

# Daniel J. Graham, Ph.D.

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## EDUCATION

2008	Cornell University Advisor: David J. Field	Ph.D. in Psychology
2004	Cornell University	M.S. in Physics
2001	Middlebury College	B.A. in Physics

## APPOINTMENTS

Postdoctoral Researcher	<b>University of Vienna</b> Psychological Basic Research	2011-present Vienna, Austria
Postdoctoral Researcher	<b>Dartmouth College</b> Psychological and Brain Sciences	2010-2011 Hanover, NH
Postdoctoral Researcher	<b>Dartmouth College</b> Department of Mathematics	2008-2010 Hanover, NH
Graduate Assistant/ NIH Kirschstein-NRSA Fellow	<b>Cornell University</b> Department of Psychology	2004-2008 Ithaca, NY

## PUBLICATIONS

**Graham, D. J.** 2011. Visual Perception: Lightness in a High Dynamic Range World. *Current Biology*, in press.

**Graham, D. J.** and Meng, M. 2011. Artistic representations: clues to efficient coding in human vision. *Visual Neuroscience*, 28, 371-379.

**Graham, D. J.** and Rockmore, D. N. 2011. The packet switching brain. *Journal of Cognitive Neuroscience*, 23 (2), 267-276.

**Graham, D. J.** and Meng, M. 2011. Altered spatial frequency content in paintings by artists with schizophrenia. *i-Perception* 2 (1), 1-9.

**Graham, D. J.**, Hughes, J. M., Leder, H. and Rockmore, D. N. 2011. Statistics, vision and the analysis of artistic style. *Wiley Interdisciplinary Reviews--Computational Statistics*, doi: 10.1002/wics.197.

Hughes, J. M., **Graham, D. J.**, Jacobsen, C. R. and Rockmore, D. N. 2011. Comparing higher-order spatial statistics and perceptual judgments in the stylometric analysis of art. *Proceedings of European Signal Processing Conference*, in press.

Hughes, J. M., **Graham, D. J.** and Rockmore, D. N. 2010. Quantification of artistic style through sparse coding analysis in the drawings of Pieter Bruegel the Elder. *Proceedings of the National Academy of Sciences USA*, 107(4), 1279-1283. **\*\*Subject of a Nature News & Views article published Feb. 25 2010\*\***

**Graham, D. J.** and Redies, C. 2010. Statistical regularities in art: relations with visual coding and perception. *Vision Research* 50 (16) 1503-1509. **\*\*3<sup>rd</sup> most downloaded article from Vision Research as of Nov. 20 2010\*\***

## Daniel J. Graham, Ph.D.

Graham, D. J., Friedenberg, J. D., Rockmore, D. N. and Field, D. J. 2010. Mapping the similarity space of paintings: image statistics and visual perception. *Visual Cognition* 18 (4), 559-573.

Graham, D. J., Friedenberg, J. D. and Rockmore, D. N. 2010. Preference for art: similarity, statistics, and selling price. *Proceedings of SPIE: Human Vision and Electronic Imaging* 7527, 75271A1.

Hughes, J. M., Graham, D. J. and Rockmore, D. J. 2010. Stylometrics of artwork: uses and limitations. *Proceedings of SPIE: Computer Vision and Image Analysis of Art* 7531, 75310C1.

Graham, D. J. 2009. Art statistics and visual processing: insights for picture coding. *Proceedings of the Picture Coding Symposium* (Chicago, IL).

Graham, D. J., Friedenberg, J. D. and Rockmore, D. N. 2009. Efficient visual system processing of spatial and luminance statistics in representational and non-representational art. *Proceedings of SPIE: Human Vision and Electronic Imaging* 7240, 72401N1.

Graham, D. J. and Field, D. J. 2008. Variations in intensity statistics for representational and abstract art, and for art from the eastern and western hemispheres. *Perception* 37 (9), 1341-1352.

Graham, D. J. and Field, D. J. 2008. Global nonlinear compression of natural luminances in painted art. *Proceedings of SPIE: Computer Image Analysis in the Study of Art*, 6810, 68100K1.

Graham, D. J. and Field, D. J. 2007. Statistical regularities of art images and natural scenes: Spectra, sparseness and nonlinearities. *Spatial Vision*, 21 (1-2), 149-164.

Graham, D. J., Chandler, D. M. and Field, D. J. 2006. Can the theory of "whitening" explain the center-surround properties of retinal ganglion cell receptive fields? *Vision Research*, 46 (18), 2901-2913.

Cuesta-Lopez, S., Peyrard, M. and Graham, D. J. 2005. Model for DNA hairpin denaturation. *European Physical Journal E-Soft Matter*, 16 (3), 235-246.

### BOOKS

Graham, D. J., Friedenberg, J. D., Hughes, H. C., Owren, M. and Bonato, F. (in preparation). *Sensation and Perception: A Modern Synthesis*, Boston: Pearson.

### BOOK CHAPTERS

Graham, D. J. and Field, D. J. 2008. Natural Images: Coding Efficiency. In L. R. Squire (Ed.) *Encyclopedia of Neuroscience* Vol. VI (pp. 19-27). Oxford: Academic Press.

Graham, D. J. and Field, D. J. 2006. Sparse coding in the neocortex. In *Evolution of Nervous Systems*, Vol. III (pp. 181-187), J. Kaas, L. Krubitzer eds. Oxford: Academic Press.

## Daniel J. Graham, Ph.D.

### THESES

**Graham, D. J.** 2008. The relationship between efficient coding of natural scenes in the human visual system and statistical regularities in art. Doctoral Dissertation, Department of Psychology, Cornell University.

**Graham, D. J.** 2004. Efficient retinal ganglion cell coding and the statistics of natural scenes. Master's Thesis, Department of Physics, Cornell University.

### BOOK REVIEWS

**Graham, D. J.** The Evolution of the Eye from Algae and Jellyfish to Humans. *Perception*, in preparation.

**Graham, D. J.** Evolution's Witness. *Perception*, in preparation.

**Graham, D. J.** 2004. In the Blink of an Eye. *American Paleontologist* **12**, 13-17.

### GRANT SUPPORT AND AWARDS

2008–2010: **National Science Foundation** Small Grant for Exploratory Research DMS-0746667, \$200,000 (to D. Rockmore, supporting Graham)

2007: **Provost's Diversity Fellowship**, Cornell University

2004–2007: **National Institutes of Health** Kirschstein-National Research Service Award (Individual pre-doctoral), EY015393, \$131,075

2002: **NSF LOCNET Fellowship**, Ecole Normale Supérieure-Lyon, FRANCE.

2001–2004: **NSF IGERT Program in Nonlinear Dynamics Fellowship**, Cornell University

### CONFERENCE PRESENTATIONS

**Graham, D. J.** and Meng, M. (2011, May). Lightness constancy in visual artists. Vision Sciences Society, Naples, FL.

Hughes, J. M., **Graham, D. J.**, Jacobsen, C. R. and Rockmore, D. N. (2011, August). Higher-order Spatial Statistics and Perceptual Judgments in the Stylometric Analysis of Art. EUSIPCO 2011 (19th European Signal Processing Conference), Barcelona, ESP.

**Graham, D. J.** and Meng, M. (2010, November). Rapid classification of paintings: Evidence for efficient artistic representations. Psychonomic Society, St. Louis, MO.

**Graham, D. J.** and Meng, M. (2010, August). Altered spatial frequency content in paintings by artists with schizophrenia. Talk presented at the European Conference on Visual Perception, Lausanne, SWITZERLAND.

**Graham, D. J.**, Friedenber, J. D. and Rockmore, D. N. (2010, January). Preference for art: similarity, statistics, and selling price. Talk presented at the SPIE Electronic Imaging Conference on Human Vision and Electronic Imaging, San Jose, CA.

Hughes, J. M., **Graham, D. J.** and Rockmore, D. J. (2010, January) Stylometrics of artwork: uses and limitations. Talk presented at the SPIE Electronic Imaging Conference on Computer Image Analysis in the Study of Art, San Jose, CA.

**Graham, D. J.**, Friedenber, J. D. and Rockmore, D. N. (2009, August). Mathematics, perception, and the visual arts: new perspectives. Talk presented at Society for Mathematical Psychology, Amsterdam, NETHERLANDS.

## **Daniel J. Graham, Ph.D.**

**Graham, D. J.**, Friedenberg, J. D. and Rockmore, D. N. (2009, July). The efficiency of visual artwork: relating cognitive and perceptual processing to nonlinear image statistics. Poster presented at the Cognitive Science Society, Amsterdam, NETHERLANDS.

**Graham, D. J.** (2009, May). Art statistics and visual processing: insights for picture coding. Invited panelist at the Picture Coding Symposium, Chicago, IL.

**Graham, D. J.**, Friedenberg, J. D. and Rockmore, D. N. (2009, January). Intensity statistics of artwork: connections to human visual perception. Talk presented at the SPIE Electronic Imaging Conference on Human Vision and Electronic Imaging, San Jose, CA.

**Graham, D. J.**, Friedenberg, J. D., Rockmore, D. N. and Field, D. J. (2008, August). Mapping the similarity space of paintings: Is there a role for image statistics? Talk presented at the European Conference on Visual Perception, Utrecht, NETHERLANDS.

**Graham, D. J.** and Field, D. J. (2008, January). Global nonlinear compression of natural luminances in painted art. Talk presented at the SPIE Electronic Imaging Conference on Computer Image Analysis in the Study of Art, San Jose CA.

Cutting, J. E., **Graham, D. J.** and Field, D. J. (2008, February). From a neuroesthetics to a neuroarthistory. College Art Association, Dallas TX.

**Graham, D. J.**, Page, K. B. and Field, D. J. (2006, August). Relating nonlinearities to statistical regularities in paintings. Talk presented at the European Conference on Visual Perception, St. Petersburg, RUSSIA.

**Graham, D. J.**, Chandler, D. M. and Field, D. J. (2005, August). How alike are natural scenes and paintings? Characterizing the spatial statistical properties of a set of digitized, grey-scale images of painted art. European Conference on Visual Perception, La Coruna, SPAIN.

**Graham, D. J.**, Chandler, D. M. and Field, D. J. (2004, May). Decorrelation and response equalization with center-surround receptive fields. Vision Sciences Society, Sarasota, FL.

### **REVIEWING DUTIES**

- ***Behavioral and Brain Sciences***
- ***Current Biology***
- ***i-Perception***
- ***PLoS One***
- ***PLoS Computational Biology***
- ***Physica A: Statistical Mechanics and its Applications***
- ***Psychological Science***
- ***Seeing and Perceiving***
- ***Signal Processing***
- ***Vision Research***

### **INVITED LECTURES**

Department of Psychological Basic Research,  
University of Vienna, AUSTRIA, June 1, 2011.

Laboratory of Computational Neuroscience,  
Ecole Polytechnique Federale de Lausanne, SWITZERLAND, August 25, 2010.

Department of Psychological and Brain Sciences,

## **Daniel J. Graham, Ph.D.**

Dartmouth College, Hanover, NH, USA, March 4, 2010.

Redwood Neuroscience Institute,

University of California, Berkeley, CA, USA, November 18, 2009.

School of Optometry,

University of California, Berkeley, CA, USA, November 20, 2009.

Department of Mathematics,

Middlebury College, VT, USA, September 16, 2009.

Van Gogh Museum,

Amsterdam, NETHERLANDS, October 21, 2008.

School of Medicine,

Friedrich-Schiller-University, Jena, GERMANY, September 2, 2008.

Department of Mathematics,

Dartmouth College, Hanover, NH, USA, May 27, 2008.

Herbert F. Johnson Museum of Art,

Cornell University, April 18, 2007.

### **TEACHING AND ADVISING**

#### **• UNIVERSITY OF VIENNA**

- ***Introductory Seminar: Cognitive Foundations of Experience and Behavior (Psychology 200022)***: An introduction to cognitive psychology for first-year students covering basic aspects of research methods, literature review, critical analysis, etc. I teach and perform all duties for this course.
- **Diploma Advisor (equivalent to undergraduate thesis advisor)**
  - **Eva Karesch**: Statistics of Facial Attractiveness
  - **Franziska Schiller**: New Theories of Animal Camouflage
  - **Maria Noisternig**: Luminance Scaling in Representational Artwork
  - **Bianca Schwarz**: Luminance Statistics and Evolutionary Aesthetics

#### **• DARTMOUTH COLLEGE**

- ***Current Topics in Applied Mathematics: Mathematical Methods and Models in Visual Neuroscience (Mathematics 126)***: An advanced undergraduate and graduate student course of my own design introducing models of visual system function. Topics include Fourier analysis, information theory, efficient coding, and receptive field mapping techniques. I performed all duties including syllabus design, administration of quizzes, student projects, and problem sets. ***Taught in 2008, 2009, and 2010.***

#### **• MIDDLEBURY COLLEGE**

- **Senior Thesis Reader (external)**
  - **Anna Rosenblatt**: *Visual Processing: Optimizing a Basis*, 2010, Department of Physics, Middlebury College.

#### **• CORNELL UNIVERSITY**

- **Teaching Assistant**
  - ***Perception (PSYCH 2050)***

## Daniel J. Graham, Ph.D.

- *Human Perception: Applications to Computer Graphics, Art, and Visual Display (PSYCH 3420)*

### **BRIEF SUMMARY OF RESEARCH**

*Keywords:* vision, psychophysics, perception, neural processing, computational neuroscience, cognition, statistics, natural scenes, efficient coding.

#### 2011-present **Faculty of Psychology, University of Vienna**

- Measurement and modeling of human perception of art style.
- Investigations of lightness perception in artists.
- Artistic transforms of natural objects and scenes.
- Aesthetics of artistic representations of the human face.

#### 2010 – 2011 **Department of Psychology, Dartmouth College**

- Perceptual effects of artistic training.
- Perceptual processing in natural vision.
  - Evidence of efficient processing of faces in portraits.
- Art and mental disorders.
  - Visual deficits explain statistical regularities in patient artwork.

#### 2008 – 2010 **Department of Mathematics, Dartmouth College**

- Geometry of perceptual space of artwork.
  - Image statistics relevant to early visual system coding predict basic human perceptual judgments of artwork.
- Art authentication using visual system coding models.
  - Sparse coding models distinguish authentic artworks from fakes.
- Proposal for new framework of neocortical neural coding using dynamic routing.
  - The “packet switching brain” hypothesis.

#### 2004 – 2008 **Department of Psychology, Cornell University**

- Efficient neural coding in the human visual system.
- Computational studies of neural coding in the primate retina.
  - Current “decorrelation” models are insufficient to explain center-surround receptive field organization in retinal ganglion cells, while an alternative response normalization model succeeds in explaining response data.
  - Sparseness contributes to efficient retinal processing of natural scenes.
- Studies of basic statistical regularities in human artwork.
  - Artwork shares many of the statistical regularities of natural scenes, indicating that they are well matched to human neural coding.
  - Artistic luminance transforms are related to contrast nonlinearities.

#### 2002 **Ecole Normale Supérieure-Lyon (France)**

- Computational modeling of DNA hairpin denaturation using molecular dynamics.

#### 2001 – 2004 **Department of Physics, Cornell University**

- Research in nonlinear dynamics in primate vision and biophysics.