



HANDBOOK OF CATEGORIZATION IN COGNITIVE SCIENCE

EDITED BY: **Henri Cohen and Claire Lefebvre**



“Anyone concerned with language, semantics, or categorization will want to have this encyclopedic collection.”

Professor Eleanor Rosch, Dept of Psychology, University of California, Berkeley, USA

HANDBOOK OF CATEGORIZATION IN COGNITIVE SCIENCE

Edited by

HENRI COHEN

Universite du Quebec a Montreal, Quebec, Canada

and

CLAIRE LEFEBVRE

Universite du Quebec a Montreal, Quebec, Canada

2005



ELSEVIER

Amsterdam • Boston • Heidelberg • London • New York • Oxford • Paris
San Diego • San Francisco • Singapore • Sydney • Tokyo

ELSEVIER B.V.
Sara Burgerhartstraat 25
P.O. Box 211
1000 AE Amsterdam
The Netherlands

ELSEVIER Inc.
525 B Street, Suite 1900
San Diego, CA 92101-4495
USA

ELSEVIER Ltd
The Boulevard
Langford Lane Kidlington
Oxford OX5 1GB
UK

ELSEVIER Ltd
84 Theobalds Road
London WC1X 8RR
UK

© 2005 Elsevier Ltd. All rights reserved.

This work is protected under copyright by Elsevier Ltd, and the following terms and conditions apply to its use:

Photocopying

Single photocopies of single chapters may be made for personal use as allowed by national copyright laws. Permission of the Publisher and payment of a fee is required for all other photocopying, including multiple or systematic copying, copying for advertising or promotional purposes, resale, and all forms of document delivery. Special rates are available for educational institutions that wish to make photocopies for non-profit educational classroom use.

Permissions may be sought directly from Elsevier's Rights Department in Oxford, UK; phone (+44) 1865 843830, fax (+44) 1865 853333, e-mail: permissions@elsevier.com. Requests may also be completed on-line via the Elsevier homepage (<http://www.elsevier.com/locate/permissions>).

In the USA, users may clear permissions and make payments through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA; phone: (+1) (978) 7508400, fax: (+1) (978) 7504744, and in the UK through the Copyright Licensing Agency Rapid Clearance Service (CLARCS), 90 Tottenham Court Road, London W1P 0LP, UK; phone: (+44) 20 7631 5555; fax: (+44) 20 7631 5500. Other countries may have a local reprographic rights agency for payments.

Derivative Works

Tables of contents may be reproduced for internal circulation, but permission of the Publisher is required for external resale or distribution of such material. Permission of the Publisher is required for all other derivative works, including compilations and translations.

Electronic Storage or Usage

Permission of the Publisher is required to store or use electronically any material contained in this work, including any chapter or part of a chapter.

Except as outlined above, no part of this work may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission of the Publisher.

Address permissions requests to: Elsevier's Rights Department, at the fax and e-mail addresses noted above.

Notice

No responsibility is assumed by the Publisher for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. Because of rapid advances in the medical sciences, in particular, independent verification of diagnoses and drug dosages should be made.

First edition 2005

Library of Congress Cataloging in Publication Data

A catalog record is available from the Library of Congress.

British Library Cataloguing in Publication Data

A catalogue record is available from the British Library

ISBN: 0 08 044612-4

∞ The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).
Printed in The Netherlands.

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER

BOOK AID
International

Sabre Foundation

HANDBOOK OF CATEGORIZATION IN COGNITIVE SCIENCE

PREFACE

The content of most of the chapters in this book was presented as part of the Summer Institute on categorization that took place at the Université du Québec à Montréal (UQAM) for 10 days in June and July 2003. The objective of this Institute was to address the problem of categorization through the lens of all the disciplines that are at the heart of the Cognitive Sciences: Cognitive Anthropology, Linguistics, Philosophy, Neuroscience, Psychology and Cognitive Computer Science. This book is a natural, concrete outcome of the Institute.

In planning this book, we wanted all aspects of categorization to be represented. We therefore filled the holes in the original program by soliciting contributions from researchers who had not been involved directly in the Summer Institute on categorization. In its present form, the book contains some 50 chapters. To our knowledge, it is the first time in history that the problem of categorization has been considered from so many angles within a single book.

We would like to thank the members of the scientific committee of the Summer Institute for their contributions, which have had a major impact on the contents of this book (Henrietta Cedergren for Linguistics, Pierre Poirier for Philosophy, Henri Cohen for Neuroscience, Stevan Harnad for Psychology, Bernard Lefebvre for Cognitive Computer Science, and Claire Lefebvre as the Director of the Institute). We would like to thank Robert Proulx, Dean of the Faculty of Human Sciences, for his support throughout. The financial contribution from the Faculty enabled us to prepare this exceptionally large manuscript. Last but not least, we are grateful to Zofia Laubitz, Marlene Busko, and Sanja Obradović for making an important contribution by copy-editing and finalizing the manuscript.

Henri Cohen
Claire Lefebvre

LIST OF CONTRIBUTORS

Archambault, Annie

Département de Psychologie, C.P. 6128, Succ. Centre-ville, Montreal, QC, H3C 3J7 Canada.

Ashby, F. Gregory

Department of Psychology, University of California, Santa Barbara, CA 93106, USA.

Baker, Mark C.

Department of Linguistics, Rutgers University, 18 Seminary Place, New Brunswick, NJ 08901, USA.

Barsalou, Lawrence W.

Department of Psychology, Emory University, Atlanta, GA, 30329, USA.

Biskri, Ismail

Département de mathématique et d'informatique, Université du Québec à Trois-Rivières, 3351 Boul. des Forges, Trois-Rivières, G9A 5H7 Canada.

Blair, Mark

Psychology building, 1101 E 10th Street, Indiana University, Bloomington, IN 47405-7007, USA.

Blais, Caroline

Département de Psychologie, Université de Montréal, C.P. 6182, Succ. Centre-ville, Montreal, QC, H3C 3J7 Canada.

Boster, James S.

Department of Anthropology, U-2176, 354 Mansfield Road, University of Connecticut, Storrs, CT 06269-2176, USA.

Bouchard, Denis

Département de Linguistique, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Cangelosi, Angelo

Adaptive Behaviour and Cognition Research Group, School of Computing, Communications and Electronics, University of Plymouth, Portland Square A316, Plymouth PL4 8AA, UK.

Clark, Eve V.

Department of Linguistics, Margaret Jacks Hall (Bldg 460), Stanford University, Stanford, CA 94305-2150, USA.

Cohen, Henri

Cognitive Neuroscience Center, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Cook, Richard S.

University of California at Berkeley, 1203 Dwinelle Hall, Berkeley, CA 94720-2650, USA.

Cousineau, Denis

Université de Montréal, C.P. 6128, Succ. Centre-ville, Montreal, QC, H3C 3J7 Canada.

Cutler, Anne

Max Planck Institute for Psycholinguistics, PO Box 310, 6500 AH Nijmegen, The Netherlands.

De Pasquale, Jean-Frédéric

Département d'informatique, U. du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Diday, Edwin

Paris IX Dauphine University, Place du Maréchal de Lattre de Tassigny, Bureau B633, 75775 Paris cedex 16, France.

Dubois, Didier

CNRS, Porte 308, IRIT, Université Paul Sabatier, 118 route de Narbonne, 31062, Toulouse, cedex 4, France.

Dubuisson, Colette

Département de Linguistique, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Eliasmith, Chris

Department of Philosophy, University of Waterloo, Waterloo, ON, N2L 3G1 Canada.

Esteva, Francesc

IIIA – Institut d'Investigació en Intel·ligència Artificial, CSIC – Spanish Scientific Research Council, Campus Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain.

Faucher, Luc

Département de philosophie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Filoteo, J. Vincent

UCSD/VA, 3350 La Jolla Village Drive, San Diego, CA 92161-116A, USA.

Forest, Dominic

Département de Philosophie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Gärdenfors, Peter

Cognitive Science, Kungshuset, Lundagård, Lund University, SE-222 22 Lund, Sweden.

Gil, David

Department of Linguistics, Max Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, Leipzig 04103, Germany.

Gillon, Brendan S.

Department of Linguistics, McGill University, 1085 Doctor Penfield Avenue, Montreal, QC, H3A 1A7, Canada.

Godo Lacasa, Lluís

Institut d'Investigació en Intel·ligència Artificial (IIIA), Consejo Superior de Investigaciones Científicas (CSIC), 08193 Bellaterra, Spain.

Goldstone, Robert R.

Psychology building, 1101 E 10th Street, Indiana University, Bloomington, IN 47405-7007, USA.

Gosselin, Frederic

Département de Psychologie, Université de Montréal, C.P. 6182, Succ. Centre-ville, Montreal, QC H3C 3J7 Canada.

Goudbeek, Martijn

Max Planck Institute for Psycholinguistics, P.O. Box 310, 6500 AH Nijmegen, The Netherlands.

Hanson, Catherine

Psychology Department, Rutgers University, 101 Warren St., Newark, NJ 07102, USA.

Hanson, Stephen Jose

Psychology Department, Rutgers University, 101 Warren St., Newark, NJ 07102, USA.

Hardy-Vallée, Benoît

Institut Jean-Nicod, UMR 8129, Ibis, Avenue de Lowendal, F-75007 Paris, France.

Harnad, Stevan

Cognitive Neuroscience Center, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville Montreal, QC, H3C 3P8 Canada.

Hélie, Sébastien

Laboratoire d'Études en Intelligence Naturelle et Artificielle, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Kay, Paul

International Computer Science Institute, Berkeley, ICSI, 1947 Center St, Suite 600 Berkley, CA 94704-1198, USA.

Kodratoff, Yves

CNRS, LRI, Université Paris-Sud XI, 91405 Orsay, France. Tel.: 33-1 69156904; Fax: 33-1 69156586; E-mail: yk@lri.fr

Labelle, Marie

Département de linguistique, Université du Québec à Montréal, C.P. 8888, Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Lalumera, Elisabetta

Dipartimento di Discipline della Comunicazione, Università degli Studi di Bologna, Via A. Gardino 23, 40131, Bologna, Italy.

Larochelle, Serge

Département de Psychologie, Université de Montréal Université de Montréal, C.P. 6128, Succ. Centre-ville, Montreal, QC, H3C 3J7 Canada.

Lefebvre, Claire

Département de linguistique et didactique des langues, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Lillo-Martin, Diane

Department of Linguistics, University of Connecticut, 337 Mansfield Road, Unit 1145, Storrs, CT 06269-1145, USA.

Machery, Edouard

Department of History and Philosophy of Science, University of Pittsburgh, CL 1017, Pittsburgh, PA 15260, USA.

Maddox, W. Todd

Department of Psychology and Institute for Neuroscience, 1 University Station A 8000, University of Texas, Austin, TX, 78712, USA.

McCabe, Éric

Département de Psychologie, Université de Montréal, C.P. 6182, Succ. Centre-ville, Montreal, QC, H3C 3J7 Canada.

Meunier, Jean-Guy

Département de Philosophie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Millikan, Ruth* Gerrett

Department of Philosophy, U-2054, University of Connecticut, Storrs, CT 06269-2054, Office: 202 Manchester Hall, USA.

Mineau, Guy

Faculty of Sciences and Engineering, Department of Computer Science and Software Engineering, Université Laval, Québec, QC, G1K 7P4 Canada.

Muysken, Pieter

Linguistics, Radboud University, Nijmegen. Postbus 9103, Nijmegen, The Netherlands.

Napoli, Amedeo

LORIA, LORIA, B.P. 239, 54506 Vandoeuvre les Nancy, France.

Nolfi, Stefano

Institute of Cognitive Sciences and Technologies, National Research Council (CNR), Viale Marx 15 00137 Rome, Italy.

Panaccio, Claude

Département de Philosophie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Papafragou, Anna

108 Wolf Hall, University of Delaware, Newark, DE 19716, USA.

Parisot, Anne-Marie

Département de Linguistique, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Pevtzow, Rachel

Psychology building, 1101 E 10th Street, Indiana University, Bloomington, IN 47405-7007, USA.

* Important: Pending upon Elsevier's permission to reproduce

Poirier, Pierre

Département de Philosophie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Poulin-Dubois, Diane

Psychology Department, Concordia University, 7141 Sherbrooke Street West, Montreal, QC, H4B 1R6 Canada.

Prade, Henri

CNRS, porte 307, IRIT, Université Paul Sabatier, 118 route de Narbonne, 31062, Toulouse, cedex 4, France.

Prinz, Jesse J.

Department of Philosophy, CB#3125, Caldwell Hall, University of North Carolina, Chapel Hill, NC 27599, USA.

Proulx, Robert

Faculté des Sciences Humaines, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Ravizza, Susan M.

Department of Psychology, UC Davis Imaging Research Center, 4701 X Street, Sacramento, CA 95817, USA.

Regier, Terry

Department of Psychology, University of Chicago, 5848 S. University Avenue, Office: Green 414, Chicago, IL 60637, USA.

Rey, Georges

Department of Philosophy, University of Maryland, College Park, MD 20742, USA.

Robert, Serge

Department of Philosophy, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC H3C 3P8 Canada.

Rogosky, Brian J.

Psychology building, 1101 E 10th Street, Indiana University, Bloomington, IN 47405-7007, USA.

Shi, Rushen

Département de Psychologie, Université du Québec à Montréal, C.P. 8888 Succ. Centre-ville, Montreal, QC, H3C 3P8 Canada.

Smits, Roel

Max Planck Institute for Psycholinguistics, Wundtlaan 1, P.O. Box 310, 6500 AH Nijmegen, The Netherlands.

Sowa, John F.

VivoMind LLC, 21 Palmer Avenue, Croton-on-Hudson, NY 10520, USA. Tel.: 914-271-5557; E-mail: sowa@bestweb.net

Swingley, Daniel

Department of Psychology, University of Pennsylvania, 3401 Walnut Street 302 C, Philadelphia, PA 19104, USA.

Thagard, Paul

Philosophy Department, University of Waterloo, Waterloo, ON, N2L 3G1 Canada. Tel.: 519-888-4567, ext 3594; Fax: 519-746-3097; E-mail: pthagard@uwaterloo.ca

Toombs, Ethan

Philosophy Department, University of Waterloo, Waterloo, ON, N2L 3G1 Canada.

Travis, Lisa deMena

McGill University, 1085 Dr. Penfield Avenue, Department of Linguistics, Montreal, QC H3A 1A7 Canada.

Valentin, Vivian V.

Department of Psychology, University of California Santa Barbara, CA 93106, USA.

White, Lydia

Department of Linguistics, McGill University, 1085 Dr. Penfield Avenue, Montreal, QC, H3A 1A7 Canada.

TABLE OF CONTENTS

See Color Plate Section at the back of this book

Preface v

Bridging the Category Divide
HENRI COHEN and CLAIRE LEFEBVRE

1. Introduction	2
2. Organization of the book	2
3. Major common themes	7
3.1. The notions of category and categorization	7
3.2. The nature of categories: Discrete, vague, or other	9
3.3. Are there modality effects on categories?	10
3.4. Are there universal categories? Are there innate categories?	11
4. Bridging the category divide	13
References	15

PART 1 – CATEGORIZATION IN COGNITIVE SCIENCE

Chapter 1

To Cognize is to Categorize: Cognition is Categorization
STEVAN HARNAD

Abstract	20
1. Sensorimotor systems	21
2. Invariant sensorimotor features (“affordances”)	21
3. Categorization	21
4. Learning	22
5. Innate categories	23
6. Learned categories	23
7. Supervised learning	24
8. Instrumental (operant) learning	24
9. Color categories	25
10. Categorical perception	25
11. Learning algorithms	26
12. Unsupervised learning	27
13. Supervised learning	27
14. Vanishing intersections?	28
15. Direct sensorimotor invariants	29

16. Abstraction and hearsay	30
17. Abstraction and amnesia	30
18. Invariance and recurrence	31
19. Feature selection and weighting	32
20. Discrimination versus categorization	32
21. Recoding and feature selection	33
22. Learned categorical perception and the Whorf hypothesis	34
23. Uncertainty reduction	35
24. Explicit learning	36
25. Categorization is abstraction	36
26. Sensorimotor grounding: direct and derivative	36
27. The adaptive advantage of language: hearsay	37
28. Absolute discriminables and affordances	39
29. Cognitive science is not ontology	39
30. Cognition is categorization	40
Appendix A. There is nothing wrong with the “classical theory” of categorization	40
Appendix B. Associationism begs the question of categorization	41
References	42

Chapter 2

A Modular Approach to Grammatical Categories Evidence from Language Diversity and Contact

PIETER MUYSKEN

Abstract	46
1. Introduction	47
2. Modularity and mismatch	48
3. Grammaticalization: The case of <i>pe</i> in Sranan (Suriname)	52
4. Mismatches in complexity of representations: The case of <i>ku</i> in Cuzco Quechua (Peru)	54
5. Lexical nondistinctness	55
5.1. The case of <i>timap</i> in Palikur	55
5.2. ‘For’ prepositions to become complementizers	56
5.3. Adjectives versus adverbs	57
6. Lexical overspecification: Dutch gender and definiteness	57
7. The status of null elements: Subjects in Sranan and Papiamentu	58
8. Partially overlapping categories: predicate adjectives in Creoles	59
9. Differences in lexical richness	60
10. Evidence from language contact	61
10.1. Otomanguean-Spanish language contact	62
10.2. Borrowing of content words in Salishan languages	65
11. Concluding remarks	67
Appendix	67
References	68

Chapter 3

Philosophical Analysis as Cognitive Psychology: The Case of Empty Concepts

GEORGES REY

Abstract	72
1. Introduction	73
2. Misadventures of the Classical View	73
3. Terminological issues	75
3.1. Existential vs. (purely) intentional usage	75
3.2. Concepts as between representations and referents	77
4. The inadequacies of Externalism	77
5. The need for internal roles	82
5.1. The Quinean challenge	82
5.2. The analytic data	83
5.3. Rivals to the Analytic Explanation	85
6. Conclusion	87
References	88

Chapter 4

Categories and Cognitive Anthropology

JAMES S. BOSTER

Abstract	92
1. Introduction	93
2. Cognition and culture, universalism and relativism	93
3. Paradigms and taxonomies	94
4. Kinship terminologies	101
5. Color classification	105
6. Ethnobiology	109
7. Towards a science of the stimulus	114
References	116

Chapter 5

Categorization in Neuroscience: Brain Response to Objects and Events

CATHERINE HANSON and STEPHEN JOSÉ HANSON

Abstract	119
1. Introduction	120
2. Representing object categories in the brain	121
2.1. Category-specific representation	122
2.2. Feature-specific representation	123
2.3. Process-specific representation	125
2.4. Summary	125
3. Acquiring category knowledge	126
3.1. Summary	130

4. Categorizing actions and events	130
4.1. The nature of event knowledge	130
4.2. When categorization of action fails	132
4.3. The perception of events	133
4.4. Summary	136
5. Conclusion	136
References	137

Chapter 6

Categorization in Cognitive Computer Science

JOHN F. SOWA

Abstract	141
1. Computation in cognitive science	142
2. The great categorization debates	144
3. From local features to global structures	148
4. Categorization and reasoning	153
5. Levels of cognition	158
References	161

PART 2 – SEMANTIC CATEGORIES

Chapter 7

Semantic Categorization

BRENDAN S. GILLON

Abstract	167
1. Introduction	168
2. The notional approach to lexical categories	169
3. The notional approach to lexical subcategories	170
4. Structural approach to semantic categories	172
5. Coordinators and subordinators	175
6. English nouns	181
7. Conclusion	184
Acknowledgments	184
References	184

Chapter 8

Emotion Categories across Languages

JAMES S. BOSTER

Abstract	188
1. Introduction	189
2. Methods of assessing cultural emotion systems	191
2.1. The Method of Translation	191
2.2. The Method of Mapping	198

3. Theories of emotion	210
4. Cross-cultural scenarios as a tool to compare emotion categories	213
5. Conclusion	218
References	220

Chapter 9

The World Color Survey Database

RICHARD S. COOK, PAUL KAY and TERRY REGIER

Abstract	224
1. Introduction	225
2. The WCS: History and methodology	225
3. Data processing and analysis	228
4. Cleaning the data	232
5. Original format of the data and creation of the WCS Online Data Archive	232
6. Uses of the WCS archive	234
6.1. Universals of color naming	234
6.2. Variation in color naming	237
7. Conclusion	240
References	240

Chapter 10

Atoms, Categorization and Conceptual Change

PAUL THAGARD and ETHAN TOOMBS

Abstract	243
1. Introduction	244
2. Theories of concepts	245
3. The ancient concept of an atom	246
4. Revival of the concept of the atom	248
5. Modern development of the concept of an atom	249
6. Theories and meaning	252
7. Conclusion	253
References	253

Chapter 11

Relations between Language and Thought: Individuation and the Count/Mass Distinction

ANNA PAPAFRAGOU

Abstract	256
1. Introduction	257
2. Strong discontinuity proposals	260
2.1. Quine	260
2.2. Abstract individuation in language and thought	262