

Entry for *International Directory of Logicians*, 2008

VAN BENTHEM, Johannes Franciscus Abraham Karel

Specialties: Modal logic, epistemic logic, dynamic logic, logics of time and space, semantics of natural language: generalized quantifiers and categorial grammars, substructural proof theory, philosophical logic, logics of computation, information update and interaction, logic and games.

Born: 12 June 1949 in Rijswijk, Zuid-Holland, Netherlands.

Education: University of Amsterdam, PhD Mathematics, 1977; MSc Mathematics, 1973; MA Philosophy, 1972; BSc Physics 1969.

Dissertation: *Modal Correspondence Theory*; supervisor Martin Löb.

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Regular Academic or Research Appointments: UNIVERSITY PROFESSOR, PURE AND APPLIED LOGIC, UNIVERSITY OF AMSTERDAM 2003–; PROFESSOR, PHILOSOPHY, STANFORD UNIVERSITY 2005–; University of Amsterdam, Mathematics and Computer Science, 1986–2003; University of Groningen, Philosophy and Mathematics, 1977–1986; University of Amsterdam, Philosophy, 1973–1977.

Visiting Academic or Research Appointments: Visiting University Professor, Sun Yat-Sen University, Guangzhou, 2005–; Bonsall Chair, Stanford University, 1991–2005; Senior Researcher, Center for the Study of Language and Information, Stanford, 1988–; Simon Fraser University, Burnaby, Mathematics, 1984.

Research Profile: In the 1970s, van Benthem worked in the ‘correspondence theory’ of modal axioms and their definability in first- and higher-order logics. A spin-off was the theorem characterizing the modal language as consisting of just those first-order formulas that are invariant for bisimulation. Cf. *Modal Correspondence Theory*, 1977, *Modal Logic and Classical Logic*, 1983. Recent publications in this line are about modal model theory for infinitary languages (J. Barwise & J. van Benthem, 1999, ‘Interpolation, Preservation, and Pebble Games’, *Journal of Symbolic Logic* 64:2, 881–903), modal fixed-point languages (‘Minimal Predicates, Fixed-Points, and Definability’, *Journal of Symbolic Logic* 70:3, 696–712, 2005; ‘Modal Frame Correspondences and Fixed-Points’, *Studia Logica* 83:1, 133–155, 2006), and modal abstract model theory (‘Lindström Theorems for Fragments of First-Order Logic’, *Proceedings LICS 2007*, 280–292, with Balder ten Cate and Jouko Väänänen).

Around 1980 van Benthem turned to the philosophy of science (‘The Logical Study of Science’, *Synthese* 51, 1982, 431–472), and temporal point- and interval-ontology: *The Logic of Time*, 1983. A related theme are logics of topology, and geometry (M. Aiello & J. van Benthem, ‘A Modal Walk Through Space’, *Journal of Applied Non-Classical Logic* 12, 2004, 319–363; J. van Benthem & G. Bezhanishvili, 2007, ‘Modal Logics of Space’, *Handbook of Spatial Logics*, 217–298).

In the later 1980s, van Benthem switched to natural language. His *Essays in Logical Semantics* (1986) is about semantic universals and expressive power for generalized quantifiers, with classification theorems in terms of the ‘Number Tree’, monotonicity properties, and automata complexity. There is also a first calculus of ‘natural logic’ for reasoning directly on linguistic surface form, using type-theoretic derivation with monotonicity marking. This work led to a study of categorial grammars as resource-bounded substructural proof systems. Results include a semantics for meaning composition via ‘linear lambda terms’, the study of expressive power and semantic constraints in finite type hierarchies, a general account of logicity as permutation invariance, and systematic connections between proof-theoretic and grammatical issues. Most of this work is collected in the book *Language in Action*, 1991.

In the 1990s, van Benthem returned to modal logic, now with a view to computation. Results include a characterization of the regular operations on imperative programs as those that are ‘safe for bisimulation’, and a first-order model theory of process equivalences (J. van Benthem & J. Bergstra, 1995, ‘Logic of Transition Systems’, *Journal of Logic, Language and Information* 3, 247–283). Modal techniques also brought to light decidable ‘core versions’ of undecidable computational formalisms, such as ‘arrow logic’: a decidable version of relational algebra. Another side of this coin was the discovery of the ‘Guarded Fragment’, a new large decidable part of first-order logic (H. Andréka, J. van Benthem & I. Németi, 1998, ‘Modal Logics and Bounded Fragments of Predicate Logic’, *Journal of Philosophical Logic* 27, 217–274). This work is collected in the monograph *Exploring Logical Dynamics*, 1996.

Van Benthem's key interest since his Spinoza project ‘*Logic in Action*’ (1996–2001) is ‘logical dynamics’, making actions of inference, observation, information update, belief revision, or preference change first-class citizens. These come together in the study of rational agency using *dynamic-epistemic logics* (‘One is a Lonely Number’, Z. Chatzidakis et al., eds., 2006, *Logic Colloquium '02*, A.K. Peters, Wellesley, 96–129; ‘Logics of Communication and Change’, *Information and Computation* 204, 2006, 1620–1662, with Jan van Eijck and Barteld Kooi; ‘Dynamic Logic of Belief Change’, *Journal of Applied Non-Classical Logics* 17, 2007, 129–155). In this view, logic is essentially about multi-agent communication, and ‘intelligent interaction’. This leads to new interfaces between logic and game theory (*Logic in Games*, ILLC, Amsterdam; ‘Games in Dynamic Epistemic Logic’, *Bulletin of Economic Research* 53, 2001, 219–248; ‘Extensive Games as Process Models’, *Journal of Logic, Language and Information* 11, 2002, 289–313; ‘Logic Games are Complete for Game Logics’, *Studia Logica* 75, 2003, 183–203; ‘Rational Dynamics’, *International Game Theory Review* 9, 2007, 377–409). This new take on what logic is about also seems highly relevant to its past and future interfaces with philosophy (‘Logic in Philosophy’, in D. Jacquette, ed., 2007, *Handbook of the Philosophy of Logic*).

In Amsterdam, van Benthem holds the chair of Evert Willem Beth, created in 1950, whose broad view of logic in between philosophy, mathematics, computer science, linguistics, cognitive psychology, and even rational public debate, now lives on in the Institute for Logic, Language and Computation. His position at Stanford is at a similar interdisciplinary interface, against the backdrop of the Center for the Study of Language and Information, pioneered by Jon Barwise and others in the early 1980s.

Main Publications: Major book publications:

1. *The Logic of Time* (1983, 1991),
2. *Modal Logic and Classical Logic* (1985),
3. *Essays in Logical Semantics* (1986),
4. *Language in Action* (1991, 1995),
5. *Exploring Logical Dynamics* (1996),
6. *Logic in Games* (2001).

Some 350 papers in journals and books, plus some 50 items for a general public.

Textbooks: *Logic, Language and Meaning* (1982, 1991; with collective GAMUT; Dutch, English, and Spanish versions), *A Manual of Intensional Logic* (1988), *Logica voor Informatica* ('Logic for Computer Science', 1991, 2003; with four co-authors), and *Hoe Wiskunde Werkt* ('How Mathematics Works', 2004; with two co-authors).

A Chinese translation series of selected papers will appear in Beijing, starting 2008, under the title 逻辑之门 ('A Door to Logic').

Teaching: Supervised 54 master's theses, and 60 Ph.D. dissertations in logic, broadly conceived. 43 Ph.D. students have tenured positions, some 17 as full professors, 10 are postdocs, 6 work in ICT and banking, and one is an independent artist. Courses taught range from pure to applied logic in many departments (philosophy, mathematics, computer science, linguistics, economics). Current major interest: producing new generation textbooks within disciplines based on modern logic, and spreading logic as a general culture item to broader audiences, outside of Academia.

Service to the Profession: Program Chair, First Chinese Conference on Logic, Rationality and Interaction, Beijing, 2007; Fellow, Games, Action, and Social Software, Netherlands Institute for Advanced Studies NIAS, 2006; Program Committee, First Indian Conference on Logic and its Relation with Other Disciplines, IIT Bombay, 2005; Area Chair, Philosophical Logic, 12th International Congress of Logic, Methodology & Philosophy of Science, Oviedo, 2002; Program Director, First American Summer School in Logic, Language and Computation, Stanford, 2002; General Chair, TIME, Udine, 2001; Chair, Dutch National Program for Cognitive Science, 2001–2004; Program Chair *TARK*, Siena, 2001; Treasurer, Beth Foundation, Amsterdam, 2001–; Chair, Vienna Circle Archive, Amsterdam, 1999–; Vice-President, International Federation for Computational Logic, 1999–; General Program Chair, 11th International Congress of Logic, Methodology & Philosophy of Science, Florence, 1997; Program Chair, CSLI Workshops in Logic, Language & Computation, Stanford, 1992–2002; First President, European Foundation for Logic, Language and Information FoLLI, 1989–1995; Founding Director, Institute for Logic, Language and Computation ILLC, Amsterdam, 1986–1998; President, Dutch Association of Logic, 1979–1984; Chair, Departments of Philosophy, Mathematics, and Computer Science, Amsterdam and Groningen, 1973–1993.

Editor, Handbook of the Philosophy of Information, 2008; Editor, Handbook of Spatial Logics, 2007; Editor, Handbook of Modal Logic, 2006; Editor-in-Chief, Texts

in Logic and Games, 2006–; Managing Editor Synthese, 2005–; Managing Editor, Transactions on Computational Logic, 2005–; Editor, Handbook of Logic and Language, 1997; Managing Editor, Journal of Logic, Language and Information, 1991–1996; Managing Editor, Logic and Computation; 1990–1995; Managing Editor, Linguistics and Philosophy, 1989–1992; Coordinating Editor, Journal of Symbolic Logic, 1989–1993; Nominating Editor, The Philosopher's Annual, 1988–; Member Editorial Board of 15 further journals. Editor of 13 anthologies and proceedings.

Vision Statement: Logic is becoming a general study of inference, information flow, computation, and intelligent interaction, extending far beyond traditional concerns with 'valid consequence', and drawing upon many sources, from mathematics to cognitive science. We need this agenda expansion to, not just prove our consistency, but justify our existence today. I hope that this will lead to new fundamental insights on a par with the intellectual peaks of the 1930s which still awe us. Viewed in this way, logic is a core subject of benefit across Academia. My ambition is to make it even a part of basic intellectual education in high schools, and for a general public.

Honours and Awards: Honorary Member, European Foundation of Logic, Language and Information, 2005; University Professor, University of Amsterdam, 2003; Hollandsche Maatschappij van Wetenschappen, 2002; Institut International de Philosophie, 2001; Doctor h.c., Université de Liège, 1998; Dutch National Spinoza Prize, 1996–2001; Who's Who International (1995, 2004, 2007); Royal Dutch Academy of Arts and Sciences KNAW 1992; Academia Europaea, 1991.