CV OF DR. JUSTUS V. VERHAGEN (OCT 2024)

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Nationality: Dutch & American

Current position

July 2019-present:
Fellow, The John B. Pierce Laboratory, New Haven CT

April 2022-July 2024: (Ended by expiration of Affiliation Agreement between Yale and Pierce)
Senior Research Scientist, Department of Neuroscience, Yale School of Medicine (co-terminus)

Jan 2013-Mar 2022:
Associate Professor, Department of Neuroscience, Yale School of Medicine (co-terminus)

Jan 2013-June 2019:
Associate Fellow, The John B. Pierce Laboratory, New Haven CT

Jan 2007-2013:
Assistant Fellow, The John B. Pierce Laboratory, New Haven CT
Assistant Professor, Department of Neuroscience, Yale School of Medicine (co-terminus)

Previous positions

Post-doctoral fellow (Oct 2004-Jan 2007)
Boston University, Department of Biology
Research Instructor collaborating with Dr. Matt Wachowiak
- Optical imaging of olfactory bulb in awake restrained rats
- Investigating the relation between natural sniffing patterns and bulbar spatio-dynamic neural activity patterns

Post-doctoral fellow (Sept 2000-Sept 2004)
University of Oxford, Department of Experimental Psychology
Research Officer of Laboratory of Prof. Edmund Rolls
- Responsible for all aspects involved with electrophysiological characterization of the monkey orbitofrontal cortex, insular cortex, lateral hypothalamus and amygdala
- Single unit responses to oral taste, temperature, texture and fat in the orbitofrontal cortex, insular cortex and amygdala of the awake rhesus macaque

Education

Ph.D. (May 2001)
University of Delaware, Dept. of Psychology, Neuroscience program
Supervisor: Dr. Tom Scott
Subject: taste coding in the rat thalamus

Drs. (1996; five-year Dutch course, approximately equivalent to M.Sc.)
University of Amsterdam, Medical Biology, The Netherlands
Intern Research at the Free University of Amsterdam under direction of Dr. G.R.M.M. Haenen
Intern Research at the University of Delaware under direction of Drs. S. Levine and E. Satinoff.

Publications

Neuroscience

Close to submission:

Misha Izydorczak*, Maggie Oumov*, Mansiben V. Udhwani*, Faysal Fostok, Guillermo Coronas-Samano, Basavaraju G. Sanganahalli [4,5,6], Peter Herman [4,5,6], Fahmeed Hyder [4,5,6,7], **Justus V. Verhagen**[1,2].
*Behavioral deficits and exacerbated hemodynamics during lifespan of a mouse model of late onset Alzheimer's disease expressing humanized APOEε4 and Trem2*R47H.*

Ankita Gumaste[1,2,3], Maggie M. Oumov[2] and **Justus V. Verhagen**[1,2,3]
Influence of Odor Plume Properties on Behavioral Decisions and Odor Representations in the Mouse Olfactory Bulb. Review.

Published *(2.1/yr since 2003)*

47 Gumaste A, Baker KL, Izydorczak M, True AC, Vasan G, Crimaldi JP, **Verhagen J**.
Behavioral discrimination and olfactory bulb encoding of odor plume intermittency.
Elife 13:e85303. doi: 10.7554/eLife.85303; 2024
PMID: 38441541
Video abstract: https://www.youtube.com/watch?v=czZ4UZMLOrw

46 James S, Sanggaard S, Akif A, Mishra SK, Sanganahalli BG, Blumenfeld H, **Verhagen JV**, Hyder F, Herman P.
Spatiotemporal features of neurovascular (un)coupling with stimulus-induced activity and hypercapnia challenge in cerebral cortex and olfactory bulb.
J Cereb Blood Flow Metab. 43(11):1891-1904. doi: 10.1177/0271678X231183887; 2023
PMID: 37340791

45 **Verhagen JV**, Baker KL, Vasan G, Pieribone VA, Rolls ET.
Odor encoding by signals in the olfactory bulb.

J Neurophysiol 129(2):431-444. doi: 10.1152/jn.00449.2022. 2023
PMID: 36598147

44 Mishra SK, Herman P, Crair M, Constable RT, Walsh JJ, Akif A, **Verhagen JV**, Hyder F.
Fluorescently-tagged magnetic protein nanoparticles for high-resolution optical and ultra-high field magnetic resonance dual-modal cerebral angiography.
Nanoscale 14(47):17770-17788. doi: 10.1039/d2nr04878g; 2022
PMID: 36437785

43 Sanganahalli BG, Thompson GJ, Parent M, **Verhagen JV**, Blumenfeld H, Herman P, Hyder F.
Thalamic activations in rat brain by fMRI during tactile (forepaw, whisker) and non-tactile (visual, olfactory) sensory stimulations.
PLoS One 17(5): e0267916. doi: 10.1371/journal.pone.0267916. eCollection; 2022
PMID: 35522646

42 Crimaldi J, Lei H, Schaefer A, Schmuker M, Smith BH, True AC, Verhagen JV, Victor JD.
Active sensing in a dynamic olfactory world.
J Comput Neurosci. doi: 10.1007/s10827-021-00798-1; 2021
PMID: 34591220

41 Baker KL, Izydorczak M, Jackson R, **Verhagen JV**.
An Automated Sensitive Approach For Measuring Whole Gut Transit Time.
Neurogastroenterol Motil. 2020 Sep;32(9):e13894. doi: 10.1111/nmo.13894; 2020
PMID: 32468651

40 Sanganahalli BG, Baker KL, Thompson GJ, Herman P, Shepherd GM, **Verhagen JV**, Hyder F.
Orthonasal versus retronasal glomerular activity in rat olfactory bulb by fMRI.
NeuroImage, 212:116664; j.neuroimage.2020.116664; 2020

39 Gumaste A, Coronas-Samano G, Hengenius J, Axman R, Connor EG, Baker KL, Ermentrout B, Crimaldi JP, **Verhagen JV**.
A comparison between mouse, in silico, and robot odor plume navigation reveals advantages of mouse odor-tracking.
E Neuro pii: ENEURO.0212-19.2019. doi: 10.1523/ENEURO.0212-19; 2020
Video abstract: https://www.youtube.com/watch?v=UBhRwKEj-NM

38 Baker KL, Vasan G, Gumaste A, Pieribone VA, **Verhagen JV**.
Spatiotemporal dynamics of odor responses in the lateral and dorsal olfactory bub.
PLOS Biology 17(9):e3000409. doi: 10.1371/journal.pbio.3000409; 2019

37 Baker KL, Dickinson M, Findley T, Gire D, Louis M, Suver M, **Verhagen JV**, Nagel K, Smear M.
Algorithms for Olfactory Search Across Species.
J Neurosc 38(44):9383-9389. doi: 10.1523/JNEUROSCI.1668-18; 2018

36 Thompson GJ, Sanganahalli BG, Baker KL, Herman P, Shepherd GM, **Verhagen JV**, Hyder F
Spontaneous activity forms a foundation for odor-evoked activation maps in the rat olfactory bulb.
Neuroimage pii: S1053-8119(18)30051-X; 2018

35 Coronas-Samano G, Baker KL, Ivanova AV, **Verhagen JV**
Fus1 KO mouse as a model of oxidative stress mediated sporadic Alzheimer's disease: circadian disruption, association and long-term spatial and olfactory memory impairments.
Front Aging Neurosci 15;8:268; 2016

34 Coronas-Samano G, Ivanova AV, **Verhagen JV**
The habituation/cross-habituation test revisited: guidance from sniffing and video-tracking.
Neural Plasticity *Article ID 9131284; 2016*

33 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV**
Respiration Gates Sensory Input Responses in the Mitral Cell Layer of the Olfactory Bulb.
PLoS One *11(12):e0168356. doi: 10.1371; 2016*

32 Sanganahalli BG, Rebello MR, Herman, P, Shepherd GM, **Verhagen JV,** Hyder F
Comparison of glomerular activity patterns by fMRI and wide-field calcium imaging: implications for principles underlying odor mapping.
NeuroImage *pii: S1053-8119(15)01070-8*; 2016

31 **Verhagen JV**
A role for lung retention in the sense of retronasal smell.
Chemosens Percept ;8(2):78-84; 2015

30 Rebello MR, Kandukuru P, **Verhagen JV**.
Direct behavioral and neurophysiological evidence for retronasal olfaction in mice.
PLoS One 10(2):e0117218. doi: 10.1371; 2015

29 Rebello MR, McTavish TS, Willhite DC, Short SM, Shepherd GM, **Verhagen JV**
Perception of odors linked to precise timing in the olfactory system.
PLOS Biology 12(12):e1002021. doi: 10.1371; 2014

28 Gautam SH, Short SM and **Verhagen JV**
Retronasal odor concentration coding in glomeruli of the rat olfactory bulb.
Frontiers Int Neurosc 8:81; 2014

27 Cenier T, McGann JP, Tsuno Y, **Verhagen JV**, Wachowiak M
Testing the sorption hypothesis in olfaction: A limited role for sniff strength in shaping primary odor representations during behavior.
J Neurosci 33(1): 79–92; 2013

26 Gautam SH and **Verhagen JV**
Direct behavioral evidence for retronasal olfaction in rats.
PLOS One 7(9): e44781; 2012

25 Gautam SH and **Verhagen JV**
Retronasal odor representations in the dorsal olfactory bulb of rats.
J Neurosc 6;32(23):7949-7959; 2012

24 Gautam SH, Rebello MR, **Verhagen JV**
Taste quality and intensity of 100 stimuli as reported by rats: the taste-location association task.
Frontiers Behav Neurosci 6:19; 2012

23 Park JH, Platisa J, **Verhagen JV**, Gautam SH, Osman A, Kim D, Pieribone VA, Culurciello E.
Head-mountable high speed camera for optical neural recording.
J Neurosci Methods 201(2):290-5; 2011

22 Gautam SH and **Verhagen JV**
Evidence that the sweetness of odors depends on experience in rats.
Chem Senses 35(9): 767-776; 2010

21 Rolls ET, Critchley HD, **Verhagen JV**, Kadohisa K.
The representation of information about taste and odor in the orbitofrontal cortex.
Chemosens Percept 3: 16-33; 2010

20 Wachowiak M, Wesson DW, Pirez N, **Verhagen JV**, Carey RM
Low-level mechanisms for processing odor information in the behaving animal.
Ann. N.Y. Acad. Sci. 1170: 286–292; 2009

19 Carey RM, **Verhagen JV***, Wesson DW, Pirez N, Wachowiak M
Temporal structure of receptor neuron input to the olfactory bulb imaged in behaving rats.
J Neurophysiol. 101(2): 1073-1088; 2008; * *equal contribution*

18 Wesson DW, **Verhagen JV**, Wachowiak M
Why sniff fast? The relationship between sniff frequency, odor discrimination and receptor neuron activation in the rat.
J Neurophysiol. 101(2): 1089-102; 2008

17 Wesson DW*, Carey RM*, **Verhagen JV*** and Wachowiak M
Rapid encoding and perception of novel odors in the rat
PLOS Biology 6(4): e82; 2008; * *equal contribution*

16 **Verhagen JV**, Katz DB
More time to taste. Focus on "Variability in responses and temporal coding of tastants of similar quality in the nucleus of the solitary tract of the rat"
J. Neurophysiol. 99(2):413-4; 2008 (editorial)

15 **Verhagen JV**, Wesson DW, Netoff TI, White JA, Wachowiak M
Sniffing controls an adaptive filter of sensory input to the olfactory bulb.
Nature Neuroscience 10(5): 631-639; 2007

14 **Verhagen JV**
The neurocognitive bases of human multimodal food perception: Consciousness.
Brain Research and Brain Research Reviews 53(2):271-286; 2006 (review)

13 **Verhagen JV** and Engelen L
The neurocognitive bases of human multimodal food perception: Sensory integration.
Neuroscience & Biobehavioral Reviews 30(5): 613-650; 2006 (review)

12 Kadohisa M, Rolls ET and **Verhagen JV**
Neuronal representations of stimuli in the mouth: the primate insular taste cortex, orbitofrontal cortex and amygdala.
Chemical Senses 30(5): 401-419; 2005

11 Kadohisa M, **Verhagen JV** and Rolls ET
The primate amygdala: neuronal representations of the viscosity, fat-texture, temperature, grittiness and taste of foods.
Neuroscience 132(1): 33-48; 2005

10 **Verhagen JV**, Giza BK and Scott TR
Effect of amiloride on gustatory responses in the ventroposteromedial nucleus of the thalamus in rats.
J. Neurophysiol. 93(1): 157-166; 2005

9 **Verhagen JV**, Kadohisa M and Rolls ET
The primate insular/opercular cortex: neuronal representations of the viscosity, fat texture, grittiness, temperature and taste of foods.
J. Neurophysiol. 92(3): 1685-1699; 2004

8 **Verhagen JV** and Scott TR
Artificial neural network analysis of gustatory responses in the thalamic taste relay of the rat.
Physiol & Behav. 80(4): 499-513; 2004

7 Rolls ET, **Verhagen JV** and Kadohisa M
Representation of the texture of food in the primate orbitofrontal cortex: neurons responding to viscosity, grittiness, and capsaicin.
J. Neurophysiol. 90(6): 3711-3724; 2003

6 Kadohisa M, **Verhagen JV** and Rolls ET
Orbitofrontal cortex: neuronal representation of oral temperature and capsaicin in addition to taste and texture.
Neuroscience 127(1): 207-221; 2004

5 **Verhagen JV**, Kadohisa M and Rolls ET
Neurons in the primate orbitofrontal cortex respond to fat texture independently of viscosity.
J. Neurophysiol. 90(3): 1514-1525; 2003

4 **Verhagen JV**, Gabbott PL, Rolls ET
A simple method for reconditioning epoxy-coated microelectrodes for extracellular single neuron recording.
J. Neurosc. Meth. 123(2):215-217; 2003

3 **Verhagen JV**, Giza BK, Scott TR
Responses to taste stimulation in the ventroposteromedial nucleus of the thalamus in rats.
J. Neurophysiol. 89(1):265-275; 2003

2 Scott TR, **Verhagen JV**, Giza BK, Karádi Z and Oomura Y
Neural responses to MSG in rats and monkeys.
Sensory Neuron 3(3): 213-225; 2001 (review)

1 Scott TR and **Verhagen JV**
Taste as a factor in the management of nutrition.
Nutrition 16(10):874-885; 2000 (review)

Other publications

10 Rahman, MT and **Verhagen JV**
Implementing Quantitative Declarations of Authorship Contribution: A Call to Action
J Scientometric Res 12(2): 431-435; 2023; DOI:10.5530/jscires.12.2.039

BOOK 2: Verhagen JV
Patterns and textures. Photographic impressions. (145 photos; 145 pages; fine art photography)
Blurb, Inc (CA, USA); 2021
ISBN-10 1006705562; ISBN-13: 978-1006705564

9 **Verhagen, JV**

Interaural crosstalk cancellation measurements for ambiophonics: a case for hybrid adjustable ICC. **THE BAS SPEAKER. Journal of the Boston Audio Society** V38:2; 2016

8 **Verhagen, JV**
Spaced Coincident Recording Offers Enhanced Flexibility and Realism.
THE BAS SPEAKER. Journal of the Boston Audio Society V38:1; 2016

7 **Verhagen JV**
HRTF-free Headphone Measurements.
THE BAS SPEAKER. Journal of the Boston Audio Society V36:2; 2014

6 **Verhagen JV**, Wallace KJ, Collins SC and Scott TR
QUAD system offers fair shares to all authors.
Nature 426(6967): 602; 2003

5 Biewenga GP, Dorstijn MA, **Verhagen JV**, Haenen GR, Bast A
Reduction of lipoic acid by lipoamide dehydrogenase.
Biochem. Pharmacol. 51(3): 233-238; 1996

4 **Verhagen JV**, Haenen GRMM and Bast A
Nitric oxide radical scavenging by wines.
J. Agric. Food Chem. 44(12): 3733-3734; 1996

BOOK 1: Verhagen JV
RIBBON LOUDSPEAKERS. Theory and construction.
Audio Amateur Publications (NH, USA). 2001
ISBN-10: 1882580443 / ISBN-13: 978-1882580446 English edition.
ISBN 10: 7115211078 / ISBN 13: 9787115211071 Chinese edition.

3 **Verhagen JV**
The Rane active crossovers.
AudioXpress 32(12): 69-71; 2001 (review)

2 **Verhagen JV**
Ribbons made easy.
AudioXpress 32(5): 56-63; 2001

1 **Verhagen JV**
A novel cabinet construction method.
Speaker Builder 21(4): 34-39; 2000

Presentations

Neuroscience (2.7/yr since 1999)

67 **Verhagen, JV**., Fulton, K. (May 2024)
Ready for dinner: Odor plume intermittency-based navigation to food, and social odor cues-based selection of food. ***Association for Chemoreception Sciences*** (AChemS) Early Career Investigator Seminar.

66 Oumov M, Sanganahalli BG, Herman P, Hyder F, **Verhagen JV** (November 2023)
Temporary hyper-responsive neurovascular coupling in middle-aged APOE4-TREM2 mice as early marker for LOAD
Poster at **Society for Neuroscience** (SfN) meeting, Washington, D.C.

65 **Verhagen, JV**. (April 2023)
Gordon Shepherd: Flavor and retronasal smell
Invited talk for "A CELEBRATION OF GORDON M SHEPHERD, M. D, D. PHIL." at ***Association for Chemoreception Sciences*** (AChemS) meeting, Bonita Springs, FLA, USA.

64 Herman P , Sanggaard S, Akif A, James S, Sanganahali BG, Blumenfeld H, **Verhagen JV**, Hyder F. (May 2022)
Simultaneous in vivo optical imaging of cortical glucose metabolism and neuronal activity during somatosensory stimulation. Talk at BRAIN & BRAIN PET, UK.

63 James S, Sanggaard S, Akif A, Blumenfeld H, **Verhagen JV**, Hyder F, Herman P (May 2022)
Mild hypercapnia transiently suppresses neural activity during vasodilation: Implications for gas-based calibrated fMRI. Talk at BRAIN & BRAIN PET, UK.

62 Schmuker M, Schaefer A, Smith B, **Verhagen JV**, Victor JD, Crimaldi J. (2021)
What's in a plume? Accessing the information encoded in spatio-temporal odor plumes.
Talk at **German Neuroscience Soc. Meeting**, Germany.

61 Verhagen JV (October 2020)
Odor coding and discrimination over time by mice: new insights.
Invited talk for Monell Chemical Senses Center.
https://www.youtube.com/watch?v=lLFG8DCJt9A

60 Verhagen JV, Baker KL, Vasan G, Pieribone VA, Rolls ET (June 2020)
Odor information rapidly accrues in the mouse dorsal and lateral olfactory bulb.
Poster at the **International Symposium for Olfaction and Taste**, Portland, OR, USA

59 Izydorczak M, Gumaste A, Baker KL, Crimaldi JP, Nagel, K, **Verhagen JV** (November 2019)
Mouse detection of fluctuating odors based on intermittency.
Poster at **Society for Neuroscience** (SfN) meeting, Chicago, Ill., USA.

58 Baker KL, Vasan G, Gumaste A, Pieribone VA, **Verhagen JV** (November 2019)
Spatio-temporal dynamics of odor responses in the lateral and dorsal olfactory bulb.
Poster at **Society for Neuroscience** (SfN) meeting, Chicago, Ill., USA.

57 Herman P, Sanganahalli BG, Baker KL, Kumar S, **Verhagen JV**, Hyder F (July 2019)
Synaptic contributions to glomerular activity by calcium imaging and fMRI.
BRAIN & BRAIN PET 2019 satellite meeting: "Advances in Multi-Scale Neuroimaging of Cerebral Blood Flow and Metabolism in relation to Brain Activity" at Sunkyunkwan University in Suwon, South Korea (July 9-10, 2019).

56 Gumaste A, Baker KL, Crimaldi JP, Nagel, K, **Verhagen JV** (September 2019)
Mouse detection of fluctuating odors based on intermittency.
CHEMICAL SENSES 45 (2), 136-137
Talk (by AG) at **European Chemoreception Research Organization** (ECRO) meeting, Trieste, Italy. Chair: Michael Schmuker.

55 Gumaste A., Baker K.L., Connors E., Crimaldi J., Nagel K., **Verhagen J.V**. (November 2018)

Mouse detection of fluctuating odors based on odor plume properties.
Poster at **Society for Neuroscience** (SfN), San Diego, CA.

54 Baker, KL, Coronas-Samano G, McHugh MK, Crimaldi JP, **Verhagen JV** (November 2018)
Mouse Navigation in a Virtual Reality Environment.
Talk (by JVV) at **Society for Neuroscience** (SfN) meeting, San Diego, CA, USA.

53 Coronas-Samano G, Gumaste A, Axman R, Hengenius J, Ermentrout B, Crimaldi J, and **Verhagen JV**. (November 2018)
Odor plume source navigation algorithms evaluated in an Arduino robot using pair of spatially separated sensors.
Poster at **Society for Neuroscience** (SfN) meeting, San Diego, CA, USA.

52 Sanganahalli BG, Thompson GJ, Herman P, Shepherd GM, **Verhagen JV**, Hyder F (June 2018)
Orthonasal versus retronasal glomerular activity in rat olfactory bulb by fMRI.
Poster at the Joint Annual Meeting **ISMRM-ESMRMB**, Paris, France.

51 **Verhagen JV**. (April 2018)
Olfactory chromatography in contemporary context: Sorption and the olfactory bulb
Invited talk for Max M. Mozell Chromatography Journal Club. ***Association for Chemoreception Sciences*** (AChemS) meeting, Bonita Springs, FLA, USA.

50 Baker, KL, Coronas-Samano G, McHugh MK, Crimaldi JP, **Verhagen JV** (April 2018)
Assessment of mouse navigation in a virtual reality odor environment.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Bonita Springs, FLA, USA.

49 Gumaste A, Coronas-Samano G, McHugh MK, Baker KL, Crimaldi JP, **Verhagen JV** (November 2017)
Mouse navigation to ethologically relevant odors in a complex odor environment.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

48 **Verhagen JV**, Thompson GJ, Sanganahalli BG, Baker KL, Herman P, Shepherd GM, Hyder F. (November 2017)
Resting state activity forms a foundation for odor-activation maps in the anesthetized rat olfactory bulb using intrinsic imaging and fMRI.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

47 Baker KL, Coronas-Samano G, McHugh MK, Crimaldi JP, **Verhagen JV** (November 2017)
Assessment of mouse navigation in a virtual reality odor environment.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

46 Coronas-Samano G, Baker KL, Tan WJT, Ivanova AV, **Verhagen JV** (November 2017)
Fus1 KO mice as new model for sAD: dysfunction of the electron transport chain and compensatory enhanced blood volume responses in the olfactory bulb.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

45 Thompson GJ, **Verhagen JV**, Baker KL, Sanganahalli BG, Shepherd GM, Hyder F (April 2017)
Stimulus-evoked fMRI activations are a subset of resting-state fMRI networks in the rat olfactory bulb.
Poster at **ISMRM** meeting, Honolulu, HI, USA.

44 Thompson GJ, Sanganahalli BG, **Verhagen JV**, Baker KL, Shepherd GM, Hyder F (April 2017)

Stimulus-evoked activations are a subset of resting-state networks: Comparison between fMRI and optical imaging in the rat olfactory bulb.
Poster at **BRAIN** meeting, Berlin, Germany.

43 Coronas-Samano G, Baker KL, Ivanova AV and **Verhagen JV** (November 2016)
Fus1 KO female mice have olfactory, spatial and association memory impairments and sleep/awake cycle disturbances in adult age: a new model for sAD.
Poster at **Society for Neuroscience** (SfN) meeting, San Diego, CA, USA.

42 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV** (April 2016)
Respiration Gates Sensory Input Responses in the Mitral Cell Layer of the Olfactory Bulb.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Fort Myers, Fla, USA.

41 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV** (November 2015)
Circuit models identify mechanisms of respiration driven lateral inhibition underlying mitral activity.
Talk at **Society for Neuroscience** (SfN) meeting, Chicago, Ill., USA.

40 **Verhagen, JV.** (October 2015)
Time in olfactory coding and perception: optogenetic behavioral and electrophysiological studies.
Invited talk at WVU (host: Kevin Daly).

39 Sanganahalli BG, Rebello MR, Herman P, Shepherd GM, **Verhagen JV,** Hyder F (June 2015)
Odor-evoked fMRI maps are coupled to calcium-sensitive dye imaging patterns of input activity in the olfactory bulb.
Talk at **Brain 15** meeting, Vancouver, Canada

38 Sanganahalli BG, Rebello MR, Herman, P, Shepherd GM, **Verhagen JV,** Hyder F (June 2015)
Odor-evoked fMRI maps are coupled to calcium-sensitive dye imaging patterns of input activity in the olfactory bulb.
Talk at **ISMRM** meeting, Toronto, Canada

37 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV** (April 2015)
The spatio-temporal input-output function of the olfactory bulb is modulated by respiratory cycle activity.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Fort Myers, Fla, USA.

36 Coronas-Samano G, Kandukuru P, Ivanova AV and **Verhagen JV** (November 2014)
Fus1-knockout mice as a model for sporadic Alzheimer's disease have olfactory-mediated behavioral and cognitive dysfunction rescued by N-acetyl cysteine.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

35 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV** (November 2014)
The spatio-temporal input-output function of the olfactory bulb is modulated by respiratory cycle activity.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

34 **Verhagen, JV** (May 2014)
The importance and mechanisms of time on ms scale in smell coding: optogenetic behavior and electrophysiology.
Invited talk at University of Binghamton, Dept. Psychology. Host: Dr. Patricia Di Lorenzo

33 Short SM, McTavish TM, Morse TM, Shepherd GM, **Verhagen JV** (April 2014)
The effect of glomerular input patterns on mitral cell responses in the olfactory bulb.

Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Huntington Beach, CA, USA.

32 Gautam SH, Rebello MR, **Verhagen JV** (April 2013)
Retronasal odor intensity coding in the dorsal olfactory bulb of rats.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Huntington Beach, CA, USA.

31 Rebello MR, Sanganahalli BG, Shepherd GM, Hyder F, **Verhagen JV** (April 2013)
Multi-modal functional imaging of rat olfactory bulb with orthonasal and retronasal odorant stimulation: functional insights through complementary techniques.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Huntington Beach, CA, USA.

30 Rebello MR, McTavish TS, Willhite DC, Shepherd GM, **Verhagen JV** (April 2013)
ChannelRhodopsin mice use temporal information encoded in the olfactory bulb for odor sensation.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Huntington Beach, CA, USA.

29 Verhagen JV (October 2011)
The sweet scent of taste: taste acquisition by odorants in rats.
Invited talk; Monell first ARO lecture

28 Willhite DC, McTavish TS, Shepherd GM and Verhagen JV (April 2011)
Discrimination of static and dynamic optical patterns presented to the olfactory bulb of transgenic mice expressing channelrhodopsin in mitral cells.
SYMPOSIUM: OPTOGENETICS: USING LIGHT TO STUDY SMELL
Chair/Organizer: Murthy V and **Verhagen JV**
Oral presentation at ***Association for Chemoreception Sciences*** (AChemS) meeting, St. Petersburg, FL, USA.

27 Gautam SH and **Verhagen JV** (April 2011)
Direct behavioral evidence for retronasal olfaction in rats.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, St. Petersburg, FL, USA.

26 Willhite DC, Phillips ME, Zinter J, Olsen E, **Verhagen JV** (November 2010)
Controlling the stimulus: a microscope design for awake-behaving channelrhodopsin activation.
Poster at **Society for Neuroscience** (SfN) meeting, San Diego, USA.

25 Gautam SH and **Verhagen JV** (April 2010)
Calcium imaging of retronasal odor responses in the olfactory bulb of the anesthetized rat.
Oral presentation at ***Association for Chemoreception Sciences*** (AChemS) meeting, St. Petersburg, FL, USA.

24 Gautam SH and **Verhagen JV** (April 2010)
Taste-location generalization as a novel tool to study rodent taste and flavor perception.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, St. Petersburg, FL, USA.

23 Gautam SH and **Verhagen JV** (April 2009)
Rat as a model for the study of multimodal integration of flavor.

Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

22 Gautam SH and **Verhagen JV** (November 2008)
Rat as a model for the study of multimodal integration of flavor.
Poster at **Society for Neuroscience** (SfN) meeting, Washington D.C., USA.

21 Wesson DW, **Verhagen JV**, Wachowiak M (November 2007)
Why sniff fast? High-frequency sniffing, odor discriminations, and receptor neuron activation in the behaving rat.
Poster at **Society for Neuroscience** (SfN) meeting, San Diego, USA.

20 **Verhagen JV** (August 2007)
Neural coding and integration of multimodal flavor: animal models.
Oral invited presentation at the **American Chemical Society** (ACS) meeting, Boston, MA, USA.

19 Wachowiak M, **Verhagen JV**, Wesson DW (April 2007).
The role of sampling behavior in modulating odor coding in awake animals.
Oral presentation at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

18 Carey RM, **Verhagen JV**, Wesson DW, Wachowiak M (April 2007).
Temporal dynamics of receptor neuron input to the olfactory bulb of behaving rats.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

17 **Verhagen JV**, Wesson DW, Netoff TI, White JA, Wachowiak M (November 2006).
Modulation of primary sensory odor representations by sniffing imaged from the olfactory bulb of awake behaving rats
Poster at **Society for Neuroscience** (SfN) meeting, Atlanta, GA, USA.

16 Wesson DW, **Verhagen JV**, Wachowiak M (November 2006)
Sniffing behavior of rats during learning and performance of odor discrimination tasks.
Poster at **Society for Neuroscience** (SfN) meeting, Atlanta, GA, USA.

15 Wesson DW**, Verhagen JV**, Wachowiak M (April 2006).
Sniffing patterns of rats during learning and performance of odor discrimination tasks.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

14 **Verhagen JV**, Wesson DW, Wachowiak M (April 2006).
Relationship between sniffing and odor representations imaged from the olfactory bulb of awake rats.
Oral presentation at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

13 **Verhagen JV**, Wesson DW, Wachowiak M (November 2005).
Relationship between sniffing and odor representations imaged from the olfactory bulb of awake rats.
Poster at **Society for Neuroscience** (SfN) meeting, Washington DC, USA.

12 Rolls ET, Kadohisa MK, **Verhagen JV** and de Araujo IE (July 2004).
Representation in the primate orbitofrontal cortex, amygdala, and insular/frontal opercular cortex of the sensory properties including taste of food in the mouth.
Oral presentation at **ISOT/JASTS** meeting, Kyoto, Japan.

11 Kadohisa MK, Rolls ET and **Verhagen JV** (July 2004).
Representation in the primate orbitofrontal cortex, amygdala, and insular/frontal opercular cortex of the sensory properties of food in the mouth.
Poster at **ISOT/JASTS** meeting, Kyoto, Japan.

10 Kadohisa M, Rolls ET, **Verhagen JV** and Line S (November 2003).
Taste, oral texture, fat, temperature and capsaicin-responsive neurons in the primate amygdala.
Poster at **Society for Neuroscience** (SfN) meeting, New Orleans, USA.

9 **Verhagen JV**, Critchley H, Kadohisa M and Rolls ET (April 2003).
Taste information in the monkey orbitofrontal cortex.
Oral presentation at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

8 Kadohisa M, **Verhagen JV**, Rolls ET (April 2003).
Encoding by neurons in the primate insular cortex of taste, texture and temperature.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

7 **Verhagen JV**, Rolls ET and Kadohisa M (July 2002).
Encoding by neurons in the primate orbitofrontal cortex of taste, texture and temperature.
Poster at ***European Chemoreception Research Organization*** (ECRO) meeting, Erlangen, Germany.

6 **Verhagen JV**, Rolls ET and Kadohisa M (June 2002).
Oral fat and viscosity representations in the primate orbitofrontal cortex.
Poster at ***Xth Food Choice Conference***, Wageningen, The Netherlands.

5 **Verhagen JV**, Rolls ET and Kadohisa M (April 2002).
Taste, texture and fat representations in the primate orbitofrontal cortex.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

4 **Verhagen JV**, Giza BK and Scott TR (April 2001).
The effect of amiloride on taste responses in the rat taste thalamus.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

3 **Verhagen, JV**, Giza, BK and Scott, TR (November 2000).
The effect of amiloride on taste responses in the rat taste thalamus.
Poster at ***Society for Neuroscience*** (SfN) meeting, New Orleans, FL, USA.

2 **Verhagen, JV**, Giza, BK and Scott, TR (April 2000).
Taste in the rat thalamus.
Poster at ***Association for Chemoreception Sciences*** (AChemS) meeting, Sarasota, FL, USA.

1 **Verhagen, JV**, Giza, BK and Scott, TR (October 1999).
Taste in the rat thalamus.
Poster at ***Society for Neuroscience*** (SfN) meeting, Miami Beach, FL, USA.

Other presentations

3 **Verhagen, JV**
The PurestMusic line source loudspeaker system.
Talk at the Connecticut Audio Society, Killingworth, CT (Oct 2020).

2 **Verhagen, JV**
Beyond stereo: Ambiophonics & Virtual Hall playback systems.
Talk at the Connecticut Audio Society, Killingworth, CT (July 2015).

1 **Verhagen, JV**
Ribbon loudspeakers.
Talk at the Boston Audio Society, Boston, MA (November 2006).

Teaching experience

Yale School of Medicine
2018-2023 (Sept-Oct.) Connections to the World
- Master course, mandatory for all ~100 2nd year medical students (Structure and Function of the Nervous System, NBIO 500b/NSCI 510b)
- One of 4 neuroanatomy lab teachers for ~25 students (16 teachers for all ~100 students across 4 labs)
- Presented interactively neuroanatomy during 7 weekly meetings of gross anatomy, spinal cord, brainstem 1&2, midbrain, motor systems, sensory systems and cortex.
- Quadrupled size of Taste and Smell chapters of iBook lab manual by Prof. Mike Schwartz
- Created a 3D printed color-coded model of the major ascending and descending pathways of the CNS from spinal cord to cortex, one for each lab
- Managed the lab as lead instructor since 2020
- Very good student feedback (distributions and references on request)
- Taught pro-bono (no % effort or other compensations)

Boston University
- Guest lecture for Neurophysiology course (summer 2005; Dr. Wachowiak)
- multimodal integration and its neuroscientific underpinnings

University of Oxford
- Tutorials and classes Brain & Behavior (St. Michaelmass term 2003 & 2004)
- 12 undergraduate students each year
- tutorials: in depth discussion of current articles (visual system, motor cortex, attention, prefrontal cortex)
- classes: group discussions and presentations of articles

M.Sc. student project (February - April 2003)
- trained student (Samantha Line, M.Sc.) in primate neurophysiology
- assisted writing thesis-project (discussions, articles, corrections)

University of Delaware
Teaching Assistant (TA) Learning & Motivation (1999 - 2000)
- 4 lab sections independent of professor (Dr. Cicala)
- set up collaboration with Animal Care Facility

Guest lectures for Sensation & Perception class (spring 1999; Dr. Northmore)
- The chemical senses
- 2 lectures, 2 classes of 35 students each
- made exam questions and graded them

TA Sensation & Perception (fall 1998 - spring 1999)
- 2 large lab sections independent of professor (Dr. Northmore)
- co-designed one of 5 lab projects ("Sound localization")

TA Brain & Behavior (fall 1997 - spring 1998)
- assisted professor (Dr. Skeen), graded
- managed 6 undergraduate TAs
- gave review sessions

Stedelijk Gymnasium Haarlem (High School)
- Teaching Internship (1996)
- taught four biology lectures to two classes (14-year-old students), "classification of shells"
- made and graded their exams
- observed 2 senior biology teachers from Educational Science viewpoint, including Rose of Leary

Outreach

ATLAS Middle School, New Haven, CT https://nmsnewhaven.org/atlas/ (9/24/2021)
I gave the ~15 students sealed cadaver brains to explore, from various species (mouse, cat, ferret, human). Then I guided a dissection of sheep brains in 5 groups, teaching the students about gross brain anatomy and exposing the hippocampus.

Brain Awareness Week, Franklin Institute, Philadelphia, PA (2000)
Demonstrated interactive displays on chemical senses and touch to children.

Funding

Current:

NSF: 1559639 Next Generation Networks for Neuroscience (NeuroNex). Technology-enabled, Team-based Neuroscience (9/2020- 8/2025)
- PI: Justus Verhagen, part of team IRG3 on Active Sampling (45% effort)
- NeuroNex: From Odor to Action: Discovering Principles of Olfactory-Guided Natural Behavior
- Annual direct costs: $149,000 (@81% OH)

Past:

NIH/NIDCD: R01 DC014723 (4/2016-3/2021)
- PI: Justus Verhagen (30% effort);
- *Multimodal flavor integration and retronasal olfaction in the mouse*
- Annual direct costs: $212,500
- 15th percentile, 30 impact score

NIH/NIDCD: administrative supplement to R01 DC01472 (Mar 2020; 2020-2021)

- PI: Justus Verhagen; main collaborator Fahmeed Hyder (Yale)
- To characterize temporal AD-related changes in Fus1 KO mouse model of mitochondrial dysfunction using neurobehavioral and imaging approaches.
- $329k direct costs

NSF: IOS-1555880 (11/2015-10/2019 with NCE)
- PI: Justus Verhagen (25% effort)
- *Collaborative research: Olfactory navigation: dynamic computing in the natural environment*
- Cracking the olfactory code; Pres. Obama BRAIN Initiative
- Virtual odor navigation in mice
- $1,109,895 total to PI ($363k-$374k/yr)

NIH/NIDCD: R01 DC011286 (7/2011-3/2018 with NCE)
- PI: Justus Verhagen (20% effort)
- co-investigators: Gordon Shepherd & Fahmeed Hyder (Yale).
- *Bulbar maps to retronasal smell by optical calcium imaging and fMRI in acute rat*
- Investigation of the effect of route of odorants on responses of the entire OB using micro-fMRI and responses of the dorsal OB with high temporal resolution using optical imaging, in the same rats
- Annual direct costs: $250,000
- 14th percentile, 25 impact score

NIH/NIDCD: R01 DC009994 (6/2009-5/2011 ARRA, 6/2011-5/2013 NIDCD)
- PI: Justus Verhagen (New Investigator) (65% effort)
- *Multimodal flavor integration and retronasal olfaction in the rat*
- Annual direct costs: $200,000
- 36th percentile, 203 priority score on first cycle

NIH/NIDCD: R03 DC008197 (4/2006-4/2010 w NCE)
- PI: Justus Verhagen; main collaborator: Dr. Matt Wachowiak
- *Sniffing and optical imaging of olfactory bulb responses in awake rat*
- Annual direct costs: $50,000

Submitted: None.

Planned:

Cracking mouse odor navigation: unraveling the strategies used by mice during navigation to sources of odor plumes.
Grant application: NIH BRAIN RFA-DA-24-041, October 2025
PIs: Justus V. Verhagen, John Crimaldi, Bard Ermentrout, Volker Steuber.
Aim 1. Estimate smell-triggered navigation decisions in mice.
Aim 2. Define and validate formal and hypothesized mouse strategies with robots.
Aim 3. Formalize these algorithms with computational models.

Disentangling neuronal-astrocytic activities in relation to brain metabolism in Late Onset Alzheimer's Disease.
Grant application: NIH NIA R01, October 2025
PIs: Justus V. Verhagen and Fahmeed Hyder
Aim 1. Relate behavioral deficits in LOAD to basal metabolic alterations in neurons and astrocytes.
Aim 2. Relate stimuli-induced deficits in neuronal/astrocytic activities to altered networks in LOAD.
Aim 3. Relate rapamycin-induced behavioral recuperation in LOAD to cell-specific improvements.

Ad-hoc grant reviewer

- NIH/NIDCD Chemosensory Fellowship Review (F31/F32) 2021 (May & Oct)
- Leverhulme Trust (2018)
- Welcome Trust, DBT, India Alliance (2016)
- Israel Science Foundation (2015)
- The Royal Society, Welcome Trust, Sir Henry Dale Fellowship (2012)
- NWO, Netherlands Organization for Scientific Research (2011)
- National Science Foundation (2004)

Awards

Polak Young Investigator Award (Association for Chemoreception Sciences, 2006)
- recognizes innovative research in chemosensory sciences for research on the relationship between imaged bulbar input and sniffing in awake rats

Lockey Bequest Awards, University of Oxford
- 2002 Travel and housing funds for AChemS meeting
- 2000 Travel funds for SfN meeting

AChemS Awards, University of Delaware
- 2000 Travel funds for Sarasota meeting
- 1999 Free housing at Sarasota meeting

Block fellowship, University of Delaware
- 1996 (tuition and stipend)

Mentorship

• Sofya Calvin	High school volunteer (senior, summer 2014)
• Sravya Jaladanki	High school volunteer (senior, summer 2015)
• Medha Illindalla	High school volunteer (junior, summer 2019)
• Tehreem Pasha	High school volunteer (junior, summer 2019, spring 2023)
• Eric Grinn	High school volunteer (senior, summer 2021)
• Qasim Pasha	High school volunteer (junior, summer 2022)
• Noor Scheers	High school volunteer (junior, summer 2024)
• Felix Elston	High school volunteer (junior, summer 2024)
• Eshanika Shee	High school volunteer (junior, summer 2024)
• Anne Bolkestein	High school volunteer (senior, winter 2024)
• Mendel Bus	High school volunteer (senior, winter 2024)

- Reed Axman — College student (junior, summer 2018, winter 2018)
- Kate Mozzochi — College student (junior, summer 2018, summer 2019)

- Michelle Gregoire, B.Sc. — Intern (summer 2019), U. New Haven
- Halle Ellal, B.Sc — Intern (winter 2019-2020), U. New Haven
- Suneeti Madhavan, B.Sc. — Intern (winter 2019-2020), U. New Haven
- Mansi Udhwani, B.Sc. — Intern (summer 2021), U. New Haven

- Padma Kandukuru, M.Sc. — Volunteer (2014)

- Billy Coronas, M.Sc. — Research Assistant (JBP 2014-2018)
- Michelle Izydorczak, B.Sc. — Research Assistant (JBP 2019-2022)
- Faysal Fostok, B.Sc. — Research Assistant (JBP 2022-2023)
- Maggie Oumov, B.Sc. — Research Assistant (JBP 2023-2024)
- Priyanka Aguchiya, B.Sc. — Research Assistant (JBP 2024-present)

- Ankita Gumaste, B.Sc. — Graduate student (JBP 2017-2022)
  Grant awarded: **NIH NRSA 1F31DC018708-01A1; Role: PI**
  "Mammalian behavioral discrimination and neural processing of naturalistic odor plumes based on intermittency"; Sept 2020-Aug 2022; total cost: $30,500/yr
- Emily Perszyk, B.Sc. — Graduate student (JBP rotation 2018)
- Gregg Castolucci, B.Sc. — Graduate student (Yale 2012-17), thesis committee member

- Doug Storace, Ph.D. — Postdoctoral NRSA Mentor (Yale 2013-2017)
- Tom Eiting, Ph.D. — Postdoctoral NSRA Mentor (U. Utah 2015-2018)

- Shree Hari Gautam, Ph.D. — Postdoctoral fellow (JBP 2007-2012)
- Michelle L. Rebello, Ph.D. — Postdoctoral fellow (JBP 2011-2013)
- David Willhite, Ph.D. — Postdoctoral fellow (JBP 2011)
- Tom McTavish, Ph.D. — Postdoctoral fellow (JBP 2012)
- Shaina Short, Ph.D. — Postdoctoral fellow (JBP 2013-2015)
- Keeley L. Baker, Ph.D. — Postdoctoral fellow (JBP 2016-2020)
- Dominique Eghlidi, Ph.D. — Postdoctoral fellow (JBP 2019)

- Sam Sutton, Ph.D. Candidate — Trainee exchange at Pierce (2 weeks 2024) (U. Hertfordshire, UK)
- Tariq Hilmi, Ph.D — Trainee exchange at Pierce (2 months 2024) (U. Hertfordshire, UK)
- Alyson Brokaw, Ph.D — Trainee exchange at Pierce (3 weeks 2024) (Leehigh U., PA)

Affiliations

- Association for Chemoreception Sciences (AChemS; 1999-present)
- Society for Neuroscience (SfN; 1999-present)
- Member of the Audio Engineering Society (AES; 2017-present)
- Connecticut Audio Society (CAS; 2008-present)

- Boston Audio Society (BAS; 2008-present)

Services

- Association for Chemoreception Sciences (AChemS) Scientific Program Committee (2013-2017)

- Yale BBS Interdepartmental Neuroscience Program (INP) graduate student selection committee member (2019-2021; INP Director: Dr. C. Greer)

- Technical Services Committee member, the John B. Pierce Laboratory (Nov 2008-2014)
- Technical Services Committee co-Chair, the John B. Pierce Laboratory (Nov 2015-2017)
- **Technical Services Committee Chair**, the John B. Pierce Laboratory (Nov 2017-2022)

- **co-founding member Diversity Committee**, the John B. Pierce Laboratory (June 2016-2022)

- **co-founding member GreenPierce**, the John B. Pierce Laboratory (2018-2022)

- IACUC Associate Chair, the John B. Pierce Laboratory (Jan 2011-Jan 2013)
- **IACUC Chair**, the John B. Pierce Laboratory (Jan 2013-Aug 2023)

- editorial board member Neuroscience Journal (Hindawi Publishing Corporation)
- review editor Perception Science, a specialty of Frontiers in Neuroscience and Psychology (Oct 2016-present)
- review editor Frontiers in Integrative Neuroscience (2014-current)

Audio engineering

CEO & Founder (2008-present) of **Purest Music**, LLC (Killingworth, CT)
- design and sales of high-end audio equipment
- specialized in psychoacoustics of halls, rooms and loudspeakers
- designed and built unique dipolar line source capable of >110dB SPL 20-20kHz
- designed and built 25-channel virtual concert hall convolution-based playback system
- author of unique book on ribbon loudspeaker design and physics and several audio engineering papers
- Audio Engineering Society (AES) member

References

Patrica M. Di Lorenzo, Ph.D.
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