

Charles R. Twardy

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EDUCATION ◇ **PhD: History & Philosophy of Science and in Cognitive Science**, Indiana University, Bloomington, 1999.

Dissertation: *Causation, Causal Perception, and Conservation Laws*.

◇ **MA: History & Philosophy of Science**, Indiana University, Bloomington, 1995.

◇ **BA: Cosmology & Culture (Interdisciplinary)**, University of Virginia, Charlottesville, VA, 1993. Distinguished Majors Program, High Distinction.

Thesis: *The Philosophy of Mayan Astronomy*.

Minor: History of Science and Technology.

HONORS, AWARDS, & GRANTS ◇ **ARC grant**: Bayesian networks for epidemiology, 2003, \$150K (author, not PI)

◇ **Monash Arts-IT grant**, 2003, \$10K

◇ **NSF Postdoctoral Research Fellowship**, 2000-2002, \$36K/yr. (Monash Univ.)

◇ **National Science Foundation Graduate Research Fellowship**, 1994-1997.

REFEREED PUBLICATIONS Handfield, T., Twardy, C. R., Korb, K. B. & Oppy, G. "The metaphysics of causal models: Where's the *biff*?" *Erkenntnis*, 68:149–168. 2008. <http://dx.doi.org/10.1007/s10670-007-9060-3>

Twardy, C., Nicholson, A., Korb, K. & McNeil, J. "Epidemiological data mining of cardiovascular Bayesian networks", *Electronic Journal of Health Informatics*, 1:1 2006. <http://www.ejhi.net/ojs/index.php/ejhi/article/view/e3>

Twardy, C., Gardner, S. & Dowe, D. "Empirical Data Sets are Algorithmically Compressible: Reply to McAllister." *Studies in the History & Philosophy of Science, Part A* 36:2 391–402, June 2005. <http://dx.doi.org/10.1016/j.shpsa.2005.04.004>

Marriott, K., Moulder, P., Hope, L. & Twardy, C.: "Layout of Bayesian Networks", in V. Estivill-Castro (ed), *Proceedings of the Twenty Eighth Australasian Computer Science Conference (ACSC 2005)*, Newcastle, NSW, Australia, 31 January - 3 February 2005, Australian Computer Society Inc., Sydney, NSW, Australia, ISBN: 1-920682-20-1 & ISSN: 1445-1336, pp 97-106.

Twardy, C. & Korb, K. "A criterion for probabilistic causality" *Philosophy of Science* 71:3 (July 2004) 241–262.

Twardy, C. "Argument maps improve critical thinking." *Teaching Philosophy* 27:2, 95–116. June 2004.

Twardy, C.R. & Bingham, G.P. "Causation, causal perception, and conservation laws." *Perception & Psychophysics* 64:6, 956–968. 2002.

Twardy, C. "Philosophical Lessons from Maya Astronomy." *Indiana Journal of Hispanic Literatures*. 13:25–30. Fall 1998.

Charles R. Twardy

- BOOK
CHAPTERS Nicholson, A. E. & Twardy, C. R. & Korb, K. B. & Hope, L. R. “Bayesian networks for clinical decision support”, ch. 3 in Olivier Pourret, Patrick Nam and Bruce G. Marcot (eds) *Bayesian Belief Networks: A Practical Guide to Applications*. John Wiley & Sons, March 2008. ISBN: 978-0-470-06030-8.
- REPORTS Twardy, C. R. & Koester, R. K. & Gatt, Sgt. R. “Missing Person Behaviour: An Australian Study (Final Report to the National SAR Council).” June 2006. sarbayes.org/natsar.pdf (Also: Washington state in May, New Zealand in November.)
- Korb, K. B. & Twardy, C. R. & Handfield, T. & Oppy, G.: Causal Reasoning with Causal Models, Clayton School of Information Technology, Monash University, Melbourne, 45pp. Technical report 2005/183. <http://www.csse.monash.edu.au/publications/2005/tr-2005-183-full.pdf>
- Spring, D. & Twardy, C. & Cacho, O. “Survey of weed detection and control methodologies: Detectability estimation and effort allocation.” Report to the Office of the Chief Plant Protection Officer, Dept. of Agriculture, Fisheries, and Forestry”. February 2005
- Twardy, C. R. & Nicholson, A. E. & Korb, K. B. & McNeil, J. “Data mining cardiovascular Bayesian networks.” School of Computer Science & Software Engineering, Monash University, Melbourne. 10pp. Technical Report 2004/165. <http://www.csse.monash.edu.au/publications/2004/tr-2004-165-full.pdf>
- Twardy, C.R. & Gatt, Sgt. R. “Missing Person Behaviour: An Australian Study (Preliminary Report to the National SAR Council).” Sydney, November, 2003.
- Twardy, C.R. & Korb, K.B. “Causal interaction in Bayesian networks.” School of Computer Science & Software Engineering, Monash University, Melbourne. 11pp. Technical Report 2002/118. www.csse.monash.edu.au/publications/2002/tr-2002-118-full.ps
- CONFERENCE PAPERS & POSTERS Twardy, C.R. & Wright, E.J. & Cannon, S.J. & Takikawa, M. “Credibility Models”, in K.B. Laskey & S.M. Mahoney & J. Goldsmith (eds) *Proceedings of the Fifth UAI Bayesian Modeling Applications Workshop (UAI-AW 2007)*, Vancouver, British Columbia, Canada, July 19, 2007. CEUR Workshop Proceedings, v.268. <http://ceur-ws.org/Vol-268>.
- Oboler, A. & Twardy, C. & Albrecht, D. Super Iterator: A design pattern for Algorithm and Data structure collections. ITNG 2007 poster. <http://www.computer.org/cps>
- Twardy, C. R. & Nicholson, A. E. & Korb, K. B. & McNeil, J. Data mining cardiovascular Bayesian networks. ARC Research Network on Data Mining and Knowledge Discovery (DM&KD) Health Data Mining Workshop. April 2005, Univ. of South Australia. (Presented by Ann Nicholson). (Written paper is the same as CSSE Technical Report 2004/165, above.)
- Twardy, C. & Handfield, T. & Korb, K. & Oppy, G. The art (or science) of causal modelling. Australasian Association of Philosophy conference, South Molle Island, July 2004.
- The causal interpretation of Bayesian networks (with Kevin Korb). Joint International Conference on Cognitive Science / Australasian Cognitive Science Conference. University of New South Wales, Sydney, 13–17 July 2003.

Charles R. Twardy

Probabilistic Causality and Bayesian Networks (with Kevin Korb). Macquarie Summer Statistics Workshop 2003: Graphical Models. Macquarie University, February 2003.

Measuring causal interaction (with Kevin Korb). Australian Association for the History, Philosophy, and Social Studies of Science, University of Sydney. June 2002.

SAR*Bayes*: Predicting Lost Person Behavior. National Association for Search & Rescue conference (NASAR 2002), Charlotte. 30 May - 2 June, 2002. sarbayes.org/nasar.pdf

Type & token causation in Bayesian networks. (with Kevin Korb) Australian Association for the History, Philosophy, and Social Studies of Science, Univ. of Melbourne. 25-28 June, 2001.

Causal Perception. Australian Association for Philosophy, Univ. of Queensland, St. Lucia. July 2-7, 2000.

Hume, Newton, & Maclaurin. 27th Annual Hume Conference, Williamsburg. July 24-29, 2000.

Causation, Causal Perception, and Conservation. Society for Philosophy and Psychology, Stanford Univ., Palo Alto. Poster. June 17-22, 1999.

Causal Perception and Philosophy of Science, Mephistos 1998. Univ. of Minnesota, Minneapolis. September 1998.

Astronomy in Maya Hieroglyphic Sources. Mexican Codices and Archeology: an international symposium. Indiana Univ., Bloomington. December 1997.

The ubiquitous, elusive Vander Weyde and his telephone. Fourth International Symposium on Telecommunications History, Denver. June 19-20, 1996.

Alexander Graham Bell's notebooks and the world-wide web: a case for hypertext scholarship. With Michael E. Gorman. SHOT/4S, Charlottesville. October 21-24, 1995.

TIME as an addition to Kitcher's philosophy of scientific explanation. Mephistos 1995, Indiana Univ., Bloomington. April 1995.

Science below the line of demarcation? The history and philosophy of Mayan cosmology. Mephistos 1994, Harvard, Boston. 1994.

ACADEMIC
TALKS

Probabilistic causation in Bayesian networks. University of New South Wales philosophy seminar. October 2003.

Causation in Bayesian Networks. Cognitive Lunch weekly seminar, Indiana University Cognitive Science program, Sep. 2002.

Aspects & Avatars of Causation in Bayesian Networks

- August 2001: MINDforum, Monash University Philosophy & Psychology reading group.
- September 18 2001: HPS Departmental Seminar, Univ. of Melbourne.
- October 19, 2001: Quantitative Modeling Group Seminar, Dept. of Psychology, Univ. of Melbourne.

Causation, Causal Perception, and Conservation. Computer Science & Software Engineering Seminar, June 2000.

Charles R. Twardy

- PUBLIC TALKS Aviation before the Wright Brothers. Experimental Aircraft Association, Chapter 604, Bloomington, IN. October, 1999.
- REVIEWS Review of Jon Williamson's *Bayesian Networks and Causality*. In *International Studies in the Philosophy of Science*, 2006 forthcoming.
- Review of Clark Glymour's *Arrows of the Mind*. In *Philosophy of Science*, July 2005. (72:3).
- "Notes on Cooper et al 2004: Compatibility of Land SAR Procedures with Search Theory ". <http://sarbayes.org/cooper.shtml>
- "Notes on 'Controversial Topics in Inland SAR Planning, Draft Feb. 2004' ". <http://sarbayes.org/newsar.shtml>
- Review of Phil Dowe's *Physical Causation*. In *Philosophy of Science*, June 2001. (68:2 266-268).
- Review of Basilio Catania's *Antonio Meucci, the Inventor and His Times*. "Antonio Meucci-L'Inventore e il suo tempo." *Technology & Culture*, January 2000. http://muse.jhu.edu/journals/technology_and_culture/v041/41.1twardy.html
- PROFESSIONAL ACTIVITIES Reviewer (2007): AAAI
- Reviewer (2004): several computer science conferences
- Organized (with Kevin Korb): Causal Inference (with attention to Bayesian networks), symposium at the Joint International Conference on Cognitive Science (Sydney, July 2003)
- Organized (with Kevin Korb): Melbourne Bayes Net Workshop: Modeling with Bayesian Networks. (July 2003)
- Reviewer (2003): Cognitive Science Society annual conference, International Conference on Machine Learning, Uncertainty in Artificial Intelligence
- Organized (with Kevin Korb): Causation & Bayesian Networks, double-session symposium & workshop at PSA 2002 (Philosophy of Science Association annual conference, November 2002).
- Reviewer: *Philosophical Papers* (2002)
- Reviewer: *Philosophy of Science*. (since 2000)
- Organized: Mephistos 1995 Graduate Student Conference in History, Philosophy, and Sociology of Science, Technology, and Medicine. Bloomington. (Spring 1995)
- WORK HISTORY
- ◇ **Senior Scientist**, OnLine Star, Inc. [OLS] (2007-present)
 - Project Scientist**, Information Extraction & Transport, Inc. [IET] (2005–2007) (In mid-2007, the research core of IET became OLS.)
 - Research, analysis and modeling, including: Bayesian credibility models for ONR, hierarchical Bayesian fusion model for NGA, background research & cluster analysis on rootkits for DARPA; Bayesian network approaches to game theory, and a report on cognitive decathlon design to DARPA; sensor fusion; probabilistic logic
 - Proposals: SBIR/STTR & BAA

Charles R. Twardy

- ◇ **Self-employed**, Prior Analytics (2005-2006)
 - Created the Australian Lost Person Behavior report, helped develop the International SAR Incident Database, & automated the analysis and report generation for these. (The project was funded by a USDA SBIR grant to Hummingbird Consulting.)
- ◇ **Research Fellow**, Monash University Computer Science & Software Engineering (2000-2005)
 - Developed Bayesian network theories of causation: showed flaws in previous accounts of causal unanimity, and created a more general account of “type” causation accounting for complicated interactions. Demonstrated that empirical data is actually compressible, contra McAllister’s published claims. Published an article beginning to unite process and counterfactual theories.
 - Wrote a winning ARC-funded grant Bayesian Networks for Epidemiology. (AU\$150K.) In my year on the grant I compared existing risk models of coronary heart disease using machine-learning metrics, and developed new models using Bayesian networks. The Bayesian models did nearly as well, with a simpler structure.
 - Consulted for projects on fog forecasting at Sydney airport, farming impact on sea grass population at the Great Barrier Reef, applying search theory to weed eradication, identifying biological cohorts in Murray Cod, numerical taxonomy of leeches, and water quality in Sydney Harbour. Some of these were student projects I supervised.
 - Founded the *SARBayes* project for predicting lost person behavior: established the Australian lost person database; developed software for optimal resource allocation (managed, designed, contributed)
 - Methods: unsupervised classification (clustering), Bayesian networks, decision trees, standard regression and summary statistics, exploratory data analysis.
 - Teaching: CSSE senior project (9 stus), informal logic class (200 students, co-taught), critical thinking (150 stus + 1 tutorial), philosophy of science (tutorial, 15 stus). Supervision of honours (senior) projects.

TEACHING EXPERIENCE ◇ **Instructor**: Stratford University (2008 Q3). BUS 520 “Research Methods” – *scheduled.*)

- ◇ **Instructor**: Stratford University (2008 Q2. SCI 410 “Impact of science & technology on business & industry.”)
- ◇ **Distance Instructor**: Stratford University (Fall 2005). SCI 410 “Impact of science & technology” (online) and SCI 110 “General science” (online)
- ◇ **Instructor**, Melbourne University Philosophy (Fall 2002). PHIL 161-003: Critical Thinking. (150 students, 12 in tutorial session)
- ◇ **Teaching Assistant**, Melbourne University History & Philosophy of Science (Fall 2002). HPS 136-034: Science, Life, & Mind (taught by Neil Thomason). (1 tutorial section: 15 students)
- ◇ **Instructor**, Monash University Computer Science & Software Engineering (Fall 2001). CSE3301 3rd -year (senior) project: Software for Search & Rescue. (9 students).

Charles R. Twardy

- ◇ **co-Instructor**, Monash University Philosophy (Fall 2001). First-year informal logic. (200 students).
 - ◇ **Instructor**, Indiana University (Spring 1998). Taught HPSC X100 Invention and Discovery. (15 students)
 - ◇ **Instructor**, Indiana University (Fall 1997). Taught HPSC X100 Invention and Discovery. (28 students)
 - ◇ **Reading Supervisor**, Indiana University (Fall 1996). HPSC X300 Independent Readings in Archaeoastronomy. (1 student)
 - ◇ **Teaching Assistant**, Indiana University (Fall 1996). HPSC X100: Ancient Science, Modern Superstition. (Office hours, review sessions, grading papers for Prof. Michael Dickson.)
- RESEARCH PROJECTS
- ◇ **SARBayes** Collecting and analyzing data on lost-person behavior using Bayesian networks, and developing software tools to improve search management. Formal search theory. Perception.<http://sarbayes.org>
 - ◇ **Unified Causation** Integrating a process theory of causation into a Bayesian causal modeling framework. Automated causal inference. *Testing* theories of causation.
 - ◇ **Machine Learning** AI techniques (esp. Bayesian networks) applied to epidemiology, environmental science (esp. invasives), search & rescue, meteorology, object recognition.
- RESEARCH INTERESTS
- Philosophy of science, cognitive science, induction, causation, causal reasoning, inference & perception, Bayesian models of causal reasoning, teaching critical thinking, invention & discovery, search theory.
- THESIS SUPERVISION
- ◇ **Honors Thesis:** James Bernard (2004): *Building Bayesian Models for the Analysis of Critical Knowledge Gaps in Australian Freshwater Fish*. Monash CSSE. With David Green.
 - ◇ **Honors Thesis:** Don Permezel (2004): *Open Source Software: Adding the Snob Clustering Algorithm to Gnumeric*. (External supervisor for Electrical Engineering Student.)
 - ◇ **Honors Thesis:** Shannon Watson (2003): *Modeling water quality in Sydney Harbour with Bayesian Networks*. Monash CSSE. With Ann Nicholson.
 - ◇ **Honors Thesis:** Adam Golding (2001), *SARbayes: Bayesian Networks in Search & Rescue*. Monash CSSE. With Kevin Korb.
- PROJECT SUPERVISION
- ◇ **Extended Chess:** CSSE 1st/2nd-year advanced project (2003): Create an electronic game similar to Steve Jackson's Knightmare™ Chess. 2 students learned Python and Pygame, created a working chess program and then extended it to allow for playing cards to modify the rules. With Nathan Hurst.
 - ◇ **SORAL: SARBayes Optimal Resource Allocation Library:** 3 students over 2 summers (2002, 2003). Modular C++ library of advanced resource allocation algorithms for SAR. Extensive documentation. Supervised and participated. With David Albrecht.
- ACADEMIC MEMBERSHIP
- American Philosophical Association
Philosophy of Science Association