron, & K. Olsen (Eds.), *The development of sex differences and similarities in behaviour*. (pp. 175-189). Amsterdam: Kluwer Academic Publishers.
- 160) Hinton, S. C., & Meck, W. H. (1997). How time flies: Functional and neural mechanisms of interval timing. In C.M. Bradshaw & E. Szabadi (Eds.), *Time and behaviour: Psychological and neurobiological analyses*. (pp. 409-457). New York: Elsevier.
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- Penney, T. B., Allan, L. G., Meck, W. H., & Gibbon, J. (1998). Memory mixing in duration bisection. In D.A. Rosenbaum & C.E. Collyer (Eds.), *Timing of behavior: Neural, psychological and computational perspectives.* (pp.165-193). Cambridge, MA: MIT Press.
- 163) Meck, W. H. (2002). Distortions in the content of temporal memory: Neurobiological correlates. In S.B. Fountain, M.D. Bunsey, J.H. Danks, & M.K. McBeath (Eds.), *Animal cognition and sequential behavior: Behavioral, biological, and computational perspectives.* (pp. 175-200). Boston, MA: Kluwer Academic Press.
- 164) MacDonald, C. J., & Meck, W. H. (2003). Cortico-striatal mechanisms of interval timing and bird song: Time flies and may also sing. In W.H. Meck (Ed.), *Functional and neural mechanisms of interval timing*. (pp. 393-418). Boca Raton, FL: CRC Press.
- 165) Matell, M. S., Meck, W. H., & Nicolelis, M. A. L. (2003). Integration of behavior and timing: Anatomically separate systems or distributed processing? In W.H. Meck (Ed.), *Functional and neural mechanisms of interval timing*. (pp. 371-391). Boca Raton, FL: CRC Press.
- 166) Meck, W. H. (2003). Introduction: Persistence of time. In W.H. Meck (Ed.), *Functional and neural mechanisms of interval timing*. (pp. xvii-xli). Boca Raton, FL: CRC Press.
- 167) Balci, F., Meck, W. H., Moore, H., & Brunner, D. (2009). Timing deficits in aging and neuropathology. In J.L. Bizon, & A. Wood (Eds.), *Animal models of human cognitive aging*. (pp. 161-201). Totowa, NJ: Humana Press.
- 168) Gu, B. M., & Meck, W. H. (2011). New perspectives on Vierordt's law: Memory-mixing in ordinal temporal comparison tasks. In A. Vatakis, A. Esposito, S. Cummins, M. Giagkou, F. Cummins, & G. Papadelis (Eds.), *Multidisciplinary aspects of time and time perception*. COST TD0904 International Workshop, Athens, Greece, October 2010 Revised Selected Papers, Lecture Notes in Artificial Intelligence 6789. (pp. 67–78). Berlin: Springer-Verlag.
- 169) Eagleman, D. M., & Meck, W. H. (2012). How is time presented in the brain? In D.M. Eagleman (Ed.). '10 unsolved mysteries of neuroscience'. (pp. xx-yy). New York, NY: Oxford.
- 170) van Rijns, H., Gu, B-M., & Meck, W. H. (2012). Coincidence-detection models of interval timing: Decoding time from cortico-striatal ensemble activity. In H. Merchant & V. de Lafuente (Eds.), 'Neurophysiology of temporal processing'. (pp. xx-yy). New York NY: Springer-Verlag.

#### Commentaries, Editorials, Encyclopedia Entries, Forwards, Indexed Abstracts, & Reviews:

- Meck, W. H. (1985). Hippocampus and "general" mnemonic function: Only time will tell. [Commentary on J.N.P. Rawlins (1985). Associations across time: The hippocampus as a temporary memory store.] *Behavioral and Brain Sciences*, 8, 509-510.
- 172) Meck, W. H. (1992). Book review of H. Rahmann & M. Rahmann's text, *The neurobiological basis of memory and behavior*. New York: Springer-Verlag. *The New England Journal of Medicine*, **327**, 1538-1539.
- **173)** Meck, W. H. (1993). Forward to Euan M. Macphail's text, *The neuroscience of animal intelligence: From the seahare to the seahorse.* (pp. xvii-xix). New York: Columbia University Press.
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- 175) Meck, W. H. (1994). Cholinergic function and the internal clock. Behavioural Pharmacology, 5, 27.
- 176) Hinton, S. C., Meck, W. H., & MacFall, J. R. (1996). Peak-interval timing in humans activates frontal-striatal loops. *NeuroImage*, **3**, S224.
- 177) Lustig, C. A., & Meck, W. H. (1998). Attention mediated temporal processing deficits as a function of age, signal modality, and time of day. *Journal of Cognitive Neuroscience*, (Suppl.), 134.

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- 179) Williams, C. L., Wong, R. W., Zeisel, S. H., Mar, M.-H., & Meck, W. H. (2000). Supplementation with methyl group donors, folate or choline during late pregnancy in rats improves visuospatial memory performance of the offspring. *Teratology*, 61, 462.
- 180) Lustig, C., & Meck, W. H. (2001). Chronic treatment with haloperidol induces working memory deficits in feedback effects of interval timing. *Journal of Cognitive Neuroscience*, (Suppl.), 89.
- **181)** Meck, W. H. (2002). Coincidence detection as the core process for interval timing in frontal-striatal circuits, *NeuroImage*, (Program Booklet), 668.
- **182)** Meck, W. H., & Williams, C. L. (2002). Nootrophics. *Encyclopedia of Cognitive Science*, pp. 1021-1026, London, UK: Nature Publishing Group/Macmillan Publishers Ltd.
- 183) Fortin, C. Fairhurst, S. Malapani, C., Morin, & Meck, W. H. (2004). Attentional time-sharing during timing in the PI/GAP task. *International Journal of Psychology*, **39** (5-6), 54-55 Suppl.
- 184) Agostino, P. V., Peryer, G., Meck, W. H. (2008). How music fills our emotions and helps us keep time. *Behavioral and Brain Sciences*, **31**, 575-576.
- 185) Lustig, C., & Meck, W. H. (2009). Book review of Torkel Klingberg's text, *The overflowing brain: Information overload and the limits of working memory*. New York: Oxford University Press. *The New England Journal of Medicine*, 360, 1469.
- 186) Buhusi, C. V., & Meck, W. H. (2010). Timing behavior as a target for drug action. In I.P. Stolerman (Ed.), *Encyclopedia of Psychopharmacology*. pp. 1319-1323, Heidelberg, Germany: Springer.
- 187) Allman, M. J., & Meck, W. H. (2012). Principle features for the classification of individual differences in timing and time perception. In D. Lloyd & V. Arstila (Eds.), *Subjective time: An anthology of the philosophy, psychology, and neuroscience of temporality*, pp. xx-yy, Cambridge, MA: MIT Press, in press.
- 188) Meck, W. H., Doyère, V., & Gruart, A. (2012). Interval timing and time-based decision making. *Frontiers in Integrative Neuroscience*, 6:13. doi: 10.3389/fnint.2012.00013

#### **<u>Reprinted Articles:</u>**

189) Meck, W. H., Smith, R. A., & Williams, C. L. (1989). Organizational changes in cholinergic activity and enhanced visuospatial memory as a function of choline administered prenatally or postnatally or both. *Behavioral Neuroscience*, 103, 118-146. Reprinted (1990) in J.P.J. Pinel (Ed.), *Current Research in Biopsychology*. Boston, MA: Allyn & Bacon.

#### **Edited Books and Journals (Special Issues):**

- 190) Meck, W. H. (2003). Functional and neural mechanisms of interval timing. CRC Press, Boca Raton, FL.
- 191) Meck, W. H. (2004). Guest Editor: Special issue of Cognitive Brain Research 'Neuroimaging of interval timing'.
- **192)** Meck, W. H. (2005). Guest Editor: Special issue of *Brain and Cognition* 'Neuropsychology of timing and time perception'.
- 193) Meck, W. H., Doyère, V., & Gruart, A. (2012). Guest Editors: Special issue of *Frontiers in Integrative Neuroscience* 'Interval Timing and Time-Based Decision Making'. www.frontiersin.org/Integrative%20Neuroscience/specialtopics/interval timing and time based/169

#### **Published Abstracts and Other Presentations:**

- 1) Meck, W.H., & Church, R.M. Simultaneous temporal processing. Paper presented at the 51<sup>st</sup> annual meeting of the Eastern Psychological Association, Hartford, CT, April, 1980.
- 2) Church, R.M., & Meck, W.H. Acquisition and cross-modal transfer of classification rules for temporal intervals. Paper presented at the 3<sup>rd</sup> Harvard Symposium on the Quantitative Analyses of Behavior, Cambridge, MA, June, 1980.
- 3) Meck, W.H., Komeily-Zadeh, F., & Church, R.M. Changing an internal clock's criterion. Paper presented at the 52<sup>nd</sup> annual meeting of the Eastern Psychological Association, New York, NY, April, 1981.
- 4) Meck, W.H., Komeily-Zadeh, F., & Church, R.M. Interference of signal timing by response timing. Paper presented at the 22<sup>nd</sup> annual meeting of the Psychonomic Society, Philadelphia, PA, November, 1981.
- 5) Meck, W.H. Separation of internal clock and memory processes. Paper presented at the 53<sup>rd</sup> annual meeting of the Eastern Psychological Association, Baltimore, MD, April, 1982.

- 6) Church, R.M., & Meck, W.H. The processing of numerical attributes. Invited presentation given at the Harry Frank Guggenheim Conference on Animal Cognition, Columbia University, New York, NY, June 4, 1982.
- 7) Meck, W.H. Selective adjustment of the speed of internal clock and memory storage processes. Invited presentation given at the Department of Psychology, Washington State University, Pullman, WA, March, 1983.
- 8) Meck, W.H. Selective adjustment of the speed of internal clock and memory storage processes. Invited presentation given at Seminar in Biological and Experimental Psychology at the New York State Psychiatric Institute and Columbia University School of Medicine, New York, NY, March, 1983.
- 9) Meck, W.H. Selective adjustment of the speed of internal clock and memory storage processes. Invited presentation given at the annual meeting of the Psychology Section of The New York Academy of Sciences, New York, NY, March, 1983.
- 10) Gibbon, J., Church, R.M., & Meck, W.H. Clock, memory and decision processes in different timing tasks. Invited presentation given at The New York Academy of Sciences Conference on Timing and Time Perception, New York, NY, May, 1983.
- **11)** Meck, W.H. Internal clock, memory, and attentional processes in animal time discrimination. Invited presentation given at The New York Academy of Sciences Conference on Timing and Time Perception, New York, NY, May, 1983.
- **12)** Meck, W.H., & Church, R.M. The cholinergic nervous system and temporal memory in rats. Paper presented at the 13<sup>th</sup> annual meeting of the Society for Neuroscience, Boston, MA, November, 1983.
- **13)** Meck, W.H., & Church, R.M. Nutrients that modify internal-clock and memory-storage speeds. Paper presented at the 24<sup>th</sup> annual meeting of the Psychonomic Society, San Diego, CA, November, 1983.
- 14) Meck, W.H. Physiological basis of timing and temporal memory processes. Invited presentation given at the Department of Psychology, Emory University, Atlanta, GA, April, 1984.
- **15)** Meck, W.H. Post-reinforcement signal processing by rats. Paper presented at the 55<sup>th</sup> annual meeting of the Eastern Psychological Association, Baltimore, MD, April, 1984.
- 16) Church, R.M., & Meck, W.H. Biological basis of the remembered time of reinforcement. Invited presentation given at the 7<sup>th</sup> Harvard Symposium on the Quantitative Analyses of Behavior: Biological Determinants of Reinforcement and Memory, Cambridge, MA, June, 1984.
- 17) Meck, W.H. Internal clock and reward pathways share physiologically similar information-processing stages. Invited presentation given at the 7<sup>th</sup> Harvard Symposium on the Quantitative Analyses of Behavior: Biological Determinants of Reinforcement and Memory, Cambridge, MA, June, 1984.
- 18) Meck, W.H., & Church, R.M. Arginine vasopressin innoculates against age-related changes in temporal memory. Invited presentation given at The New York Academy of Sciences Conference on Memory Dysfunctions: An Integration of Animal and Human Research from Preclinical and Clinical Perspectives, New York, June, 1984.
- **19)** Meck, W.H. Does the putative role of antidiuretic hormone (ADH) in memory facilitation hold water? Invited presentation given at the Department of Psychology, Brown University, Providence, RI, June, 1984.
- **20)** Meck, W.H. Scalar timing in temporal memory: Dopaminergic-cholinergic interactions. Invited colloquium presentation given at the Department of Psychology, The Johns Hopkins University, Baltimore, MD, September, 1984.
- 21) Meck, W.H. Cholinergic function and temporal memory: Septo-hippocampal and nucleus basalis-cortical pathways. Invited colloquium presentation given at Neuroscience Section of the Department of Psychology, Princeton University, Princeton, NJ, October, 1984.
- 22) Meck, W.H. &, Church, R.M. Opioid effects on timing behavior in the rat: Possible actions on dopaminergic and GABAnergic neurons. Presentation given at the 14<sup>th</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1984.
- **23)** Meck, W.H. Vasopressin metabolite neuropeptide facilitates simultaneous temporal processing by rats. Paper presented at the 25<sup>th</sup> annual meeting of the Psychonomic Society, San Antonio, TX, November, 1984.
- 24) Angell, K.E., & Meck, W.H. Repeated administration of pyrithiamine leads to a proportional increase in the remembered duration of events. Poster presentation given at the 56<sup>th</sup> annual meeting of the Eastern Psychological Association, Boston, MA, March, 1985.
- 25) Meck, W.H. Time's arrow: A neuropsychopharmacological perspective. Invited presentation given at the Department of Psychology, Columbia University, New York, NY, March, 1985.
- 26) Meck, W.H. Time's arrow: A neuropsychopharmacological perspective. Invited presentation given at the Department of Psychology, Duke University, Durham, NC, April, 1985.
- 27) Brown, M., Hohmann, C.F., Lowenstein, P.R., Meck, W.H., Wenk, G.L., & Coyle, J.T. Age related re-appearance of partial basal forebrain cholinergic deficits. Paper presented at the 15<sup>th</sup> annual meeting of the Society for Neuroscience, Dallas, TX, October, 1985.
- **28)** Meck, W.H., Church, R.M., Wenk, G.L., & Olton, D.S. Ibotenic acid lesions of the medial septal area and nucleus basalis magnocellularis cause differential impairments in temporal memory. Paper presented at the 15<sup>th</sup> annual meeting of the Society for Neuroscience, Dallas, TX, October, 1985.

- 29) Meck, W.H. Properties of the internal clock. Invited colloquium presentation given at the Department of Psychology, Columbia University, New York, NY, October, 1985.
- **30)** Meck, W.H. Internal structure and the representation of temporal patterns. Paper presented at the 26<sup>th</sup> annual meeting of the Psychonomic Society, Boston, MA, November, 1985.
- **31)** Meck, W.H. The influence of processing speed on temporal and spatial memory. Presentation given at Research Seminar in Cognitive Psychology, Columbia University, New York, NY, March 31, 1986.
- 32) Meck, W.H. Psychophysiology of timing and temporal memory. Invited presentation given at the M.D.-Ph.D. Seminar Series, Columbia University, New York, NY, April 1, 1986.
- **33)** Meck, W.H. Animal models of memory dysfunctions: Research and clinical applications. Invited presentation given at a meeting of the Psi Chi Honor Society, Columbia University, New York, NY, September 29, 1986.
- **34)** Smith, R.A., Meck, W.H., & Williams, C.L. Pre- and postnatal choline supplementation modifies cholinergic function and produces long-term facilitation of spatial memory. Poster presented at the 19<sup>th</sup> annual meeting of the International Society for Developmental Psychobiology, Annapolis, MD, November 8, 1986.
- **35)** Meck, W.H., Church, R.M., Wenk, G.L., & Olton, D.S. Simultaneous temporal processing and the basal forebrain cholinergic system. Poster presented at the 16<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 11, 1986.
- 36) Church, R. M., Gibbon, J., & Meck, W. H. Application of scalar timing theory to individual trials. Paper presented at the 27<sup>th</sup> annual meeting of the Psychonomic Society, New Orleans, LA, November 14, 1986.
- **37)** Meck, W.H. Counting behavior in rats: A mode control model of temporal integration. Invited presentation given at the Midwestern Psychological Association's symposium on "Numerical Skills in Animals", Chicago, IL, May 7, 1987.
- **38)** Meck, W.H., & Williams, C.L. Sex differences in spatial ability: Consequences of early hormonal manipulations. Poster presentation at the Conference on Reproductive Behavior, Tlaxcala, Mexico, June 14-17, 1987.
- **39)** Gibbon, J., Meck, W.H., & Church, R.M. Implications of the break-run-break pattern in the peak procedure. Paper presentation given at the 28<sup>th</sup> annual meeting of the Psychonomic Society, Seattle, WA, November, 1987.
- **40)** Meck, W.H., & Williams, C.L. Choline administration to pregnant rats induces persistent modifications of the content of temporal memory in the male offspring. Presentation given at the 20<sup>th</sup> annual meeting of the International Society for Developmental Psychobiology, New Orleans, LA, November 15, 1987.
- **41)** Williams, C.L., & Meck, W.H. Sex differences in spatial memory of rats: Early organizational effects of gonadal steroids on brain lateralization. Presentation given at the 17<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 18, 1987.
- **42)** Meck, W.H. Psychoactive drugs and the psychology of life extension. Invited presentation given at a meeting of the Lifelong Learners Association, Columbia University, New York, NY, December 4, 1987.
- 43) Meck, W.H. Neuronal plasticity in the developing brain: Relevance to animal learning and cognition. Invited symposium presentation given at the 6<sup>th</sup> Annual Winter Conference on Animal Learning, Winter Park, CO, January 16-20, 1988.
- 44) Meck, W.H. Developmental aspects of the choline produced facilitation of spatial memory. Invited presentation given at Seminar in Biological and Experimental Psychology at the New York State Psychiatric Institute and Columbia University School of Medicine, New York, NY, March 28, 1988.
- **45)** Meck, W.H. How perinatal exposure to dietary choline could produce organizational enhancement of memory. Invited University Seminar presentation given at the Rutgers University Behavioral Neuroscience Colloquium series, New Brunswick, NJ, October 26, 1988.
- **46)** Church, R.M., Miller, K.D., Gibbon, J. & Meck, W.H. Symmetrical and asymmetrical sources of variance in temporal generalization. Paper presented at the 29<sup>th</sup> annual meeting of the Psychonomic Society, Chicago, IL, November, 1988.
- 47) Meck, W.H., Gibbon, J., Allan, L.G., & Shapiro, A.G. Psychometric functions with and without reversals in temporal bisection. Paper presented at the 29<sup>th</sup> annual meeting of the Psychonomic Society, Chicago, IL, November 10, 1988.
- **48)** Meck, W.H., Shapiro, A.G., & Williams, C.L. Prenatal choline exposure produces long-term improvement in temporal processing. Poster presented at the 18<sup>th</sup> annual meeting of the Society for Neuroscience, Toronto, Canada, November 14, 1988.
- 49) Shapiro, A.G., Williams, C.L., & Meck, W.H. Choline supplementation during development: Time frames for spatial memory facilitation. Poster presented at the 18<sup>th</sup> annual meeting of the Society for Neuroscience, Toronto, Canada, November 14, 1988.
- **50)** Williams, C.L., Tatsis, I., & Meck, W.H. Exposure to choline during development improves spatial memory capacity of male and female rats. Poster presented at the 18<sup>th</sup> annual meeting of the Society for Neuroscience, Toronto, Canada, November 14, 1988.
- 51) Meck, W.H. How dietary choline could affect memory: Activational and organizational influences on brain-behavior relationships. Invited tutorial presented at the 13<sup>th</sup> annual Winter Conference on the Neurobiology of Learning & Memory, Park City, UT, January 14, 1989.

- **52)** Meck, W.H. Animal cognition and parallel processing: A summary. Paper presented as part of a symposium at the annual meeting of the American Association for the Advancement of Science (AAAS) -- "Psychobiological models of parallel processing in the perception of time, space, and number", San Francisco, CA, January 19, 1989.
- 53) Dallal, N.L. & Meck, W.H. Chunking of locational cues in rats' spatial memory. Paper presented at the 60<sup>th</sup> annual meeting of the Eastern Psychological Association, Boston, MA, April, 1989.
- 54) Meck, W.H. Short-term memory capacity: Influences on problem-solving and memory-coding strategies. Invited paper presented at the Dalhousie University Conference on Cognitive. Aspects of Stimulus Control, Halifax, Nova Scotia, Canada, June 13, 1989.
- 55) Williams, C.L., Attenasi, L. Williams, J., & Meck, W.H. Sex differences in spatial ability: Hormonal and temporal specificity. Poster presented at the annual meeting of the Conference on Reproductive Behavior, Saratoga Springs, NY, June, 1989.
- **56)** Meck, W.H. & Williams, C.L. Increased working memory capacity as a function of pre- and/or postnatal choline enrichment: A correlated ChAT immunocytochemistry and Golgi analysis in the diagonal band and dentate gyrus. Poster presented at the 19<sup>th</sup> annual meeting of the Society for Neuroscience, Phoenix, AZ, October, 1989.
- 57) Williams, C.L., Meck, W.H., & Loy, R. Perinatal choline supplementation produces long-term modifications in the morphology and distribution of cells in the diagonal band region exhibiting NGF receptor immunoreactivity. Poster presented at the 19<sup>th</sup> annual meeting of the Society for Neuroscience, Phoenix, AZ, October, 1989.
- **58)** Meck, W.H. Modality-specific circadian rhythmicities in interval timing interact with training phase. Paper presented at the 30<sup>th</sup> annual meeting of the Psychonomic Society, Atlanta, GA, November, 1989.
- **59)** Meck, W.H. Multiple sensitive periods in the development of high-capacity visuospatial memory. Invited colloquium presentation given at the Center for Neural Science, Brown University, Providence, RI, December 7, 1989.
- **60)** Meck, W.H. Multiple sensitive periods in the development of high-capacity temporal-spatial memory. Invited colloquium presentation given to the faculty members of the program in Behavioral Biology, SUNY at Stony Brook, Stony Brook, NY, December 18, 1989.
- **61)** Meck, W.H. Choline induced high-capacity, high-precision visuospatial memory. Data blitz presentation given at the 14<sup>th</sup> annual Winter Conference on the Neurobiology of Learning & Memory, Park City, UT, January 13-16, 1990.
- **62)** Meck, W.H. Sensitivity of temporal memory to normal and pathological aging. Invited paper presented at a symposium on "Normal and Pathological Aging," (Leyla deToledo-Morrell organizer), 2<sup>nd</sup> annual meeting of the Neuroscience Winter Conference, St. Maarten, Netherland Antilles, February 24 March 3, 1990.
- **63)** Meck, W.H. Predictability, surprise, and chaos as determinants of the content of temporal memory. Invited colloquium presentation given at the Department of Psychology, McMaster University, Hamilton, Ontario, Canada, March 22, 1990.
- **64)** Dallal, N.L., Rakitin, B.C., & Meck, W.H. Chunking of spatial information as a function of working memory capacity. Paper presented at the 61<sup>st</sup> annual meeting of the Eastern Psychological Association, Philadelphia, PA, March 30, 1990.
- **65)** Dallal, N.L., Rakitin, B.C., & Meck, W.H. Choline-induced development of high-performance memory mediates selection of hierarchical spatial navigation. Paper presentation given at the 23<sup>rd</sup> annual meeting of the International Society for Developmental Psychobiology, Kings College, Cambridge University, Cambridge, England, July 3-6, 1990.
- **66)** Meck, W.H. Multiple sensitive periods for choline-induced development of high-performance visuospatial memory. Invited presentation given at the Institut Pasteur, Neurobiologie Moleculaire, Departement des Biotechnologies, sponsored by Jean-Pierre Changeux and Stanislas Dehaene, Paris, France, June 25, 1990.
- 67) Meck, W.H. Evidence for counting behavior in animals and children suggests a well-developed concept of number. Invited presentation given at the Centre National de la Recherche Scientifique, Ecoles des Hautes Etudes en Sciences Sociales, Laboratoire de Sciences Cognitives et Psycholinguistique, sponsored by Jacques Mehler and Stanislas Dehaene, Paris, France, June, 26 1990.
- 68) Meck, W.H., & Williams, C.L. Organizational and activational effects of choline supplementation interact to facilitate spatial memory in the rat. Poster presentation given at the 23<sup>rd</sup> annual meeting of the International Society for Developmental Psychobiology, Kings College, Cambridge University, Cambridge, England, July 3-6, 1990.
- **69)** Williams, C.L., & Meck, W.H. Sexual differentiation of spatial memory. Paper presentation given at the 23<sup>rd</sup> annual meeting of the International Society for Developmental Psychobiology, Kings College, Cambridge University, Cambridge, England, July 3-6, 1990.
- 70) Meck, W.H., & Williams, C.L. Perinatal choline supplementation and the rat thalamolimbic system: Morphological alterations in granule and pyramidal cells. Poster presentation given at the 20<sup>th</sup> annual meeting of the Society for Neuroscience, St. Louis, MO, October 28-November 2, 1990.
- 71) Williams, C.L., Cohen, R.A., & Meck, W.H. Development of sexually dimorphic spatial ability: Neural sites of estradiol action. Paper presentation given at the 20<sup>th</sup> annual meeting of the Society for Neuroscience, St. Louis, MO, October 28-November 2, 1990.

- 72) Dallal, N.L., Williams, C.L., & Meck, W.H. Prenatal choline supplementation selectively accelerates the development of relational cue navigation. Paper presented at the 62<sup>nd</sup> annual meeting of the Eastern Psychological Association, New York, NY, April, 1991.
- **73)** Kleiderman, M.E., Williams, C.L., & Meck, W.H. Neonatal hyperthyroidism inverts sex differences in the discrimination of duration and temporal order. Paper presented at the 62<sup>nd</sup> annual meeting of the Eastern Psychological Association, New York, NY, April, 1991.
- 74) Meck, W.H. Time and time again: The neurobiology of interval timing revisited. Invited presentation given to the Biopsychology Section, Department of Psychology, The Johns Hopkins University, Baltimore, MD, April, 1991.
- **75)** Meck, W. H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Invited colloquium presentation given to the Department of Psychology, Columbia University, New York, NY, September 25, 1991.
- **76)** Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Invited colloquium presentation given to the Psychobiology Section, Department of Psychology, Yale University, New Haven, CT, October 18, 1991.
- 77) Gorry, E., Meck, W.H., & Williams, C.L. An interaction between gonadal steroids and choline during development influences adult performance on the radial arm maze task. Paper presented at the 24<sup>th</sup> annual meeting of the International Society for Developmental Psychobiology, New Orleans, LA, November 9, 1991.
- 78) Dallal, N.L., Kleiderman, M.E., Meck, W.H., & Williams, C.L. Neonatal hyperthyroidism selectively delays the development of relational cue use and induces a sexually dimorphic impairment of rats' spatial navigation in adulthood. Poster presented at the 21<sup>st</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 14, 1991.
- **79)** Kleiderman, M.E., Meck, W.H., & Williams, C.L. Sex differences in the effect of neonatal hyperthyroidism on hippocampal cell morphology and interval timing processes in adult rats. Poster presented at the 21<sup>st</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 14, 1991.
- **80)** Meck, W.H. [<sup>3</sup>H]-Choline uptake in the frontal cortex of mature and aged rats is proportional to the absolute error in the content of temporal memory. Paper presented at the 21<sup>st</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 14, 1991.
- **81)** Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Invited colloquium presentation given to the Department of Psychobiology, New York State Institute for Basic Research in Developmental Disabilities, Staten Island, NY, January 22, 1992.
- **82)** Williams, C.L., & Meck, W.H. Organizational effects of gonadal steroids on sexually dimorphic spatial ability. Invited presentation given at the 18<sup>th</sup> annual meeting of the International Academy of Sex Research, Prague, Czechoslovakia, July 7-11, 1992.
- 83) Williams. C.L., & Meck, W.H. Perinatal choline supplementation, neurogenesis of basal forebrain neurons, and the sexual differentiation of spatial memory. Invited presentation given at the NATO Advanced Research Workshop: The Development of Sex Differences and Similarities in Behaviour. Château de Bonas, Gers, France, July 13-19, 1992.
- 84) Meck, W.H. Neuropharmacology of time perception. Invited seminar presentation given to the members of the Laboratoire de Medecine Experimentale, INSERM U 289, Hôpital de la Salpêtrière, Paris, France. Sponsored by Pr. Y. Agid, Dr. B. Dubois and Dr. C. Malapani, August, 1992.
- **85)** Meck, W.H. Time and time again: The neurobiology of interval timing revisited. Invited colloquium presentation given to the Biopsychology Section, Department of Psychology, Queens College, CUNY, Flushing NY, September, 1992.
- **86)** Meck, W.H. Frontal lobe dysfunction in Parkinson's disease: The cortical focus of neostriatal outflow and its influence on timing and time perception. Invited presentation given to the "Basal Ganglia Group" Columbia University College of Physicians and Surgeons, New York, NY, September, 1992.
- 87) Krivo, S., Hinton, S.C., & Meck, W.H. Organizational effects of perinatal photoperiod on interval-timing behavior in the rat. Poster presentation given at the 20<sup>th</sup> annual meeting of the International Society for Developmental Psychobiology, Newport Beach, CA, October, 1992.
- **88)** Dallal, N.L., Meck, W.H., & Williams, C.L. Selective developmental acceleration of relational cue navigation and reduction of age-related impairments in spatial processing by prenatal supplementation with choline. Poster presentation given at the 22<sup>nd</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1992.
- 89) Davachi, L., Williams, C.L., Hinton, S.C., & Meck, W.H. Photoperiodic regulation of testis size and spatial memory function in the albino rat: Organizational and activational effects. Poster presentation given at the 22<sup>nd</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1992.
- **90)** Gorry, E., Loy, R., Blusztajn, J.K., Meck, W.H., & Williams, C.L. Gonadal steroids and choline interact during development to improve radial-arm maze performance and increase hippocampal NGF in adult rats. Poster presentation given at the 22<sup>nd</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1992.
- **91)** Jackson, D.A., Meck, W.H., Williams, C.L., & Blusztajn, J.K. Supplementation with choline *in utero* reduces brain choline acetyltransferase (CAT) activity during postnatal development in the rat. Poster presentation given at the 22<sup>nd</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1992.

- **92)** Meck, W.H., & Williams, C.L. Choline supplementation during prenatal development inoculates against the agerelated decline in spatial memory of 24-26 month old rats. Poster presentation given at the 22<sup>nd</sup> annual meeting of the Society for Neuroscience, Anaheim, CA, October, 1992.
- **93)** Dallal, N.L., & Meck, W.H. Dead reckoning and the cognitive map: Vestibular inputs to spatial navigation. Paper presented at the 33<sup>rd</sup> annual meeting of the Psychonomic Society, St. Louis, MO, November 15, 1992.
- **94)** Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the long-term enhancement of memory capacity. Invited colloquium presentation given to the Department of Psychology, Indiana University, Bloomington, IN, December 8, 1992.
- **95)** Meck, W.H. Does nerve growth factor play a role in the long-term enhancement of memory induced by perinatal choline supplementation? Invited seminar presentation given to the Neurobiology Group, Regeneron Pharmaceuticals, Tarrytown, NY, December 15, 1992.
- **96)** Meck, W.H. The role of striato-frontal loops in simultaneous temporal processing. Invited colloquium presentation given to the Department of Psychology: Experimental, Duke University, Durham, NC, February 18, 1993.
- 97) Meck, W.H. The role of striato-frontal loops in simultaneous temporal processing. Invited colloquium presentation given to the Department of Psychology, Brown University, Providence, RI, March 10, 1993.
- **98)** Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Invited seminar presentation given to the Institute of Animal Behavior, The State University of New Jersey Rutgers Campus at Newark, NJ, March 31, 1993.
- **99)** Penney, T.B., Holder, M.D., & Meck, W.H. Behavioral and pharmacological modification of attentional processes involved in peak-interval timing. Paper presented at the 64<sup>th</sup> annual meeting of the Eastern Psychological Association, Arlington, VA, April, 1993.
- 100) Williams, C.L., & Meck, W.H. Hormonal and behavioral mechanisms underlying sex differences in spatial navigation. Invited symposium presentation given at the fifth annual meeting of the Human Behavior & Evolution Society, Binghamton University (SUNY), Binghamton, NY, August, 1993.
- **101)** Meck, W.H. A comparative perspective on the perception of time. Invited symposium presentation given at the Cognitive Studies Program Seminar on Comparative Cognition, Cornell University, Ithaca, NY, August, 1993.
- **102)** Meck, W.H. Animal models of numerical skills. Invited presentation given at the "Mechanisms for Number Processing Workshop" sponsored by the Institute of Cognitive and Decision Sciences and the Center for the Cognitive Neuroscience of Attention, Department of Psychology, University of Oregon, Eugene, OR, October 8-9, 1993.
- 103) Hinton, S.C., Gibbon, J., Rakitin, B.C., & Meck, W.H. Effects of feedback on human interval timing. Paper presented at the 34<sup>th</sup> annual meeting of the Psychonomic Society, Washington D.C., November 6, 1993.
- 104) Penney, T.B., Williams, C.L., & Meck, W.H. Developmental dyslexia and attentional processing in a temporal bisection task. Poster presentation given at the 21<sup>st</sup> annual meeting of the International Society for Developmental Psychobiology, Alexandria, VA, November, 1993.
- 105) Dallal, N.L., & Meck, W.H. Depletion of dopamine in the caudate nucleus but not destruction of vestibular inputs impairs short-interval timing in rats. Poster presentation given at the 23<sup>rd</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 1993.
- 106) Gorry, E., Loy, R. Meck, W.H., & Williams, C.L. Neonatal castration blocks the choline induced increase in size of septal neurons immunoreactive for NGFR. Poster presentation given at the 23<sup>rd</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 1993.
- 107) Malapani, C., Deweer, B., Pillon, B., Bubois, B., Agid, Y., Rakitin, B.C., Penney, T.B., Hinton, S.C., Gibbon, J., & Meck, W.H. Impaired time perception in Parkinson's disease is reversed with apomorphine. Paper presentation given at the 23<sup>rd</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 1993.
- 108) Meck, W.H., Malapani, C., & Gibbon, J. Cognitive and temporal memory dysfunctions in Parkinson's Disease. Invited presentation given at the New York State Office of Mental Health 6<sup>th</sup> Annual Research Conference, Albany, NY, December 8, 1993.
- 109) Meck, W.H., Penney, T.B., Hinton, S.C., & Gibbon, J. Simultaneous temporal processing and frontal-striatal loops. Invited presentation given at the 4th annual meeting of the New England Sequencing and Timing (NEST) conference, University of Massachusetts, Amherst, MA, February 12, 1994.
- 110) Hinton, S.C., Rakitin, B.C., Gibbon, J., & Meck, W.H. Parametric variation of gap duration in a peak-interval timing procedure with humans. Paper presentation given at the 65<sup>th</sup> annual meetings of the Eastern Psychological Association, Providence, RI, April 15, 1994.
- 111) Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Early Career Recognition Award presentation given at the 65<sup>th</sup> annual meetings of the Eastern Psychological Association, Providence, RI, April 16, 1994.
- **112)** Meck, W.H. Individual differences in simultaneous temporal processing. Invited symposium presentation given at the 20<sup>th</sup> annual meeting of the Association for Behavior Analysis, Atlanta, GA, May 28, 1994.

- **113)** Penney, T.B., Holder, M.D., & Meck, W.H. Behavioral and pharmacological modification of attentional processes involved in peak-interval timing. Poster presentation given at the 55<sup>th</sup> annual convention of the Canadian Psychological Association, Penticton, British Columbia, June 29 July 2, 1994.
- 114) Malapani, C., Rakitin, B., Deweer, B., Meck, W., Gibbon, J., Pillon, B., Defontaines, B., Dubois, B., & Agid, Y. Segregation of timing processes within the basal ganglia. Paper presented at the International Neuropsychological Society 16<sup>th</sup> European Conference, Angers, France, June 22-25, 1994.
- **115)** Meck, W.H. Cholinergic function and the internal clock. Invited symposium presentation given at the 5th annual meeting of the European Behavioural Pharmacology Association, Freie Universität Berlin Berlin, Germany, September 14, 1994.
- **116)** Meck, W.H. Time for a smoke: Effects of nicotine on temporal and spatial processing. Invited colloquium presentation given to the Columbia University Seminar on the Psychobiology of Animal Cognition, New York, NY, October 20, 1994.
- **117)** Meck, W.H. Functional and neural mechanisms of interval timing in rats and humans. Invited presentation given as part of the Cognitive Science Seminar Series, Duke University, Durham, NC, November 9, 1994.
- 118) Meck, W.H., & Crosby, P. The effects of acute subcutaneous nicotine on short-interval timing in rats. Poster presentation given at the 24<sup>th</sup> annual meeting of the Society for Neuroscience, Miami Beach, FL, November 13-18, 1994.
- 119) Williams, C.L., Raines, E., & Meck, W.H. Estradiol replacement improves radial-arm maze performance of perinatal choline supplemented and untreated ovariedtomized rats. Poster presentation given at the 24<sup>th</sup> annual meeting of the Society for Neuroscience, Miami Beach, FL, November 13-18, 1994.
- 120) Meck, W.H. Is there an interval clock hiding in the basal ganglia? Invited seminar presentation given to the Behavioral Neuroscience/Neurobiology Study Group, University of North Carolina, Chapel Hill, NC, February 9, 1995.
- 121) Penney, T.B., Meck, W.H., & Gibbon, J. Human temporal bisection: Mixed memories for auditory and visual signal durations. Invited presentation given at the 5th annual meeting of the New England Sequencing and Timing (NEST) conference, Brown University, Providence, RI, March 11, 1995.
- 122) Malapani, C., Karine, H., Levi, R., Penney, T., Meck, W.H., Agid, Y., & Gibbon, J. Coupled temporal memories in Parkinson's disease: A dopamine-related dysfunction. Poster presentation given at the 2nd annual meeting of the Cognitive Neuroscience Society, San Francisco, CA, March 26-28, 1995.
- **123)** Meck, W.H. Perinatal choline supplementation and the development of visuospatial memory. Invited colloquium presentation given at the Department of Psychology, Concordia University, Montreal, Quebec, Canada, April 6, 1995.
- 124) Meck, W.H. Neostriatal circuitry as a scalar memory for time. Invited colloquium presentation given at the Center for Studies in Behavioral Neurobiology, Concordia University, Montreal, Quebec, Canada, April 7, 1995.
- 125) Meck, W.H. Cognitive development: Sleep, time cycles, and neural organization. Invited presentation given at The 1995 Conference on Communicative Processes in Human Development, sponsored by the Institute for Human Communication Research, Raleigh, NC, April 26 – May 1, 1995.
- 126) Meck, W.H., & Williams, C.L. Effects of perinatal choline supplementation on nerve growth factors and long-term memory facilitation. Invited poster presentation given at the 3rd annual Retreat of the Department of Neurobiology, Duke University Medical Center, Boone, NC, October 20-22, 1995.
- 127) Meck, W.H. Effects of nicotine on interval timing behavior. Invited presentation given at the First Annual Duke Nicotine Research Symposium: Neurobehavioral Effects of Nicotine, Duke University, Durham, NC, November 8-9, 1995.
- 128) Gibbon, J., Malapani, C. Heimermann, K., DeWeer, B., Meck, W.H., & Agid, A. Coupled temporal memories in Parkinson's disease: A dopamine-related dysfunction. Paper presented at the 36<sup>th</sup> annual meeting of the Psychonomic Society, Los Angeles, CA, November 10, 1995.
- 129) Jones, J.P., Meck, W.H., Williams, C.L., & Swartzwelder, H.S. Choline availability to the developing rat fetus produces organizational changes in adult hippocampal long-term potentiation. Poster presentation given at the 25<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 11-16, 1995.
- 130) Meck, W.H., Jones, J.P., Oak, J.J., & Williams, C.L. Choline availability to the developing rat permanently alters spatial memory ability in adult rats tested on a 12-arm radial maze. Poster presentation given at the 25<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 11-16, 1995.
- 131) Sandstrom, N.J., Meck, W.H., & Williams, C.L. The effects of prenatal choline supplementation or deficiency on the development of distal cue navigation and on working memory retention. Poster presentation given at the 25<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 11-16, 1995.
- 132) Skjei, K.L., Dedesma, C.A., Meck, W.H., & Williams, C.L. Alterations in the development of spatial memory and hippocampal morphology following changes in choline availability to the fetal rat. Poster presentation given at the 25<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 11-16, 1995.
- **133)** Meck, W.H. How time flies: Functional and neural mechanisms. Invited presentation given to the Cognitive Neuroscience subgroup of the Department of Psychology, Rice University, Houston, TX, December 14, 1995.

- **134)** Meck, W.H. Perinatal choline supplementation and the development of visuospatial memory. Invited colloquium presentation given to the Department of Neurobiology and Anatomy, University of Texas Medical School, Houston, TX, December 14, 1995.
- **135)** Meck, W.H. Segregation of interval-timing processes within the basal ganglia. Paper presented as part of an invited symposium at the annual meeting of the American Association for the Advancement of Science (AAAS) -- "The Mind's Clocks: Circadian and Interval Timing Mechanisms", Baltimore, MD, February, 1996.
- **136)** Meck, W.H. Ideation from the cradle to the grave: Perinatal choline supplementation and the cellular basis of memory capacity. Invited colloquium presentation given at the Department of Psychology, Dartmouth College, Hanover, NH, March, 1996.
- 137) Hinton, S.C., MacFall, J.R., & Meck, W.H. Frontal-striatal loops activated during peak-interval timing: A functional magnetic resonance imaging study in humans. Poster presentation given at the 3<sup>rd</sup> annual meeting of the Cognitive Neuroscience Society, San Francisco, CA, March 30 April 2, 1996.
- 138) Meck, W.H. Functional and neural mechanisms of interval timing in rats and humans. Invited presentation given at the Eighth Annual Kent Psychological Forum, "Animal Cognition: Implications for Biomedical Research", Department of Psychology, Applied Psychology Center, Kent State University, Kent, OH, April 11-14, 1996.
- 139) Hinton, S.C., Meck, W.H., & MacFall, J.R. Peak-interval timing in humans activates frontal-striatal loops. Presentation given at the 2<sup>nd</sup> International Conference on Functional Mapping of the Human Brain sponsored by the Organization for Human Brain Mapping, Boston, MA, June 17-21, 1996.
- 140) Meck, W.H. Interval Timing: Functional magnetic resonance imaging studies of humans. Invited "Fellows Address" given at the 104<sup>th</sup> annual meeting of the American Psychological Association, Toronto, Ontario, Canada, August 11-13, 1996.
- 141) Penney, T.B., Meck, W.H., & Gibbon, J. Memory mixing in duration perception: Visual signals seem shorter than auditory signals. Presentation given at the 26<sup>th</sup> annual International Congress of Psychology, Montreal, Quebec, Canada, August 16-21, 1996.
- 142) Meck, W.H. Choline and development of brain-memory functions. Invited symposium presentation given at the Second International Conference on Choline Phospholipids: Molecular Mechanisms for Human Diseases, Brussels, Belgium, September 8-10, 1996.
- 143) Meck, W.H. Brain activation induced by estimation of duration: Functional magnetic resonance imaging studies in humans. Invited colloquium presentation given to the Unité de Psychobiologie des Processus Temporels and the Centre de Recherches du Cyclotron – Service de Neurologie, CHU Sart Tilman, Liège, Belgium, September 11, 1996.
- 144) Jones, J.P., Meck, W.H., Williams, C.L., & Swartzwelder, H.S. Prenatal and pre+postnatal choline supplementation reduces the threshold to induce long-term potentiation in hippocampal slices from adult rats. Poster presentation given at the 26<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 16-21, 1996.
- 145) Matell, M.S., Meck, W.H., King, G.R. Changes in rescaling temporal responding on the tri-peak procedure after modulation of cocaine reactivity. Poster presentation given at the 26<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 16-21, 1996.
- **146)** Meck, W.H. Frontal-subcortical circuits implicated in interval timing: A functional MRI analysis. Invited symposium presentation given at the 4<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, Boston, MA, March 23-25, 1997.
- 147) Bateson, M., Pauldine, L.C., & Meck, W.H. Effects of methamphetamine on the reproduction of time intervals by starlings. Poster presentation given at the 27<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, October 25-30, 1997.
- 148) Matell, M.S., & Meck, W.H. A comparision of the tri-peak and peak-interval procedure in rats: Equivalency of the clock speed enhancing effect of methamphetamine on interval timing. Poster presentation given at the 27<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, October 25-30, 1997.
- 149) Meck, W.H., Jones, J.P., Williams, C.L., Pauldine, L.C., & Holland, P.C. Choline availability to the developing rat fetus permanently alters attentional mechanisms as assessed by increments in conditioned stimulus processing. Poster presentation given at the 27<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, October 25-30, 1997.
- **150)** Pyapali, G.K., Turner, D.A., Williams, C., Meck, W. & Swartzwelder, H.S. Prenatal choline supplementation decreases the threshold for induction of long-term potentiation (LTP) in young adult rats. Poster presentation given at the 27<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, October 25-30, 1997
- 151) Wong, R.W., Vipperman, C., Meck, W.H., & Williams, C.L. Supplementation with methyl group donors, folate or choline, during late pregnancy in rats improves visuospatial memory performance of the offspring. Poster presentation given at the 27<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, October 25-30, 1997.
- **152)** Meck, W.H. Frontal-subcortical circuits implicated in timing and time perception. Invited seminar presentation given at the Institute for Cognitive and Computational Sciences, Georgetown University, Washington, D.C., February, 13, 1998.
- 153) Lustig, C.A., & Meck, W.H. Attention mediated temporal processing deficits as a function of age, signal modality, and time of day. Poster presentation given at the 5<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, San Francisco, CA, April, 1998.

- **154)** Meck, W.H. Interval timing as a tool in the study of behavioral toxicology. Invited address given at the annual meetings of the Behavioral Toxicology Society, Research Triangle Park, NC, May 2, 1998.
- **155**) Meck, W.H., Hinton, S.C., & Matell, M.S. Coincidence-detection models of interval timing: Evidence from fMRI studies of cortico-striatal circuits. Poster presentation given at the 4<sup>th</sup> International Conference on Functional Mapping of the Human Brain, Montreal, Quebec, Canada, June 7-12, 1998.
- **156)** Meck, W.H. Interval timing as a behavioral assay in the study of neurotoxic effects on frontal-striatal circuitry. Invited slide presentation given to the Integrated Toxicology Program, Duke University, Durham, NC, October 19, 1998.
- **157)** Bateson, M., Pauldine, L.C., & Meck, W.H. The effects of dopaminergic drugs on reproduction of time intervals by starlings. Presentation given at the 28<sup>th</sup> annual meeting of the Society for Neuroscience, Los Angeles, CA, November 7-12, 1998.
- **158)** Benson, A.M., & Meck, W.H. Excitotoxic lesions of the pedunculopontine tegmental nucleus disrupt the temporal control of behavior in rats. Poster presentation given at the 28<sup>th</sup> annual meeting of the Society for Neuroscience, Los Angeles, CA, November 7-12, 1998.
- 159) Matell, M.S., Manos, H.M., & Meck, W.H. The effects of clozapine on interval timing using the tri-peak procedure. Poster presentation given at the 28<sup>th</sup> annual meeting of the Society for Neuroscience, Los Angeles, CA, November 7-12, 1998.
- 160) Meck, W.H., Vipperman, C., Wong, R.W., Cermak, J.M., Blusztajn, J.K., & Williams, C.L. Modifications of prenatal choline availability alter visuospatial ability of rats across the lifespan. Poster presentation given at the 28<sup>th</sup> annual meeting of the Society for Neuroscience, Los Angeles, CA, November 7-12, 1998.
- 161) Mohler, E.R., Wong, R.W., Meck, W.H., & Williams, C.L. Prenatal choline supplementation improves radial-arm maze performance of C57BL6/J mice. Poster presentation given at the 28<sup>th</sup> annual meeting of the Society for Neuroscience, Los Angeles, CA, November 7-12, 1998.
- **162)** Matell, M. & Meck, W.H. Striatal coincidence detection model of interval timing. Poster presentation given at the 32<sup>nd</sup> annual Winter Conference in Brain Research, Snowmass, CO, January 23-30, 1999.
- **163)** Meck, W.H. Cortico-striatal circuits and interval timing: Coincidence-detection of oscillatory processes. Invited panel presentation given at the 32<sup>nd</sup> annual Winter Conference in Brain Research, Snowmass, CO, January 23-30, 1999.
- **164)** Buhusi, C.V. & Meck, W.H. Timing for the absence of a stimulus in rats. Paper presented at the 70<sup>th</sup> annual meeting of the Eastern Psychological Association, Providence, RI, April 15-18, 1999.
- 165) Meck, W.H. Coincidence-detection models of interval timing: Evidence from fMRI studies of cortico-striatal circuits. Invited presentation given at the Max Planck Institute for Cognitive Neuroscience, Leipzig, Germany, September 28, 1999.
- 166) Meck, W.H. Coincidence-detection modals of interval timing. Invited presentation given at the "Workshop on Synchronization and Coordination in Human Movement Timing". Organized by Ralf Krampe, Ralf Engbert, and Reinhold Kliegl. University of Potsdam, Potsdam, Germany, October 1 - 2, 1999.
- 167) Lamoureux, J.A., Williams, C.L., & Meck, W.H. Prenatal choline supplementation enhances sensitivity to the CS preexposure effect in rats. Poster presentation given at the 29<sup>th</sup> annual meeting of the Society for Neuroscience, Miami, FL, October 23-28, 1999.
- **168)** Matell, M.S., Meck, W.H., & Nicolelis, M.A.L. Potential coding of temporal intervals by striatal neurons. Poster presentation given at the 29<sup>th</sup> annual meeting of the Society for Neuroscience, Miami, FL, October 23-28, 1999.
- 169) Mohler, E.G., Meck, W.H., & Williams, C.L. Prenatal choline supplementation influences the performance of apolipoprotein E-deficient, heterozygous, and wildtype mice on a radial-arm maze task. Poster presentation given at the 29<sup>th</sup> annual meeting of the Society for Neuroscience, Miami, FL, October 23-28, 1999.
- 170) Meck, W.H. Coincidence-detection models of interval timing: Evidence from fMRI studies of cortico-striatal circuits. Commissioned symposium presentation given at the annual meeting of the British Psychological Society, London, England, December 20-21, 1999.
- 171) Meck, W.H. Get SET (Scalar Expectancy Theory) for a new millennium. Commissioned symposium presentation given at the annual meeting of the British Psychological Society, London, England, December 20-21, 1999.
- 172) Meck, W.H. Nutritional effects on brain development and cognition. Invited discussant at the 5th Nestlé Nutrition Workshop Clinical and Performance Programme, Mexico City, Mexico, March 27-29, 2000.
- **173)** Meck, W.H. What makes us tick circadian and interval timing compared. Invited seminar/workshop presentation given to the members of the National Science Foundation Center for Biological Timing, University of Virginia, Charlottesville, VA, April, 2000.
- 174) Meck, W.H. Metabolic imprinting of choline by its availability during gestation: Implications for cholinergic neurotransmission in adulthood. Invited symposium presentation given at the 9<sup>th</sup> annual meeting of the International Behavioral Neuroscience Society, Denver, CO, April 7, 2000.
- 175) Williams, C.L., Wong, R.W., Zeisel, S.H., Mar, M.-H., & Meck, W.H. (2000). Supplementation with methyl group donors, folate or choline during late pregnancy in rats improves visuospatial memory performance of the offspring. Invited symposium presentation given at the 24<sup>th</sup> annual meeting of the Neurobehavioral Teratology Society, Palm Beach, FL, June 24-29, 2000.

- 176) Meck, W.H. Coincidence-detection models of interval timing: Evidence from fMRI and ensemble recording studies of cortico-striatal circuits. Invited seminar presentation given to the Department of Psychology: Neural Systems Group, University of Newcastle, Newcastle upon Tyne, UK, October 17, 2000.
- 177) Meck, W.H. Neural bases of timing and time perception. Invited presentation given at the "Autumn Workshop on Temporality," sponsored by the Unite de Neurosciences Cognitives et Imagerie Cérébral and the College de France, Paris, France, October 19-20, 2000.
- 178) Buhusi, C.V., & Meck, W.H. Clock and attention effects of dopaminergic drugs in interval timing. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- 179) Cohen, D., Matell, M.A., Meck, W.H., & Nicolelis, M.A.L. Role of the medial dorsal prefrontal cortex in a time perception task. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- 180) Lamoureux, J.A., Paskalis, J.P.G., Williams, C.L., & Meck, W.H. Variations in maternal dietary intake of choline alter Pavlovian inhibitory learning of the offspring. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- 181) Matell, M.A., Chelius, C.M., Meck, W.H., & Sakata, S. Effect of unilateral or bilateral retrograde 6-OHDA lesions of the substantia nigra pars compacta on interval timing. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- 182) Mohler, E.G., Meck, W.H., Lanier, P.J., & Williams, C.L. Prenatal choline status influences the performance of adult C57BL/6 mice on a sustained attention task. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- **183)** Montoya, D.A.C., White, A.M., Williams, C., Blusztajn, J.K., Meck, W., & Swartzwelder, H.S. Altered hippocampal responsiveness to cholinergic stimulation in adulthood after prenatal choline exposure. Poster presentation given at the 30<sup>th</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November 4-9, 2000.
- **184)** Meck, W.H. Timing and time perception. Scientific advisory meeting and presentation for the "Exploring Time" exhibit at the Science Museum of Minnesota, Minneapolis, MN, January 25-27, 2001.
- **185)** Meck, W.H. Interval timing and genomics: What makes mutant mice tick? Invited presentation given at the annual Winter Conference on Animal Learning (Behavioral Genomics), Winter Park, CO, January 27-31, 2001.
- 186) Hinton, S.C., Meck, W.H., Levin, E.D., Brauer, L.H., McCarthy, G. Response inhibition activates caudate in a continuous performance task. Poster presentation given at the 8<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, New York, NY, March 25-27, 2001.
- 187) Lustig, C. & Meck, W.H. Chronic treatment with haloperidol induces working memory deficits in the feedback effects of interval timing. Poster presentation given at the 8<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, New York, NY, March 25-27, 2001.
- 188) Buhusi, C.V. & Meck, W.H. Clock and attentional effects of dopaminergic drugs on interval timing. Paper presented at the 72<sup>nd</sup> annual meeting of the Eastern Psychological Association, Washington, D.C., April 19-22, 2001.
- **189)** Lamoureux, J.A., Meck, W.H., & Williams, C.L. Variations in maternal dietary intake of choline alter the context sensitivity of Pavlovian conditioning in their offspring. Paper presented at the 72<sup>nd</sup> annual meeting of the Eastern Psychological Association, Washington, D.C., April 19-22, 2001.
- **190)** Sasaki, A., Buhusi, C.V., & Meck, W.H. Stimulus control of the switch/gate of interval timing. Paper presented at the 72<sup>nd</sup> annual meeting of the Eastern Psychological Association, Washington, D.C., April 19-22, 2001.
- 191) Meck, W.H. Attention mediated temporal processing deficits as a function of age, signal modality, and time of day. Invited presentation given at the Unite de Neurosciences Cognitives et Imagerie Cérébrale, LENA - CNRS UPR640 UPMC, Hopital de la Salpetriere, Paris, France, October 5, 2001.
- **192)** Meck, W.H. Signal modality interactions reveal developmental/aging changes in interval timing. Invited presentation given at the "Programme de l'Ecole La Thématique sur la Temporalité dans les Sciences Cognitives", Station Biologique de Roscoff Roscoff, France, October 8, 2001.
- **193)** Buhusi, C.V. & Meck, W.H. Methamphetamine, haloperidol, clozapine, and the control of the internal clock. Poster presentation given at the 31<sup>st</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 10-15, 2001.
- 194) Lamoureux, J.A., Meck, W.H., & Williams, C.L. Variations in prenatal choline availability alter contextual processing during Pavlovian conditioning in adult rats. Poster presentation given at the 31<sup>st</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 10-15, 2001.
- 195) Sasaki, A., Wetsel, W.C., Rodriguiz, R.M., & Meck, W.H. Habituation and dishabituation of the startle response as a function of the interstimulus interval in mice. Poster presentation given at the 31<sup>st</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 10-15, 2001.
- 196) Talton, L.E., Meck, W.H., Staddon, J.E.R., & LaBar, K.S. Dopamine related effects in time production and perception in pigeons and rats. Poster presentation given at the 31<sup>st</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 10-15, 2001.

- 197) Williams, C.L., Lamoureux, J.A., & Meck, W.H. Variations in maternal dietary intake of choline alter Pavlovian occasion setting learning of the offspring. Poster presentation given at the 31<sup>st</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 10-15, 2001.
- **198)** Lustig C. & Meck, W.H. Signal modality interactions reveal developmental/aging changes in interval timing. Paper presentation given at the 42<sup>nd</sup> annual meeting of The Psychonomic Society, Orlando, FL, November 15-18, 2001.
- 199) Buhusi, C.V. & Meck, W.H. Pharmacological differentiation of the clock and switch mechanisms of an internal clock. Paper presentation given at the 73<sup>rd</sup> annual meeting of the Eastern Psychological Association, Boston, MA, March 7-10, 2002.
- **200)** Meck, W.H. Persistence of time. Invited symposium presentation in memorial to John Gibbon given at the 73<sup>rd</sup> annual meeting of the Eastern Psychological Association, Boston, MA, March 7-10, 2002.
- **201)** Lustig, C. & Meck, W.H. Age deficits and sparing in simultaneous temporal processing. Poster presentation given at the 9<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, San Francisco, CA, April 14-16, 2002.
- **202)** Meck, W.H. Mode control model: Counting and timing. Invited symposium presentation given at the 1st annual retreat of the Center for Cognitive Neuroscience, Duke University, Durham, NC, May 4, 2002.
- **203)** Meck, W.H. Coincidence detection as the core process for interval timing in frontal-striatal circuits. Presentation given at the 8<sup>th</sup> International Conference on Functional Mapping of the Human Brain, Sendai, Japan, June 2-6, 2002.
- **204)** Meck, W.H. What makes mutant mice tick? Interval timing in dopamine-transporter knock-out mice. Invited colloquium presentation given to the Department of Psychology, Faculty of Integrated Arts and Sciences, Hiroshima University, Hiroshima, Japan, June 11, 2002.
- **205)** Meck, W.H. Event-related potentials in cerebellum, frontal cortex, and hippocampus during temporal discrimination. Invited seminar presentation given to the Department of Psychology, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, June 13, 2002.
- **206)** Lustig, C., & Meck, W.H. Interactions between frontal cortex and basal ganglia in working memory and interval timing. Paper presentation given at the Quebec '02 Conference on Short-term/Working Memory, Quebec City, Quebec, Canada, July 18-21, 2002.
- 207) Meck, W.H. Dopaminergic- glutaminergic effects on interval timing. Invited symposium presentation given at the 8<sup>th</sup> International Conference on Cognitive Neuroscience (ICON8) meetings, IGeSA: European Science Foundation Centre Ile de Porquerolles, France, September 9-15, 2002.
- **208)** Meck, W.H. Neuropsychological models of interval timing. Invited presentation given at the Unite de Neurosciences Cognitives et Imagerie Cérébrale, LENA CNRS UPR640 UPMC, Hopital de la Salpetriere, Paris, France, September 20, 2002.
- **209)** Meck, W.H. Neural correlates of time estimation in individuals with Parkinson's disease. Invited symposium presentation given at the 42<sup>nd</sup> annual meting of the Society for Psychophysiological Research, Washington, D.C., October 2-6, 2002.
- **210)** Brannon, E., Wolfe, L., Meck, W., & Woldorff, M. Electrophysiological correlates of timing in human infants. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- 211) Buhusi, C.V., Holland, P.C., & Meck, W.H. Ibotenic lesions of the hippocampus disrupt attentional control of interval timing. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- **212)** Lamoureux, J.A., Buhusi, C.V., Williams, C.L., & Meck, W.H. Variations in prenatal choline availability alter attentional processing of temporal information in adult rats. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- 213) Sasaki, A., Andrews, J.R., Higashikubo, B.T., & Meck, W.H. Gene-dose dependent effects on interval timing in dopamine-transporter knockout mice. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience (183.12), Orlando, FL, November 2-7, 2002.
- 214) MacDonald, C.J., & Meck, W.H. Interval timing and executive functions disentangled in a reaction time task using rats with specific dopaminergic lesions. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- 215) McGowan. P.O., Hope, T.A., Williams, C.L., Kelsoe, G., & Meck, W.H. Impairment of social recognition memory in RAG1 but not RAG2-deficient mice. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- **216)** Mohler, E.G., Meck, W.H., & Williams, C.L. (2002). Prenatal choline supplementation rescues memory deficits caused by apoliprotein-e deficiency in female C57BL/6J mice. Poster presentation given at the 32<sup>nd</sup> annual meeting of the Society for Neuroscience, Orlando, FL, November 2-7, 2002.
- **217)** Buhusi, C.V., & Meck, W.H. The wings of time: Representing stimulus duration as a distributed pattern. Paper presentation given at the 43<sup>rd</sup> annual meeting of The Psychonomic Society, Kansas City, MO, November 21-24, 2002.
- **218)** Meck, W.H. Neuroimaging studies of interval timing. Invited presentation given at the Department of Biopsychology, New York State Psychiatric Institute, New York, NY, December 3, 2002.

- 219) Meck, W.H. Neural basis of time perception. Invited colloquium presentation Distinguished Lecture Series, J.P. Scott Center for Neuroscience, Mind, and Behavior and Department of Psychology, Bowling Green State University, Bowling Green, OH, December 12, 2002.
- **220)** Meck, W.H. What makes mutant mice tick? Interval timing in dopamine-transporter knock-out mice. Invited presentation given to the Behavioral Neuroscience Seminar, Department of Psychology, Columbia University, New York, NY, February 20, 2003.
- 221) Buhusi, C.V., & Meck, W.H. (2003). Time and time again: An integrative approach to interval timing. Paper presentation given at the 10<sup>th</sup> annual meeting of the Comparative Cognition Society (CO3), Melbourne, FL, March 20, 2003.
- 222) Meck, W.H. Coincidence-detection models of interval timing: Evidence from ensemble recording studies of corticostriatal circuits. Invited presentation given to the Unité de Neurosciences Cognitives et Imagerie Cérébrale, LENA – CNRS UPR 640, Unité Pitié–Salpétrière, 47 Bd de l'Hôpital, Paris, France, April 25, 2003.
- 223) Meck, W.H. Neural basis of interval timing: Hippocampus, time, and memory. Invited presentation given at la Maison de la Recherche URECA, Université de Lille 3, Lille, France, May 15, 2003.
- 224) Meck, W.H. Coincidence-detection models of interval timing: Evidence from ensemble recording studies of corticostriatal circuits. Invited presentation given to the Laboratoire de Neurobiologie de l'Apprentissage, de la Mémoire & de la Communication, CNRS, UMR 8620, University of Paris, SUD XI, Orsay, France, May 22, 2003.
- 225) Meck, W.H. Coincidence-detection models of interval timing: Evidence from ensemble recording studies of corticostriatal circuits. Invited presentation given to the Laboratoire de Neurobiologie de la Cognition – CNRS, 31 chemin Joseph-Aiguier, Marseille, France, May 27, 2003.
- **226)** Meck, W.H. Mode-control models of counting and timing: Evidence from developmental studies with children. Invited presentation given to the Department of Psychology, Blaise Pascal University, Clermont-Ferrand, France, June 12, 2003.
- 227) Meck, W.H. Simultaneous temporal processing and the frontal cortex: A new way to think about executive function. Invited presentation given at NIH workshop on Executive Function, New York, NY, June 15-17, 2003.
- **228)** Meck, W.H. Prenatal choline availability: Impact on age-related deficits in sleep and memory. Presentation given to the National Institute of Aging Reverse-Site Visit Review Panel (Program Project 2 PO1 AG09525-13), Chevy Chase, MD, June 18, 2003.
- **229)** Jurkowski, A.J., & Meck, W.H. Could interval timing be used as an early marker for PD? Poster presentation given at the Udall Parkinson's Disease Research Center of Excellence Symposium, Duke University, Durham, NC, September 10-11, 2003.
- **230)** Meck, W.H. Interval timing: Coincidence detection by cortico-striatal circuitry. Invited colloquium presentation given to the Department of Psychology, University of Georgia, Athens, GA, October 9, 2003.
- 231) Meck, W.H. Interval timing: Coincidence detection by cortico-striatal circuitry. Invited colloquium presentation given to the Functional Imaging Research Center, Department of Neurology, Medical College of Wisconsin, Milwaukee, WI, October 22, 2003.
- 232) Meck, W.H. Attention and the frontal cortex as examined by simultaneous temporal processing. Seminar presentation given to the Advanced Systems Neuroscience class, Department of Cell Biology, Neurobiology, and Anatomy, Medical College of Wisconsin, Milwaukee, WI, October 22, 2003.
- **233)** Buhusi, C.V., Buhusi, M.C., Scripa, I., Maness, P., Schachner, M., & Meck, W.H. Impaired attentional control of temporal and spatial information in CHL1 KO mice. Poster presentation given at the 33<sup>rd</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November, 2003.
- **234)** Lamoureux, J.A., Kravitz, D.K., Williams, C.L., Meck, W.H. Variation in maternal dietary intake of choline alter both attentional and configural processing capacities of their offspring. Poster presentation given at the 33<sup>rd</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November, 2003.
- **235)** Williams, C.L., Blusztajn, J.K., & Meck, W.H. Spatial memory is differentially sensitive to the availability of choline in adulthood as a function of its supply *in utero* Poster presentation given at the 33<sup>rd</sup> annual meeting of the Society for Neuroscience, New Orleans, LA, November, 2003.
- **236)** Meck, W.H. Coincidence-detection models of interval timing. Invited presentation given at the Banbury Center meeting on the "Neural Representation and Processing of Temporal Patterns," Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, December 14-17, 2003.
- **237)** Meck, W.H. Coincidence-detection models of interval timing. Invited presentation given at the "Neural Control of Behavior: Convergent Principles from Diverse Model Systems" conference sponsored by the Department of Physiology, University of California, Los Angeles, February 5-8, 2004.
- **238)** MacDonald, C.J., & Meck, W.H. Interval timing and reaction time: evidence for a common neural substrate? Poster presented at the "Neural Control of Behavior: Convergent Principles from Diverse Model Systems" conference sponsored by the Department of Physiology, University of California, Los Angeles, February 5-8, 2004.
- **239)** Meck, W.H. Neuropsychology of interval timing. Invited symposium presentation given at TENNET XV, (Theoretical and Experimental Neuropsychology Conference), Montreal, Canada, June 24-26, 2004.

- 240) Fortin, C., Fairhurst, S., Malapani, C., Morin, L., & Meck, W.H. Attentional time-sharing during timing in the PI/GAP task. Paper presentation given at the 28th International Congress of Psychology, Beijing, China, August 8-13, 2004.
- 241) McGowan, P.O., Hope, T.A., Kelsoe, G., Meck, W.H., & Williams, C.L. Recombination activating gene 1 (RAG1) may have a novel function in brain. Poster presentation given at the 2<sup>nd</sup> annual *Neuron* satellite meeting: "Neurons and Memory", San Diego, CA, October 21-22, 2004.
- 242) Buhusi, C.V., Mocanu, M., & Meck, W.H. Abnormal memory consolidation of interval timing in rats with ibotenic lesions of the hippocampus. Poster presentation given at the 34<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, October, 23-27, 2004.
- 243) MacDonald, C.J., Meck, W.H., Nicolelis, M.A.L., & Simon, S.A. Neurons in orbitofrontal cortex encode for multiple features in a taste discrimination task. Poster presentation given at the 34<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, October, 23-27, 2004.
- 244) McGowan, P.O., Hope, T.A., Kelsoe, G., Meck, W.H., & Williams, C.L. Recombination activating gene 1 (RAG1) may have a novel function in brain. Poster presentation given at the 34<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, October, 23-27, 2004.
- **245)** Buhusi, C.V., Perera, D., & Meck, W.H. Memory for timing visual signals in albino and pigmented rats. Paper presentation given at the 76<sup>th</sup> annual meeting of the Eastern Psychological Association, Boston, MA, March 11-13, 2005.
- 246) Brannon, E., Libertus, M., Meck, W.H., & Woldorff, M. Neurophysiological correlates of time processing are modulated by interval differences in human infants and adults. Poster presentation given at the 12<sup>th</sup> annual meeting of the Cognitive Neuroscience Society, New York, NY, April 9-12, 2005.
- 247) Meck, W.H. Neural underpinnings of timing and time perception. Invited colloquium presentation given at the Institute of Psychology, University of Göttingen, Göttingen, Germany, October, 2005.
- 248) Buhusi, C.V., Perera, D., & Meck, W.H. Working memory for time in albino and pigmented rats. Poster presentation given at the 35<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 12-16, 2005.
- 249) Cheng, R.K., MacDonald, C.J., Williams, C.L., & Meck, W.H. Prenatal choline availability alters timing, emotion, and memory performance of adult rats as indexed by the DRL procedure. Poster presentation given at the 35<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 12-16, 2005.
- **250)** Jurkowski, A.J., Kuo, P., Denny, C., & Meck, W.H. Dopamine levels in young, aged, and Parkinson's adults predict behavioral and electrophysiological measures of color and time perception. Paper presentation given at the 35<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 12-16, 2005.
- 251) Libertus, K., Libertus, M., Woldorff, M., Meck, W., & Brannon, E. M. Behavioral and neurophysiological correlated of time processing in human infants. Poster presentation given at the 35<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 12-16, 2005.
- 252) MacDonald, C.J., Cheng, R.K., Laino, A.M., & Meck, W.H. Protein synthesis and the "sculpting" of a temporal criterion: Competitive interactions between dorsal and ventral striatum for learning when to start and stop responding. Poster presentation given at the 35<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November, 12-16, 2005.
- **253)** Buhusi, C.V., & Meck, W.H. Time sharing in rats. Paper presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- **254)** Cheng, R.K., Williams, C.L., & Meck, W.H. Effects of prenatal choline supplementation and reinforcement density on temporal precision in the peak-interval procedure. Poster presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- **255)** MacDonald, C.J., Cheng, R.K., Clore, E.L., & Meck, W.H. *De novo* protein synthesis in the ventral striatum is necessary for the acquisition of a new temporal criterion. Poster presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- 256) MacDonald, C.J., Cheng, R.K., Laino, A.M., & Meck, W.H. Dissociable roles for *de novo* protein synthesis in the dorsal and ventral striatum for learning when to "start" and "stop" responding. Poster presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- **257)** Meck, W.H. Amygdala inactivation reverses fear's ability to make time stand still. Invited symposium presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- 258) Pleil, K.E., Cordes, S., Meck, W.H., & Williams, C.L. Sex differences in counting and timing: Possible neuroendocrine mechanisms. Poster presentation given at the 13<sup>th</sup> annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 22-25, 2006.
- **259)** Cheng, R., MacDonald, C.J., Williams, C.L., & Meck, W.H. Prenatal choline supplementation alters daily sleep patterns in adult male and female rats: Enhancement of gamma oscillations in the hippocampus. Poster presentation (467.9) given at the 36<sup>th</sup> annual meeting of the Society for Neuroscience, Atlanta, GA, October 14-18, 2006.

- **260)** MacDonald, C.J., Cheng, R.K., Clore, E.L., & Meck, W.H. Learning when to "start" and "stop" an action sequence: Dissociable roles for *de novo* protein synthesis in the dorsal and ventral striatum. Poster presentation (572.17) given at the 36<sup>th</sup> annual meeting of the Society for Neuroscience, Atlanta, GA, October 14-18, 2006.
- **261)** Meck, W.H., & MacDonald, C.J. Amygdalar inactivation reverses fear's ability to impair divided attention and make time stand still. Poster presentation (572.18) given at the 36<sup>th</sup> annual meeting of the Society for Neuroscience, Atlanta, GA, October 14-18, 2006.
- **262)** Pleil, K.E., Cordes, S., Cheng, R.K., Meck, W.H., & Williams, C.L. Neuroendocrine mechanisms and the differential effects of cocaine and ketamine on interval timing in male and female rats. Poster presentation (572.26) given at the 36<sup>th</sup> annual meeting of the Society for Neuroscience, Atlanta, GA, October 14-18, 2006.
- **263)** Meck, W.H. Functional and neural mechanisms of interval timing. Colloquium presentation given to the Department of Psychology, University of Michigan, Ann Arbor, MI, November 8, 2006.
- **264)** Meck, W.H. Neuroanatomical localization of an internal clock: A functional link between mesolimbic, nigrostriatal, and mesocortical dopaminergic systems. Invited presentation given at the Unite de Neurosciences Cognitives et Imagerie Cérébrale, LENA CNRS UPR640 UPMC, Hopital de la Salpetriere, Paris, France, November 22, 2006.
- **265)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited presentation given as part of the seminar series on the "Cognitive Neuroscience of Magnitude Processing", Center for Cognitive Neuroscience, Duke University, January 25, 2007.
- **266)** Meck, W.H. Representation of time in the brain. Invited presentation given at the graduate student recruitment symposium, Department of Psychology and Neuroscience, Duke University, Durham, NC, February 24, 2007.
- 267) Cheng, R.K., MacDonald, C.J., Williams, C.L., & Meck, W.H. Organizational and activational effects of photoperiod on spatial and temporal memory in laboratory rats. Paper presentation given at the 14th annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 14-17, 2007.
- **268)** Hakak, O.L., Cheng, R.K., Williams, C.L., & Meck, W.H. Effects of sex and prenatal choline treatments on environmental and object exploration. Poster presentation given at the 14th annual meeting of the International Conference on Comparative Cognition, Melbourne Beach, FL, March 14-17, 2007.
- **269)** Libertus, M.E., Libertus, K., Suanda, S., Woldorff, M., Meck, W., & Brannon, E.M. Behavioral and neurophysiological correlates of interval timing in human infants follow Weber's law. Poster presentation given at the Society for Research in Child Development Biennial Meeting, Boston, MA, March 29 April 1, 2007.
- **270)** Meck, W.H. What makes us tick? Functional and neural mechanisms of interval timing. Invited lecture given at the PROUST Specific Support Action symposium on "The dimension of time and gene functioning: Focus on the nervous system" sponsored by the Department of Neuroscience, Karolinska Institutet and the Royal Swedish Academy of Sciences Kristineberg Marine Research Station, Kristineberg-Fiskebackskil, Sweden, June 7-12, 2007.
- **271)** Meck, W.H. Oscillations of local field potentials in the dorsal striatum reflect temporal memory. Invited presentation given at the Swartz Initiative in Theoretical Neurobiology Symposium on the "Neural Basis of Timing and Anticipation", Yale University, New Haven, CT, September 24, 2007.
- 272) Meck, W.H. Oscillations of local field potentials in the dorsal striatum during interval timing reflect temporal memory. Invited presentation given as part of the "In the Interest of Time" symposium at the annual meeting of The Pavlovian Society, Austin, TX, October 4-6, 2007.
- 273) Meck, W.H. Functional and neural mechanisms of interval timing. Invited seminar given to the Department of Neuroscience, Baylor College of Medicine, Houston, TX, October 26, 2007.
- 274) Cheng, R.K., Manuelli, B., MacDonald, C.J., & Meck, W.H. Oscillations of local field potentials in the dorsal striatum during interval timing reveal the encoding/decoding of temporal memory. Poster presentation (637.7) given at the 37<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 3-7, 2007.
- 275) Hakak, O.L., Cheng, R.K., Williams, C.L., & Meck, W.H. Prenatal choline supplementation enhances the magnitude of hippocampal oscillations and increases multi-cell spiking/ripple events associated with memory consolidation. Poster presentation (746.26) given at the 37<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 3-7, 2007.
- 276) Meck, W.H., Scott, A.C., Williams, C.L., & Cheng, R.K. Effects of prenatal choline supplementation on modality differences in timing and temporal memory as a function of age. Poster presentation (746.24) given at the 37<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 3-7, 2007.
- 277) Meck, W.H. Prenatal choline supplementation increases hippocampal ripple/spike activity and facilitates adult memory consolidation during REM sleep. Invited symposium presentation given as part of the Multidisciplinary Workshop on Nutrition, Brain Development and Aging: Genetics, Epigenetics and Behavior. School of Public Health, University of North Carolina, Chapel Hill – Nutrition Research Institute, Kannapolis, NC, May 12-14, 2008.
- **278)** Meck, W.H. Sundials, hourglasses, and stopwatches: Contributions of striatal neurons to large-scale oscillatory networks involved in temporal cognition. Invited presentation given at the International Neuropsychological Symposium "Neuronal mechanisms of time" organized by Anna Christina Nobre and Maria Concetta Morrone, Puerto de la Cruz, Tenerife Canary Islands, Spain, June 25, 2008.

- 279) Meck, W.H. Cortico-striatal representations of time. Invited presentation given to the Laboratorio Neurobiología de los Ganglios Basales, Cajal Institute, Madrid, Spain, July 1, 2008.
- **280)** Meck, W.H. Prenatal choline supplementation facilitates adult memory consolidation during REM sleep. Invited presentation given as part of the "Sleep-Dependent Memory Consolidation and Neural Plasticity" symposium at the 116<sup>th</sup> annual meeting of the American Psychological Association, Boston, MA, August 14-17, 2008.
- **281**) Meck, W.H. Neuropharmacology of timing and time perception. Invited Neuroscience Seminar Series presentation given to the Department of Neurosciences, Medical University of South Carolina, Charleston, SC, September 26, 2008.
- **282)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited presentation given as part of the "Genes at Work on Time" symposium for the European Union-funded Special Support Action "PROUST The Temporal Dimension of Functional Genomics", Turin, Italy, October 15-17, 2008.
- **283)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited presentation given as part of the symposium on "Time Perception" organized by Maria Concetta Morrone and David Burr, Istituto di Neuroscienze, Consiglio Nazionale della Ricerca, Pisa, Italy, October 24, 2008.
- **284)** Agostino, P.V., Cheng, R.K., Williams, C.L., West, A.E., & Meck, W.H. Learning how to time is regulated by a calcium-responsive transcription factor. Poster presentation (877.18) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- **285)** Bhave, S.R., Cheng, R.K., & Meck, W.H. The metabotropic glutamate 2/3 receptor agonist LY379268 counteracts the clock-speed enhancing effects of cocaine. Poster presentation (877.20) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- 286) Cheng, R.K., McConnell, M.W., & Meck, W.H. Characteristics of local field potentials in the dorsal striatum during the duration bisection procedure. Poster presentation (877.14) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- **287)** Cordes, S., Williamson, L.L., Alves, K., Bhave, S.R., Rodriguez, R.M., Wetsel, W.C., & Meck, W.H. The role of the norepinephrine transporter in interval timing. Poster presentation (877.21) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- **288)** Meck, W.H., Williams, C.L., & Cheng, R.K. Prenatal choline supplementation enhances the amplitude of hippocampal ripple/high frequency events and increases the percentage of their occurrence during SWS and REM sleep states. Poster presentation (290.15) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- 289) Wong-Goodrich, S.J., Glenn, M.J., Mellott, T.J., Blusztajn, J.K., Meck, W.H., & Williams, C.L. Differential sensitivity of hippocampal spatial memory and plasticity to dietary choline supply in adulthood as a function of prenatal choline availability. Poster presentation (290.5) given at the 38<sup>th</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 15-19, 2008.
- **290)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited colloquium presentation given at the Institute of Neuroscience and Brain Science, National Yang-Ming University, Taipei, Taiwan, March 17, 2009.
- **291)** Meck, W.H. Neuronal oscillations and sleep-dependent memory consolidation. Invited colloquium presentation given at the Department of Psychology, National Taiwan University, Taipei, Taiwan, March 18, 2009.
- **292)** Meck, W.H. Neuropharmacology of timing and time perception. Invited colloquium presentation given at the Department of Psychology, National Cheng-Chi University, Taipei, Taiwan, March 19, 2009.
- **293)** Meck, W.H. Expanding frontiers in neural timing systems. Invited seminar presentation given at Temasek Lifesciences Laboratory, National University of Singapore, Singapore, March 25, 2009.
- 294) Meck, W.H. Time the familiar stranger: Mysteries of mind and time (Participants: Sir Harold Evans, Daniel Gilbert, Warren Meck, and Oliver Sacks). World Science Festival 2009 invited signature program (8:00 9:30 PM), Gerald W. Lynch Theater, CUNY, New York, NY, June 13, 2009. <u>http://www.worldsciencefestival.com/2009/time-familiar-stranger</u>.
- **295)** Meck, W.H. Pathological distortions in timing and temporal memory. Invited keynote address given at the Twelfth Rhythm Perception and Production Workshop, Université Lille 3, Charles-de-Gaulle Lille, France, July 17, 2009.
- **296)** Meck, W.H. Individual differences in beat-based versus interval-based time perception. Invited presentation given at the workshop on "Intra- and Interpersonal Differences in the Experience of Time" as a part of the project "Subjective Time Phenomenological Property or Cognitive Construct?" funded by the "European Platform for Life Sciences, Mind Sciences, and the Humanities" of the Volkswagen Foundation, Turku, Finland, September 8-10, 2009.
- 297) Meck, W.H. Neurophysiology of timing and time perception. Invited Plenary symposium on "Circadian and Interval Timing" organized by Diego Golombek (University of Quilmes, Argentina), 10th Latin American Symposium of Chronobiology, Instituto Internacional de Neurociências de Natal Natal, RN, Brazil, October 21-24, 2009.
- **298)** Cheng, R.K., & Meck, W.H. Distinct ensemble unit activity and oscillatory patterns in the dorsal striatum during discrete-trial interval timing procedures. Poster presentation given at the 39<sup>th</sup> annual meeting of the Society for Neuroscience, Chicago, IL, October 17-21, 2009.
- 299) Meck, W.H., Williams, C.L., & Cheng, R.K. Oscillatory changes in the hippocampus during exploration of novel

objects as a function of prenatal choline availability and subsequent sleep states. Poster presentation given at the 39<sup>th</sup> annual meeting of the Society for Neuroscience, Chicago, IL, October 17-21, 2009.

- **300)** Cheng, R.K., Williams, C.L., & Meck, W.H. Oscillatory changes in the hippocampus during exploration of novel objects as a function of prenatal choline availability and subsequent sleep states. Slide presentation given at the "Sleep and Circadian Biology DataBlitz". Co-organized by the NIH National Center on Sleep Disorders Research and the NIH Sleep Disorders Research Advisory Board. Crystal Ballroom B, Hyatt Regency, Chicago, IL, October 19, 2009.
- **301)** Meck, W.H. How distortions in timing and temporal memory contribute to faulty decision-making. Invited presentation given at the Duke University Center for Cognitive Neuroscience Annual Retreat, Lake Johnson Park, Raleigh, NC, October 30, 2009.
- **302)** Meck, W.H. Hippocampal-striatal interactions in the temporal control of behavior. Invited conference presentation given at the 15th Biennial Scientific Meeting of The International Society for Comparative Psychology (Chair Shogo Sakata, Hiroshima University), Awaji Yumebutai International Conference Center, Awaji Island, Hyogo, Japan, May 19, 2010.
- **303)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited colloquium presentation given to the Department of Psychology, Doshisha University, hosted by Dr. Toshimichi Hata Kyoto, Japan, May 22, 2010.
- **304)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited seminar presentation given to the Department of Physiology, Kinki University, hosted by Dr. Ken-ichi Oshio Osaka, Japan, May 24, 2010.
- **305)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited colloquium presentation given at the Centre for Advanced Research on Logic and Sensibility Global Centers of Excellence Program, Keio University, hosted by Dr. Shigeru Watanabe Tokyo, Japan, May 26, 2010.
- 306) Meck, W.H. Neural features of encoding, maintenance, and decision processes in an ordinality task requiring temporal comparisons. Invited presentation given at the "Multidisciplinary Aspects of Time Perception" workshop of Time In MEntaL activitY (TIMELY): Theoretical, behavioral, bioimaging, and clinical perspectives (TIMELY) European Union Committee of Senior Officials for Scientific and Technical (COST), School of Architecture at the National Technical University of Athens Athens, Greece, October 6-8, 2010.
- **307)** Cheng, R.K., & Meck, W.H. Distinct spike-waveform features predict behavioral correlates of striatal cell subtypes during discrete-trial interval timing procedures. Poster presentation given at the 40<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 13-17, 2010.
- **308)** Gu, B-M., & Meck, W.H. Neural features of encoding, maintenance, and decision processes in a novel ordinal/temporal comparison task in rats. Poster presentation given at the 40<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 13-17, 2010.
- **309)** Yin, B., Yin, H.H., & Meck, W.H. Dorsal hippocampal lesions lead to double leftward shifts of peak time in a bi-peak procedure in mice. Poster presentation given at the 40<sup>th</sup> annual meeting of the Society for Neuroscience, San Diego, CA, November 13-17, 2010.
- **310)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited presentation given to the Department of Pharmacology (Dr. Bryan Roth host), University of North Carolina, Chapel Hill, NC, December 3, 2010.
- **311)** Meck, W.H. Social and affective neuroscience of timing and time perception. Invited presentation given at the annual meeting of the Society of Personality and Social Psychology as part of the "*Time and Mind*" symposium organized and chaired by Emily Pronin (Princeton University), San Antonio, TX, January 27-29, 2011.
- 312) Meck, W.H. EEG and research on time perception. Invited training school presentation given in conjunction with Trevor Penney (National University of Singapore) to the Time In MEntaL activitY (TIMELY) School: Theoretical, behavioral, bioimaging, and clinical perspectives (TIMELY) – European Union Committee of Senior Officials for Scientific and Technical (COST), <u>http://www.timely-cost.eu/training-school-2</u> University of Groningen, Groningen, The Netherlands – April 5, 2011.
- **313)** Meck, W.H. Neurobiology of time. Invited training school presentation given to the Time In MEntaL activitY (TIMELY) School: Theoretical, behavioral, bioimaging, and clinical perspectives (TIMELY) European Union Committee of Senior Officials for Scientific and Technical (COST), <u>http://www.timely-cost.eu/training-school-2</u> University of Groningen, Groningen, The Netherlands April 6, 2011.
- 314) Meck, W.H. Functional and neural mechanisms of interval timing. Invited colloquium given to the Department of Neurophysiology of Memory (Dr. Aleš Stuchlik, Head), Institute of Physiology, Czech Republic Academy of Science, <u>http://industry.biomed.cas.cz/332/www332\_AJ/anglicky\_index.html</u> Prague, Czech Republic – April 8, 2011.
- **315)** Lake, J.I., LaBar, K.S., & Meck, W.H. Hear it low and slow: Bidirectional pitch changes differentially influence the perception of interval duration. Poster presentation given at the 13<sup>th</sup> International Rhythm Perception and Production Workshop, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany July 13-15, 2011.
- **316)** Allman, M.J., Denckla, M.B., Cataldo, M.F., & Meck, W.H. Neural differences revealed by fMRI during a temporal discrimination procedure in children with autism. Poster presentation given at the 43<sup>rd</sup> annual meeting of the European Brain and Behavior Society (EBBS) Seville, Spain September 9-12, 2011.
- 317) Meck, W.H. Neurobiology of interval timing. Invited presentation given at the "Neurobiology of Time Perception:

From Normality to Dysfunction" meeting of Time In MEntaL activitY (TIMELY): Theoretical, behavioral, bioimaging, and clinical perspectives (TIMELY) – European Union Committee of Senior Officials for Scientific and Technical (COST), Sevilla, Spain, September 8, 2011. A satellite meeting of the European Brain and Behaviour Society (EBBS) conference also being held in Sevilla, Spain – September 9-12, 2011.

- 318) Gu, B-M., & Meck, W.H. Vierordt's law and individual differences in feedback sensitivity of temporal memory. Poster presentation given at the 41<sup>st</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 12-16, 2011.
- 319) Lake, J.I., LaBar, K.S., & Meck, W.H. The influence of non-temporal cues (or pitch) on interval timing within a beatbased structure. Poster presentation given at the 41<sup>st</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 12-16, 2011.
- 320) Meck, W.H. & Bin, Y. Fluoxetine normalizes interval-timing deficits in dopamine transporter knockout mice: Contributions of the norepinephrine transporter and serotonin-2A receptors. Poster presentation given at the 41<sup>st</sup> annual meeting of the Society for Neuroscience, Washington, D.C., November 12-16, 2011.
- 321) Meck, W.H. Coincidence detection models of interval timing. Invited presentation given at the Symposium on the Neurophysiology of Interval Timing, hosted by Dr. Hugo Merchant, Instituto de Neurobiologia, National University of Mexico Campus, Juriquilla, Queretaro, Mexico – January 19, 2012.
- **322)** Meck, W.H. The human brain as the ultimate time machine. Invited symposium presentation scheduled for Rome's 7<sup>th</sup> International Science Festival on the theme of "Brain and Time". Other invited participants include Ann Graybiel (MIT) and Lera Boroditisky (Stanford). Promoted by the Fondazione Musica per Roma and by the Capital's and the Region's administration Renzo Piano's Auditorium Parco della Musica, Rome, Italy January 21, 2012.
- 323) Meck, W.H. Unwinding the molecular basis of interval and circadian timing. Invited presentation given at the symposium on "Modeling clock mechanisms for genetic and epigenetic investigations" organized by Valter Tucci, (Department of Neuroscience and Brain Technologies Istituto Italiano di Tecnologia, Italy) for the19<sup>th</sup> International Conference On Comparative Cognition (CO3), Melbourne, FL March 10, 2012.
- 324) van Rijn, H., & Meck, W.H. Post-interval evoked N1-P2 amplitude reflects continuation of interval timing following CNV resolution. Invited presentation to be given at the symposium on "How does the brain process time?" organized by Jennifer Coull & Laurence Casini (Université de Provence) for the 1<sup>st</sup> Conference of the European Society for Cognitive and Affective Neuroscience (ESCAN), Marseille, France – May 9-12, 2012.
- **325)** Meck, W.H. Functional and neural mechanisms of interval timing. Invited distinguished speaker/seminar presentation to be given to the Department of Psychology, Koç University, Rumeli Feneri Yolu, Sarıyer 34450 Istanbul, Turkey May 15, 2012.
- **326)** Allman, M.J., Joel, S.E., Pekar, J.J., Meck, W.H., Cataldo, M.F., Landa, R.J., Mostofsky, S.H., & Denckla, M.B. fMRI reveals differences between neural systems recruited for time perception in children with and without autism. Presentation to be given at the International Meeting for Autism Research, Toronto, Canada May 17-19, 2012.
- **327)** Meck, W.H. New perspectives on Vierordt's law: Memory-mixing and sensitivity to feedback in temporal comparison procedures. Invited slide presentation to be given at the TIMELY workshop on "Temporal Processing Within and Across Senses", in commemoration of Karl Vierordt's work on time perception University of Tübingen, Tübingen, Germany October 3-6, 2012.
- **328)** Gu, B-M., & Meck, W. H. Vierordt's law and the effect of reward expectation on temporal memory. Presentation to be given at the TIMELY workshop on "Temporal Processing Within and Across Senses", in commemoration of Karl Vierordt's work on time perception University of Tübingen, Tübingen, Germany October 3-6, 2012.

## **Professional Service**

Chair, Session on Ingestive Behavior, 25th annual meeting of the Psychonomic Society, San Antonio, TX, November, 1984. Chair, Session on Animal Cognition, 26th annual meeting of the Psychonomic Society, Boston, MA, November, 1985. Co-Chair, Columbia University Seminar on the Psychobiology of Animal Cognition, 1988-1993.

Symposium Organizer: "How Dietary Choline Could Affect Memory." Thirteenth annual Winter Conference on Neurobiology of Learning and Memory, Park City, UT, January 15, 1989.

Symposium Organizer: Chair: Session in Mathematics, Statistics & Computing. 1989 Annual Meeting of the American Association for the Advancement of Science, "Psychobiological Models of Parallel Processing in the Perception of Time, Space, and Number", San Francisco, CA, January 19, 1989.

Program Subcommittee (1990 - 1992) - Abstract Reviewer, American Psychological Society annual convention.

Program Subcommittee (1990 - 1994) - Abstract Reviewer, Eastern Psychological Association annual convention.

Program Committee Co-Director (1996) - American Psychological Association (Division 6) annual meeting.

Co-Editor (with C.L. Williams), *The Physiological and Comparative Psychologist*, American Psychological Association, Division 6 Newsletter (1991-1996).

Consulting Editor, *Animal Learning & Behavior* (1987-1989) & (1998-2002). Consulting Editor, *Developmental Psychobiology* (1991-1995).

Project Advisor, NSF supported "Exploring Time" exhibit, Science Museum of Minnesota, St. Paul, MN – (1999-2002).
Project Advisor, "What Makes Us Tick?", British Broadcasting Company (BBC) documentary on chronobiology – (1999).
Executive Committee – American Psychological Association, Division 6 (2002-2004).
Guest Editor, Special Issue of *Cognitive Brain Research* – Neuroimaging of interval timing (2004).
Guest Editor, Special Issue of *Brain and Cognition* – Neuropsychology of timing and time perception (2005).
Associate Editor, *Frontiers in Integrative Neuroscience* (2007-present).
Academic Editor, *PLoS ONE* (2008-present).
Editorial Board, *PSYCHE: An Interdisciplinary Journal of Research on Consciousness* (2008-present).

Editorial Board, *PSYCHE: An Interdisciplinary Journal of Research on Consciousness* (2008-pres Associate Editor, *Frontiers in Comparative Psychology* (2010-present).

Guest Editor, Special Topic of *Frontiers in Integrative Neuroscience* – "Interval timing and time-based decision making" (2012). http://www.frontiersin.org/Integrative%20Neuroscience/specialtopics/interval timing and time based/169

#### **Guest Reviewer for the following journals:**

Acta Psychologica (n=2). American Journal of Psychology (n=1). Animal Cognition (n=4). Animal Learning & Behavior (n=20). Behavioral Neuroscience (n=21). Behavioural Brain Research (n=12). Behavioural Pharmacology (n=5). Behavioural Processes (n=20). Biological Psychiatry (n=5). Brain and Cognition (n=11). Brain Research (n=17). Brain Research Bulletin (n=1). Canadian Journal of Experimental Psychology (n=1). *Cahiers de Psychologie Cognitive* (n=1). *Cellular and Molecular Life Sciences* (n=1). Cerebral Cortex (n=5). Cognition: International Journal of Cognitive Science (n=2). Cognitive Brain Research (n=5). *Cortex* (n=1). *Current Biology* (n=3). Developmental Psychobiology (n=5). Developmental Science (n=1). Emotion (n=6). *European Journal of Neuroscience* (n=4). Experimental Brain Research (n=10). *Hippocampus* (n=4) Hormones and Behavior (n=2). Human Brain Mapping (n=4). Journal of Biological Rhythms (n=2). Journal of Cognitive Neuroscience (n=4). Journal of Comparative Psychology (n=6). Journal of Experimental Psychology: Animal Behavior Processes (n=18). Journal of Experimental Psychology: Human Perception and Performance (n=15). Journal of Experimental Psychology: General (n=2). Journal of Neurology, Neurosurgery, and Psychiatry (n=1). *Journal of Neurophysiology* (n=3). Journal of Neuroscience (n=12). Journal of Psychopharmacology (n=1). Journal of The Experimental Analysis of Behavior (n=3). Journal of the International Neuropsychological Society (n=1). Learning & Behavior (n=5). *Learning & Memory* (n=2). *Learning and Motivation* (n=7). *Nature* (n=2). Nature Neuroscience (n=4).

*Neurobiology of Disease* (n=1). Neurobiology of Learning and Memory (n=5). NeuroImage (10). *Neuropharmacology* (n=2). *Neuropsychologia* (n=11). *Neuropsychology* (n=6). Neuroscience (n=1). *Neuroscience and Biobehavioral Reviews* (n=3). *Neuroscience Letters* (n=4). Neuron (n=4). *New England Journal of Medicine* (n=2). *New Ideas in Psychology* (n=1). *Nutritional Neuroscience* (n=2). Perception & Psychophysics (n=5). Pharmacology Biochemistry & Behavior (n=14). Physiology & Behavior (n=6). PLoS Biology (n=3). Proceedings of the National Academy of Sciences (n=5). *Psychobiology* (n=11). Psychology and Aging (n=3). Psychopharmacology (n=20). *Psychological Review* (n=6). Psychological Science (n=4). Psychonomic Bulletin & Review (n=5). *Psychophysiology* (n=3). Science (n=6). The Behavioral and Brain Sciences (n=5). *The International Journal of Aging & Human Development* (n=1). *The Quarterly Journal of Experimental Psychology: Section A: Human Experimental Psychology* (n=1). The Quarterly Journal of Experimental Psychology: Section B: Comparative and Physiological Psychology (n=9). *Trends in Cognitive Sciences* (n=5). *Trends in Neurosciences* (n=3).

Conference Reviewer, The New York Academy of Sciences (n=4).

Reviewer, City University of New York (CUNY), Internal Grants Program – 1995-present (n=8). Reviewer, National Science Foundation, Animal Behavior, Psychobiology & Neuroendocrinology Sections (n=14). Reviewer, National Institutes of Health, Biopsychology Study Section (n=1). Reviewer, Natural Sciences and Engineering Research Council of Canada (n=6). Reviewer, United States Air Force Office of Scientific Research (n=1). Reviewer, Research Grants Council, Hong Kong, China. Special Reviewer, Psychobiology and Behavior Review Committee, National Institute of Mental Health, June 1993. Panel Member, Neurobiology of Cognition and Behavior Committee, National Institute of Health, November 1993. Special Reviewer, Biotechnology and Biological Sciences Research Council of Great Britain, 1995-2006. Panel Member, Basic Behavioral Sciences Services Research Subcommittee, National Institute on Drug Abuse, 1995-1999. Reviewer, The Research Grants Council - University Grants Committee, Wan Chai, Hong Kong, China, 2001-2002. Panel Member, National Institute of Health, Biobehavioral and Behavioral Processes, Special Emphasis Panel – March 2001. Panel Member, National Institute of Mental Health (NIMH), Division of Extramural Activities Review Panel - April 2001. Panel Member, National Institute of Health (NIH), Special Emphasis Panel – October 2001. Panel Member, National Institute of Mental Health (NIMH), Special Emphasis Panel – November 2001. Panel Member, National Institute of Mental Health, Special Emphasis Panel – July 2002. Panel Member, National Institute of Mental Health, Special Emphasis Panel – March 2003. Special Reviewer, French Ministry of Research – Concerted Action Integrative and Computational Neuroscience – 2003. Special Reviewer, Welcome Trust - London, United Kingdom, 2006-present. Reviewer, Natural Sciences and Engineering Research Council of Canada, 2006-present. Reviewer, National Science Foundation (NSF), 2007-present. Reviewer, Israel Science Foundation - Humanities & Social Sciences (Ofra Nagar, Administrative Assistant), 2011-present. Panel Member (2011-2012) - Grant Evaluation Committee, Programme Blanc, Commission Neurosciences (SVSE 4), French National Research Agency, Département Biologie-Santé, 212 rue de Bercy 75012 Paris, France.