

## Hrag Pailian, Ph.D.

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### SCHOLARLY PROFILE

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My research focuses on identifying the cognitive and neural mechanisms underlying storage and manipulation processes in visual working memory. I combine behavioral (development and psychophysics), neurophysiological (electroencephalography and neurostimulation), and computational (modeling, artificial neural networks) techniques to determine the architecture of this system, identify the origins of its limits, and develop novel treatment methods to enhance cognition in healthy and vulnerable populations.

### RESEARCH EXPERIENCE

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**2015 - 20** **Research Associate/Postdoctoral Fellow**, Department of Psychology, Harvard University  
Faculty Advisor: George Alvarez, Professor of Psychology  
Focus: Manipulation of Information in Visual Working Memory

### EDUCATION

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**2015** **Ph.D. in Psychological and Brain Sciences**, Johns Hopkins University.  
Thesis: Costs of Manipulating Information in Visual Working Memory  
Advisor: Justin Halberda, Professor of Psychology

**2009** **B.Sc. in Life Sciences**, University of Toronto, St. George, Canada.

### PUBLICATIONS

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1. Bill, J., **Pailian, H.**, Gershman, S.J., & Drugowitsch, J. (2020). Hierarchical structure is employed by humans during visual motion perception. *Proceedings of the National Academy of Sciences (PNAS)*. 117 (39), 24581-24589.
2. **Pailian, H.**, Carey, S.E., Halberda, J., & Pepperberg, I.M. (2020). Age and Species Comparisons of Visual Mental Manipulation Ability as Evidence for its Development and Evolution. *Nature: Scientific Reports*, 10(1), 1-7.
3. **Pailian, H.**, Wetherhold, J., Simons, D.J., & Halberda, J. (2020). Using the Flicker task to estimate visual working memory storage capacity. *Attention, Perception, & Psychophysics*, 1-19.
4. **Pailian, H.**, Libertus, M., Feigenson, L., & Halberda, J. (2016). Visual working memory storage capacity increases between ages 3 and 8 years controlling for gains in exogenous and endogenous attentional control in a visual search paradigm. *Attention, Perception, & Psychophysics*, 1-18.
5. **Pailian, H.**, & Halberda, J. (2015) The reliability and internal consistency of one-shot and flicker change detection for measuring individual differences in visual working memory capacity. *Memory & Cognition*, 43, 397-420.

6. **Pailian, H.**, & Halberda, J. (2013) Independent costs for storing and manipulating information in visual working memory. *Visual Cognition*, 21(6), 704-707.
7. **Pailian, H.**, & Halberda, J. (under review). The costs of manipulating information in visual working memory. *Psychological Science*.
8. **Pailian, H.**, Santarnecchi, E., Pascual-Leone, A., & Alvarez, G.A. (under review). Dissociable augmentation and structure of visual working memory storage and manipulation. *Nature Communications*.

## PRESENTATIONS

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### Invited Lectures

- Pailian, H.** (2020). Costs of manipulating in memory. University of Toronto, February 7, Toronto, ON.
- Pailian, H.** (2019). Neurocognitive Development of Limits in Mental Manipulation. Boston University, July 18, Cambridge, MA.
- Pailian, H.** (2019). Visual Manipulation Memory. MIT (Psychology Department), June 4, Cambridge, MA.
- Pailian, H.** (2018). The Cognitive and Neural Architecture of Visual Manipulation Memory. Harvard University (Psychology Department), November 8, Cambridge, MA.
- Pailian, H.** (2018). Limits in visual manipulation memory. University of Oxford (Psychology Department), September 7, Oxford, UK.
- Pailian, H.** (2018). Visual manipulation memory. University of York, September 5, York, UK.
- Pailian, H.** (2018). The working part of working memory. Harvard University (Carey Lab, Caramazza Lab), March 28 & April 5, Cambridge, MA.
- Pailian, H.** (2017). Visual working memory: storage vs. manipulation. University of Toronto (Mississauga Campus), November 3, Toronto, ON.
- Pailian, H.** (2017). Origins of limits in visual working memory limits. Harvard Medical School (Wolfe Lab), March 28, Cambridge, MA.
- Pailian, H.** (2015). Breaking visual working memory: (in)dependent representations for storage and manipulation. Harvard University, October 22, Cambridge, MA.
- Pailian, H.** (2014). The costs of manipulating information in visual working memory. Brown University, August 25, Rhode Island, MA.
- Pailian, H.** (2013). Constraints placed on executive control abilities in visual working memory. University of Toronto, June 30, Toronto, ON.

### Conference Talks

- Pailian, H.**, & Alvarez, G.A. (2020). Neuroaugmentation reveals dissociable neural substrates underlying storage and manipulation in visual working memory. Vision Sciences Society Conference, June 19-24, St. Petersburg, FL.
- Pailian, H.**, Doshi, F., & Alvarez, G.A. (2020). Using deep convolutional neural networks to examine the role of representational similarity in visual working memory. Visual Working Memory Symposium, June 4th, Virtual Conference.
- Pepperberg, I.M., Libertus, M., Feigenson, L., Halberda, J., & **Pailian, H.** (2019). Evolution and development of signature limits in mental manipulation. Vision Sciences Society Conference, May 19, St. Petersburg, FL.
- Pailian, H.**, & Alvarez, G.A. (2018). Limits in visual working memory manipulation. International Conference for Spatial Cognition, September 12, Rome, Italy.

- Pepperberg, I.M., & **Pailian, H.** (2017). Evolution of mechanisms underlying visual working memory manipulation: when “bird-brain” is a compliment. Psychonomic Society Conference, November 10, Vancouver, BC.
- Pailian, H.**, Stormer, V., & Alvarez, G.A. (2017). Neurophysiological marker of visual working memory manipulation. VSS, the Vision Sciences Society, May 23, St. Petersburg, FL.
- Pepperberg, I.M., & **Pailian, H.** (2017). Mechanisms of visual working memory manipulation: when “bird-brain” is a compliment. VSS, the Vision Sciences Society, May 24, St. Petersburg, FL.
- Pailian, H.**, & Halberda, J. (2015). Breaking visual working memory: independence between costs in storage and manipulation abilities. VSS, the Vision Sciences Society, May 15-20, St. Petersburg, FL.
- Pailian, H.**, & Halberda, J. (2014). On the dynamic nature of visual working memory: separate limits for the storage and manipulation of information. VSS, the Vision Sciences Society, May 16-21, St. Petersburg, FL.
- Pailian, H.**, & Halberda, J. (2014). Dynamic nature of visual working memory across time and space. VSS, the Vision Sciences Society Satellite Event, May 16-21, St. Petersburg, FL.
- Pailian, H.**, & Halberda, J. (2013). Independent costs for storing and manipulating information in visual working memory. Annual Object Perception Attention and Memory meeting, November 14, Toronto, ON, Canada.
- Pailian, H.** & Halberda, J. (2013). Moving beyond storage limitations: exploring the dynamic manipulation of representations in visual working memory. VSS, the Vision Sciences Society, May 10-15 Naples, FL.
- Wilmer, J. B., Germine, L., Ly, R., Hartshorne, J.K., Kwok, H., **Pailian, H.**, Williams, M.A., & Halberda, J. (2012). The heritability and specificity of change detection ability. VSS, the Vision Sciences Society, May 11-16, Naples Florida.

### Posters and abstracts

- Doshi, F., **Pailian, H.**, & Alvarez, G.A. (2020). Using deep convolutional neural networks to examine the role of representational similarity in visual working memory. Vision Sciences Society Conference, June 19-24, St. Petersburg, FL.
- Schmitt, W., **Pailian, H.**, & Alvarez, G.A. (2020). Using neurostimulation to augment the encoding of information in visual working memory. Vision Sciences Society Conference, June 19-24, St. Petersburg, FL.
- Pailian, H.** & Alvarez, G.A. (2019). Probing the neurocognitive architecture of visual working memory by enhancing storage vs. manipulation. Vision Sciences Society Conference, May 21, St. Petersburg, FL.
- Bill, J., **Pailian, H.**, Gershman, S., & Drugowitsch, J.. (2019). Hierarchical motion structure is employed by humans during visual perception. Vision Sciences Society Conference, May 21, St. Petersburg, FL.
- Pailian, H.**, Santarnecchi, E., Pascual-Leone, A., & Alvarez, G.A. (2018). Neuro-enhancement of visual working memory storage and manipulation via transcranial-direct current stimulation. ECVF, European Conference for Visual Perception, August 28, Trieste, Italy.
- Pailian, H.**, & Carey, S.E. (2018). Set Representations in non-linguistic thought. McDonnell Network Plenary Conference, July 10, Barcelona, Spain.
- Pailian, H.**, & Alvarez, G.A. (2018). Sources of error underlying visual working memory manipulation. Poster presented at VSS, the Vision Sciences Society, May 20, St. Petersburg, FL.

- Wilmer, J., **Pailian, H.**, Germine, L., Ly, R., & Halberda, J. (2017). Where do cognitive limitations come from and why do we care? The divergent cases of visual working memory storage and approximate number sense acuity. VSS, the Vision Sciences Society, May 19-24, St. Petersburg, FL.
- Pailian, H., Tran, E., & Alvarez, G.A.** (2016). Constraints on Information Compression in Visual Working Memory. VSS, the Vision Sciences Society, May 13-18, St. Petersburg, FL.
- Cunningham, C.A., **Pailian, H.**, & Egeth, H.E. (2014). Characterizing representations in activated long-term memory. Psychonomics Society annual meeting, November 14, Long Beach, CA.
- Graves, T., **Pailian, H.**, & Egeth, H. (2014). The role of rapid disengagement in overcoming attentional capture. VSS, the Vision Sciences Society, May 16-21, St. Petersburg, FL.
- Eisinger, R., Im, **H., Pailian, H.** & Halberda, J. (2013). Ensemble-based change detection. VSS, the Vision Sciences Society. May 10-15, Naples, FL.
- Pailian, H.**, Libertus, M., Feigenson, L., & Halberda, J. (2013). Developmental changes in visual short-term memory (VSTM) capacity between Ages 3 and 8 Years. SRCD, April 18-20 Seattle, WA.
- Pailian, H.**, Libertus, M., Feigenson, L., & Halberda, J. (2013). Measuring individual differences in children's visual short-term memory capacity using the Flicker paradigm. SRCD, April 18-20 Seattle, WA.
- Pailian, H.**, & Halberda, J. (2012). The cost of manipulating representations in working memory. VSS, the Vision Sciences Society, May 11-16, Naples, FL.
- Pailian, H.** & Halberda, J. (2011). Individual differences in visual working memory capacity assessed by the Flicker task. VSS, the Vision Sciences Society, May 6-11, Naples, FL.

## TEACHING & ADVISING EXPERIENCE

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### Instructor/Co-Instructor

Responsibilities included developing course curriculum, creating and delivering lectures, supervising labs, grading all assignments, advising students (one-on-one meetings), and managing teaching assistants.

- Harvard University, Harvard Extension School, Cambridge MA  
Mind, Body, Health, and Medicine (Fall 2017), 40 students
- Johns Hopkins University, Baltimore, Md  
Psychology of War and Genocide (Winter 2014, 2015). 30 students  
Positive Psychology (Spring 2015), 50 students

### Teaching Fellow/Assistant

Responsibilities included delivering guest lectures; supervising labs; grading all assignments; and advising students.

- Harvard University, Department of Psychology, Cambridge MA  
Brain Sciences for Future World Leaders (Spring 2016), 50 students
- Johns Hopkins University, Baltimore, Md  
Positive Psychology (Fall 2011, 2012, 2013), 60 students  
Human Sexuality (Spring 2013), 50 students  
Foundations of Mind (Spring 2012), 70 students

Introduction to Cognitive Psychology (Spring 2011), 70 students

### **Advising**

Served as a mentor for approximately 15 undergraduate students at the Harvard and Johns Hopkins universities, who were completing thesis projects or gaining research experience in the lab.

### **AWARDS & GRANTS**

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#### **Fellowships**

Natural Sciences and Engineering Research Council of Canada (NSERC) Alexander Graham Bell *PGS-D* Fellowship (2012-2015)

Natural Sciences and Engineering Research Council of Canada (NSERC) Alexander Graham Bell *PGS-M* Fellowship (2011-2012)

Galust Gulbenkian Scholarship, Galust Gulbenkian Foundation (2008)

#### **Academic Recognition**

Psychological and Brain Sciences Collaborative Research Award, Johns Hopkins University (2015)

Psychological and Brain Sciences Walter L. Clark Teaching Award, Johns Hopkins University (2015)

Research Expansion Award, Johns Hopkins University (2014)

Psychological and Brain Sciences ERP Training Grant, Johns Hopkins University (2012)

Sexual Diversity Studies Award, University of Toronto (2009)

Troy Najarian Memorial Scholarship, Armenian Relief Society, (2008)

Dr. Taverna Award in Learning and Behavior, University of Toronto (2007)

#### **Research Grants**

Foundations of Human Behavior Initiative Grant, Harvard University (2018)

Foundations of Human Behavior Initiative Grant, Harvard University (2015)

#### **Travel Awards**

Young Scientist Award, Harvard Brain Science Initiative (2018)

### **PROFESSIONAL SERVICE**

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#### **Committee Experience**

Council Member, Harvard Mind, Brain, Behavior Postdoctoral Committee (2016-17).

Symposium Organizer, Vision Sciences Society Annual Meeting – Individual Differences Symposium, (2012, 2014, 2016).

Colloquium Committee, Psychological and Brain Sciences, Johns Hopkins University (2014-15.)

President, Social-Chair, Johns Hopkins University LGBTQ+ Graduate Students (2012-15).

#### **Educational Outreach**

Brain Awareness Week, Johns Hopkins University, 2012, 2013.

Immigrants in Science, University of Toronto Armenian Students' Association

#### **Peer Reviewer**

*Proceedings of the National Academy of Sciences (PNAS), Visual Cognition, Memory; Memory and Cognition; Attention Perception & Psychophysics; Developmental Science; Journal of Cognitive Research – Principles and Implications; Journal of Vision; Journal of Developmental Psychology*

## **IN THE NEWS**

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Coverage of Pailian et al (2020): *Age and Species Comparisons of Visual Mental Manipulation Ability as Evidence for its Development and Evolution*

- **Harvard Gazette:**
- **Acadian Bird Club:**
- **NPR**
- **BBC**