

**RESEARCH DOSSIER**  
**Professor Michael R.W. Dawson**  
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**Last Updated On October 3, 2018**

**1. RESEARCH AWARDS:**

Name of Award	Year	Awarded by:
McCalla Professorship	2007-2008	Faculty of Arts, University of Alberta
Research Award (Full Professor)	2005-2006	Faculty of Arts, University of Alberta
Killam Annual Professorship	1997-1998	University of Alberta

**2. RESEARCH PHILOSOPHY:**

*Certum quod factum* (Giambattista Vico, 1710) – “one is certain only of what one builds”. I advance understanding in cognitive science by building simulations and artefacts that serve as media for exploring and discovering new ideas.

**Implications of My Research Philosophy**

- ✓ I have achieved national and international prominence for my work on the interdisciplinary foundations of cognitive science, in particular the study of how artificial neural networks and simple robots impact these foundations
  - Publication of seven books or monographs on foundations of cognitive science and modelling, with an eighth currently under review
  - Extensive theoretical contributions that have been motivated by my simulation results
- ✓ I have achieved national and international prominence for my work in developing the theory and application of artificial neural networks, accomplished by building working simulations and analyzing their internal structure
  - Invention of learning rule for a new neural network architecture (networks of value units), and new techniques for interpreting the internal structure of these networks
  - Application of neural networks to a wide array of content areas, including associative learning, music perception, movement perception, human reasoning, cognitive neuroscience, developmental psychology, spatial navigation, probability learning
- ✓ I have used advances in my research as a stimulus for introducing students to new research ideas and results
  - Extensive training of graduate and undergraduate students in my laboratory techniques
  - Development of new lecture themes (e.g., embodied cognitive science, synthetic psychology) in my undergraduate courses, fuelled by new empirical and theoretical results in my lab and beyond
  - Distribution of my results and methods through a variety of frequently-accessed web pages

**3. MOST SIGNIFICANT RESEARCH CONTRIBUTIONS:**

- ✓ One of my most significant research contributions is my training of graduate students in the theoretical and experimental aspects of cognitive science. The productive interdisciplinary cooperation between these students develops highly skilled and well-balanced future cognitive scientists. Since 1996 I have graduated 12 Ph.D. students who now have academic positions in departments of psychology, educational psychology, philosophy, computer science, and neurology; details about these students can be found on my teaching dossier.
- ✓ Dawson, M.R.W. (2018). *Connectionist Representations of Tonal Music: Discovering Musical Patterns by Interpreting Artificial Neural Networks*. Edmonton, AB: Athabasca University Press. Previously, artificial neural networks have been used to capture only the informal properties of music. However, by training artificial neural networks to make basic judgments concerning tonal music, such as identifying the tonic of a scale or the quality of a musical chord, the networks can reveal formal musical properties that differ dramatically from those typically presented in music theory. Intended to introduce readers to the use of artificial neural networks in the study of music, this book contains numerous case studies and research findings that address problems related to identifying scales, keys, classifying musical chords, and learning jazz chord progressions. A detailed analysis of networks is provided for each case study to demonstrate that focusing on the internal structure of trained networks can yield important contributions to the field of music cognition.
- ✓ Dawson, M.R.W. (2013). *Mind, Body, World: Foundations of Cognitive Science*. Edmonton, AB: Athabasca University Press. Cognitive science arose in the 1950s when it became apparent that a number of disciplines, including psychology, computer science, linguistics, and philosophy, were fragmenting. Perhaps owing to the field's immediate origins in cybernetics, as well as to the foundational assumption that cognition is information processing, cognitive science initially seemed more unified than psychology. However, as a result of differing

interpretations of the foundational assumption and dramatically divergent views of the meaning of the term information processing, three separate schools emerged: classical cognitive science, connectionist cognitive science, and embodied cognitive science. Examples, cases, and research findings taken from the wide range of phenomena studied by cognitive scientists effectively explain and explore the relationship among the three perspectives. Intended to introduce both graduate and senior undergraduate students to the foundations of cognitive science, *Mind, Body, World* addresses a number of questions currently being asked by those practicing in the field: What are the core assumptions of the three different schools? What are the relationships between these different sets of core assumptions? Is there only one cognitive science, or are there many different cognitive sciences? Giving the schools equal treatment and displaying a broad and deep understanding of the field, this book highlights the fundamental tensions and lines of fragmentation that exist among the schools and provides a refreshing and unifying framework for students of cognitive science.

- ✓ Dawson, M.R.W., Dupuis, B., and Wilson, M. (2010). *From Bricks To Brains: The Embodied Cognitive Science Of LEGO Robots*. Edmonton, AB: Athabasca University Press. This book introduces embodied cognitive science, using the construction and observation of simple robots to illustrate its foundational ideas. It focuses on the characteristics that distinguish embodied cognitive science from classical cognitive science, placing a renewed emphasis on sensing and acting, the importance of embodiment, the exploration of distributed notions of control, and how theories can be developed by synthesizing simple systems and exploring their behavior. It uses numerous examples to illustrate a key theme: the importance of an agent's environment. Even simple agents, such as LEGO robots, are capable of exhibiting very complex behavior when they can sense and affect the world around them.

#### 4. GRANT SUPPORT (SINCE 2010):

2009-2012	SSHRC Standard Research Grant, "Interpreting symbolic and subsymbolic regularities in artificial neural networks that classify musical stimuli" \$81,312 (\$26,512 for year one, \$26,400 for year two and \$28,400 for year 3)
2007-2012	NSERC Discovery Grant, "Artificial neural networks, contingency, and associative learning", \$24,745/yr

#### 5. RESEARCH CONTRIBUTIONS (SINCE 2010):

##### Under Editorial Review

1. Dawson, M.R.W. (Under editorial review). Embodied cognition. *Encyclopedia of Animal Cognition and Behavior*, edited by Jennifer Vonk and Todd K. Shackelford, Springer Publishing. (4600 words, submitted September 29, 2018).
2. Dawson, M.R.W. (Under editorial review). Probability in perceptrons and people. Monograph submitted to *Comparative Cognition & Behavior Reviews* (128,965 words, 240 pages, submitted August 11, 2018)
3. Dawson, M.R.W. Baerveldt, C., Shillabeer, E. and Richard, V. (Under editorial review). Training scientific generalists: Joseph R. Royce, Ludwig von Bertalanffy, and the 'Seminar in Theoretical Psychology'. *History of the Human Sciences*, under review. (11,704 words, submitted February 19, 2018).

##### Accepted or In Press

1. Dawson, M.R.W. Baerveldt, C., Shillabeer, E. and Richard, V. (Accepted for publication). Theoretical psychology at the University of Alberta in the context of Cold War social science. *History of Psychology*. (9814 words, accepted for publication June 26, 2018).
2. Dawson, M.R.W. (Accepted for publication). Cognitive impenetrability. *Encyclopedia of Animal Cognition and Behavior*, edited by Jennifer Vonk and Todd K. Shackelford, Springer Publishing. (1499 words, submitted March 30, 2017; accepted for publication April 29, 2017).

##### Books and Monographs

1. Dawson, M.R.W. (2018). *Connectionist Representations of Tonal Music: Discovering Musical Patterns by Interpreting Artificial Neural Networks*. Athabasca University Press, Edmonton.
2. Dawson, M.R.W. (2013) *Mind, Body, World: Foundations of Cognitive Science*. Athabasca University Press, Edmonton.
3. Dawson, M.R.W., Dupuis, B., & Wilson, M. (2010). *From Bricks to Brains: The Embodied Cognitive Science of LEGO Robots*. Athabasca University Press, Edmonton.

##### Book Chapters

1. Dawson, M. R. W. (2018). Connectionism. In Zeraatpishe, M., Faravani, M.A., Kargozari H.R., and Azarnoosh, M. (eds) *Issues in Applying SLA Theories toward Reflective and Effective Teaching*. Leiden, Brill Sense: 37-48.
2. Dawson, M. R. W. (2014). Embedded and situated cognition. In L.A. Shapiro (ed) *The Routledge Handbook Of Embodied Cognition*. Koninklijke Brill NV, Leiden, The Netherlands: 37-47.

#### Book Reviews

1. Dawson, M.R.W. (2014). Review of Britt Anderson's *Computational Neuroscience and Cognitive Modeling*. *British Journal of Psychology*, 105, 436-438.

#### Refereed Journal Articles

1. Dawson M.R.W., Zielinski J.A.Z. (2018) Key-finding by artificial neural networks that learn about key profiles. *Canadian Journal of Experimental Psychology-Revue Canadienne De Psychologie Experimentale*, 72, 153-170.
2. Dawson, M.R.W. and Gupta, M.M. (2017). Probability matching in perceptrons: Effects of conditional dependence and linear nonseparability. *PLoS ONE* 12(2): e0172431 doi:10.1371/journal.pone.0172431
3. Hathaway, J. and Dawson, M.R.W. (2014). Giant steps in the interpretation of a musical PDP network. *Eureka*, 4, 24-29.
4. Pérez, A. and Dawson, M.R.W. (2014). A brick-sorting LEGO robot. *Eureka*, 4, 19-23.
5. Dupuis, B., and Dawson, M.R.W. (2013). Get out of the corner: Inhibition and the effect of location type and number on perceptron and human reorientation. *Learning & Behavior*, 41(4), 360-378.
6. Dupuis, B, and Dawson, M.R.W. (2013). Differentiating models of associative learning: reorientation, superconditioning, and the role of inhibition. *Journal of Experimental Psychology: Animal Behavior Processes*, 39(3), 273-286.
7. Dawson, M.R.W. (2013). A case study In Gantt charts as historiophoty: A century of psychology at the University of Alberta. *History of Psychology*, 16(2), 145-157
8. Dawson, M.R.W. & Dupuis, B. (2012) Equilibria of perceptrons for simple contingency problems. *IEEE Transactions On Neural Networks And Learning Systems*, 23(8), 1340-1344
9. Guillette, L. M., Bloomfield, L. L., Batty, E. R., Dawson, M. R. W., & Sturdy, C. B. (2011). Development of a contact call in black-capped chickadees (*Poecile atricapillus*) hand-reared in different acoustic environments. *Journal of the Acoustical Society of America*, 130(4), 2249-2256.
10. Dawson, M.R.W. (2011). Cognitive architecture. in P.C Hogan (Ed.) *The Cambridge Encyclopedia of the Language Sciences*. Cambridge University Press, Cambridge. (pp. 160-162).
11. Guillette, L.M., Farrell, T.M., Hoeschele, M., Nickerson, C.M., Dawson, M.R.W., & Sturdy, C.B. (2010). Mechanisms of call note type perception in black-capped chickadees (*Poecile atricapillus*): Peak Shift in a note type continuum. *Journal of Comparative Psychology*, 124, 109-115.
12. Dawson, M.R.W. (2010). Review of Philip Robbins and Murat Aydede (Editors) *The Cambridge Handbook of Situated Cognition*. *Canadian Psychologist*, 51, 69-71.
13. Guillette, L.M., Bloomfield, L.L., Batty, E.R., Dawson, M.R.W. & Sturdy, C.B. (2010). Black-capped (*Poecile atricapillus*) and mountain chickadee (*Poecile gambeli*) contact call contains species, sex, and individual identity features *Journal of the Acoustical Society of America*, 127, 1116-1123.
- Dawson, M.R.W., Kelly, D.M, Spetch, M.L., & Dupuis, B. (2010). Using perceptrons to explore the reorientation task. *Cognition*, 114, 207-226.

#### Conference Presentations

1. Dawson, M.R.W. (2018). What was theoretical psychology? An answer from treemaps of book collections. (Poster presented at the 50<sup>th</sup> annual meeting of Cheiron: International Society for the History of the Behavioral and Social Sciences. Akron, Ohio, June 22, 2018).
2. Dawson, M.R.W. (2018). What was theoretical psychology? An answer from treemaps of book collections. (Poster presented at the 32<sup>th</sup> Annual J.R. Royce Research Conference, Department of Psychology, University of Alberta, April 6, 2018).
3. Baerveldt, C., Shillabeer, E., Richards, V., and Dawson M.R.W. (2017). Recovery and renewal: The Center for Advanced Study in Theoretical Psychology, 1965-1990. (Paper presented at the 17<sup>th</sup> Biennial Meeting of the International Society for Theoretical Psychology, Rikkyo University, Tokyo, Japan, August 22, 2017).
4. Dawson, M.R.W, Baerveldt, C., and Shillabeer, E. (2017). "Training Generalist Scientists: Joseph R. Royce, Ludwig von Bertalanffy, and Their Plan for the Core Seminar of a Theoretical Psychology Center". (Paper presented at the 49<sup>th</sup> annual meeting of Cheiron: International Society for the History of the Behavioral and Social Sciences. Starkville, Mississippi, June 23, 2017).

5. Han, J., & Dawson, M.R.W. (2017). "Generating music by predicting notes from Bach's Inventions" (Poster presented at the 31<sup>th</sup> Annual J.R. Royce Research Conference, Department of Psychology, University of Alberta, March 23 2017).
6. Dawson, M.R.W. (2016). "Structure-Process, Images, and Narratives". (Paper presentation at the joint conference of the European Society for the History of the Human Sciences (ESHHS) and the International Society for the History of Behavioral and Social Sciences (Cheiron), Barcelona, Spain, June 30, refereed).
7. Dawson, M.R.W. (2016). "How To Convert Historical Text Into A Gantt Chart". (Poster presentation at the joint conference of the European Society for the History of the Human Sciences (ESHHS) and the International Society for the History of Behavioral and Social Sciences (Cheiron), Barcelona, Spain, June 28, refereed).
8. Dawson, M.R.W. (2016). "Pylyshyn's patented procedure for producing PDP-promoting PhDs: A personal parable." (Talk presented at the Dr. Zenon W. Pylyshyn Retirement Conference, Rutgers University, May 20 2016, invited).
9. Koch-Hale, B.L., & Dawson, M.R.W. (2016). "Musical Intervals, Neural Networks, and Coarse Coding" (Poster presented at the 30<sup>th</sup> Annual J.R. Royce Research Conference, Department of Psychology, University of Alberta, March 11 2016).
10. Dawson, M.R.W. & Dupuis, B. (2016). *Telus World of Science, Dark Matters: Robotics*. "From Bricks to Brains: The Embodied Cognitive Science of LEGO Robots" (Poster, robot, and video display; March 10, 2016, invited).
11. Dawson, M.R.W. (2015). "Image processing of a Gantt chart to explore the history of a Canadian psychology department". (Poster presented at the 34<sup>th</sup> Annual Meeting of the European Society for the History of the Human Sciences, Angers, France, July 7).
12. Kersten, L., Dawson, M.R.W., & Hathaway, J. (2013). "Simple networks, complex music: An investigation into 'embodied' representations". (Paper presented at Embodied Music Cognition (EMuCog) Conference, Edinburgh, Scotland, July 23).
13. Dupuis, B., & Dawson, M.R.W. (2013). "Differentiating models of associative learning: Reorientation, superconditioning, and the role of inhibition". (Poster presented at the 12th International Conference on Cognitive Modelling, (ICCM 2013), Ottawa, ON, July 13).
14. Dawson, M.R.W. (2013). "Interpreting the internal structure of artificial neural networks can reveal new formalisms for musical cognition". (Poster presented at the 13th European Congress of Psychology, (ECP 2013), Stockholm, Sweden, July 12).
15. Dawson, M.R.W., & Hathaway, J. (2013). "Giant Steps In Interpreting PDP Networks For Jazz Progressions". (Poster presented at the 23<sup>rd</sup> annual meeting of the Canadian Society For Brain, Behavior, and Cognitive Science, Calgary, AB, June 8).
16. Dawson, M.R.W., Dupuis, B., & Jans, S. (2013). "Simple Neural Networks And Bayesian Inference: A Computational Account". (Poster presented at the 23<sup>rd</sup> annual meeting of the Canadian Society For Brain, Behavior, and Cognitive Science, Calgary, AB, June 8).
17. Dupuis, B. & Dawson, M.R.W. (2013). "Get Out Of The Corner: Inhibition and the Effect of Location type and Number on Perceptron and Human Reorientation". (Poster presented at the 23<sup>rd</sup> annual meeting of the Canadian Society For Brain, Behavior, and Cognitive Science, Calgary, AB, June 8).
18. Dawson, M.R.W., & Hathaway, J. (2013). "Giant Steps In Interpreting PDP Networks For Jazz Progressions". (Poster presented at the 27<sup>th</sup> Annual Joseph R. Royce Research Conference (Edmonton, AB, March 12).
19. Dawson, M.R.W., Dupuis, B., & Jans, S. (2013). "Simple Neural Networks And Bayesian Inference: A Computational Account". (Poster presented at the 27<sup>th</sup> Annual Joseph R. Royce Research Conference (Edmonton, AB, March 12).
20. Dupuis, B. & Dawson, M.R.W. (2013). "Get Out Of The Corner: Inhibition and the Effect of Location type and Number on Perceptron and Human Reorientation". (Poster presented at the 27<sup>th</sup> Annual Joseph R. Royce Research Conference (Edmonton, AB, March 12).
21. Dawson, M.R.W. (2011). Neural networks that use strange circles to encode musical harmony. Poster presented at the 26th Annual Meeting of the Canadian Society for Brain Behaviour and Cognitive Science (Winnipeg, MB, June 25).
22. Dupuis, B. & Dawson, M.R.W. (2011). Modules, maps, and the robots who shun them: a behaviour-based model of navigation. Paper presented at the 26th Annual Meeting of the Canadian Society for Brain Behaviour and Cognitive Science (Winnipeg, MB, June 25).

#### Colloquia

1. Dawson, M.R.W. (2016) "From Bricks to Brains: What Do Robot Bodies Tell Us About Human Minds?" *Telus World of Science, Dark Matters: Robotics* (March 10, 2016, invited).

2. University of Alberta, Department of Secondary Education, Doyal Nelson Lecture "Towards a more embodied approach to mathematics" (January 29, 2013, invited).
3. Universidad Diego Portales, La Facultad de Psicología, Centro de Estudios de la Argumentación y el Razonamiento, Santiago, Chile. "Teaching forward engineering with LEGO robots". (November 13, 2013, invited).
4. Universidad Diego Portales, La Facultad de Psicología, Centro de Estudios de la Argumentación y el Razonamiento, Santiago, Chile. "Introducing embodied cognitive science". (November 12, 2013, invited).
5. University of Alberta, Department of Philosophy. "Is the posterior perceptor an ace of Bayes?" (March 7, 2013, invited).

#### **6. OTHER RESEARCH CONTRIBUTIONS (SINCE 2010):**

Reviewer of research grants for NSERC and SSHRC; Member of the Editorial Committee of Athabasca University Press; Reviewer of book proposals and book manuscripts for different publishers (Routledge; Sage Publications). Manuscript reviewer for many different journals (*Adaptive Behavior; Advances in Cognitive Psychology; Behavioural Processes; Body and Society; Canadian Journal of Experimental Psychology; Connection Science; Experimental Brain Research; IEEE Transactions On Neural Networks and Learning Systems; Neural Computation; Neural Networks; Philosophical Psychology, PLOS One; The Spanish Journal of Psychology; Topics in Cognitive Science*). Review of papers and abstracts for presentation at international conferences (Cheiron, International Joint Conference on Neural Networks).