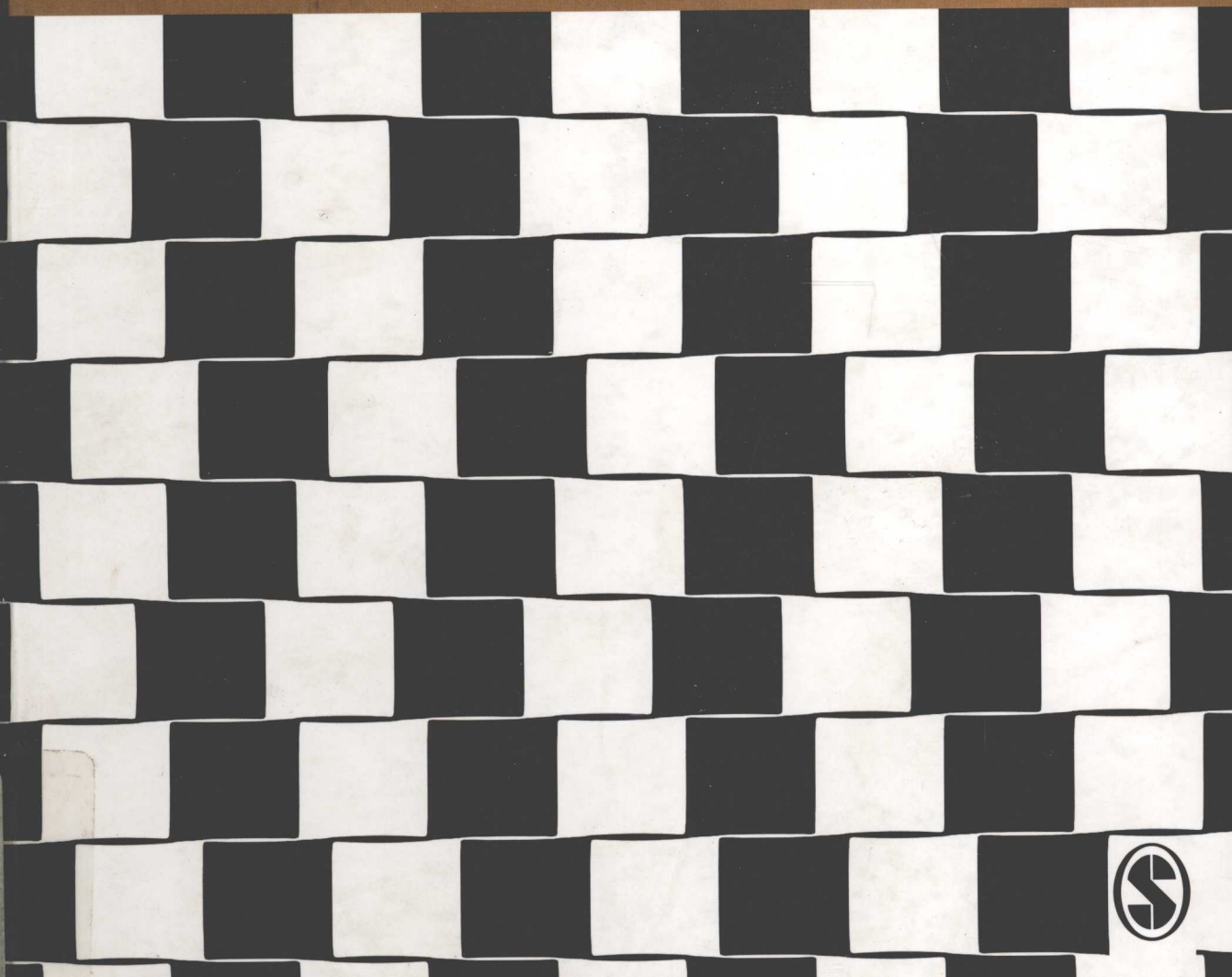
Advances in Cognitive Science

VOLUME 1

Edited by
Narayanan Srinivasan
A.K. Gupta
Janak Pandey



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List of Abbreviations

AI	Artificial Intelligence
ANCOVA	Analysis of Covariance
ANN	Artificial Neural Nets
ANOVA	Analysis of Variance
CARG	Cognitive Anthropology Research Group
CAS	Cognitive Assessment System
CBCS	Centre for Behavioural and Cognitive Sciences
CBL	Constraint-Based Lexicalist
CFG	Context-Free Grammar
CMS	Computer Models and Simulations
CPM	Coloured Progressive Matrices
CS	Conditioned Stimulus
CT	Computational Topography
DA	Dry Agriculture
DID	Dissociative Identity Disorder
DIF	Differential Item Functioning
DPEP	District Primary Education Project
EC	Extra-unit Connectedness
EEG	Electroencephalogram
EPDA	Embedded Push-down Automata
EPSP	Excitatory Post-Synaptic Potential
ERPs	Event Related Potentials
ESP	Extra-Sensory Perception
FCD	Functional Coordination Deficit
fTCD	Functional Transcranial Doppler Sonography
FHN	FitzHugh–Nagumo
fMRI	Functional Magnetic Resonance Imaging
FoR	Frames of Reference
GraPHIA	Graphical Phonological Humor Identification Algorithm
GTVH	Global Theory for Verbal Humor
HG	Hunting–Gathering
HWT	Hidden Words Test
IA	Irrigation Agriculture
ICC	Immuno-Cytochemical
ID	Intra-unit Distinctiveness
IEGs	Immediate Early Genes
IQs	Intelligent Quotients
IR	Incongruity-Resolution
ITFs	Inducible Transcription Factors
JAPE	Joke Analysis and Production Engine
KE	Knowledge Extraction
KR	Knowledge Resources
LGN	Lateral Geniculate Nuclei
LH	Left Hemisphere
LIBJOG	Light Bulb Joke Generator
LOT	Locating Objects Test
LRFB	Left-Right-Front-Back
LTAG	Lexicalized Tree-Adjoining Grammar
LTM	Long-term Memory
MEG	Magneto-encephalography
MRI	Magnetic Resonance Imaging
mV	Membrane Potential
NIMHANS	National Institute of Mental Health and Neurosciences
NIRS	Near Infrared Spectrometry
NMDA	N-methyl D-aspartate
NSEW	North-South-East-West
OET	Object Enumeration Test
OVS	Object Verb Subject
PDA	Pushdown Automata
PET	Positron Emission Tomography
RA	Relative Absolute
RH	Right Hemisphere

RHD	Right Hemisphere Damage
RLFB	Right, Left, Front and Back
RPM	Raven's Progressive Matrices
RT	Reaction time
SES	socio-economic status
SFB	Senguin Form Board
SLD	Specific Learning Disability
SOA	Stimulus Onset Asynchrony
SPEFT	Story–Pictorial Embedded Figures Test
SPM	Standard Progressive Matrices
SR	Success Rate
SRT	Syllogistic Reasoning Test
SSTH	Semantic Script Theory of Humor
STM	Short-term Memory
TMS	Transcranial Magnetic Stimulation
TRN	Thalamic Reticular Nucleus
TTX	Tetrodotoxin
UWT	Unfamiliar Words Test
VCT	Visual Closure Test
VSCCs	Voltage-sensitive Calcium Channels
WM	Working Memory

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Preface

In the last four decades, cognitive science has established itself as a truly inter-disciplinary science. Cognitive science is an intellectual enterprise that studies cognition and seeks to answer many fundamental and long-standing questions about the nature of mind and mental processes. The central assumption for cognitive science can be phrased as follows: 'The human mind is a complex system that receives, stores, retrieves, transforms and transmits information'. Here the mind is conceived as an information processor. Herbert Simon, a pioneer in cognitive science and artificial intelligence defines cognitive science as 'recognition of a fundamental set of common concerns shared by the disciplines of psychology, computer science, linguistics, economics, epistemology and social sciences generally'. Cognitive science is the multidisciplinary scientific study of cognition and its role in intelligent agency. It examines what cognition is, what it does, and how it works.

An important way in which cognitive science approaches the mind is to view the scientific study of the mind in terms of three levels of analysis proposed by David Marr for understanding cognition, namely, computational, algorithmic and implementational levels. While there have been disagreements about the three levels of analysis and the way they are related to each other, these levels of analysis provide a framework for understanding and studying cognition. Palmer and Kinchi discuss three assumptions of information processing approach: informational description, recursive decomposition and physical embodiment. These assumptions enable us to discuss mental states as informational events, specify an informational event at one level in terms of component informational events at a lower level, and use the concept of representations (states of the system that carry information) and processes (changes in states/representations).

Cognitive science employs qualitatively different research tools such as formal methods used to develop computational proofs, the programming techniques of computer science, the experimental practices of psychology, and a variety of paradigms (single-cell studies, lesions, neuroimaging) of neuroscience. Given the current advances, it is expected that cognitive science will become even more inter-disciplinary.

Cognitive science is not yet a flourishing discipline in India. Under the Universities Grants Commission (UGC) Scheme of Universities with Potential for Excellence, the University of Allahabad was selected for developing 'Behavioural and Cognitive Sciences' as an Island of Excellence. As a follow-up, the University established the Centre for Behavioural and Cognitive Sciences (CBCS) in 2002, for providing education of merit and distinction in line with new developments and challenges, as a constructive opportunity for advancement of scientific knowledge through basic and applied research and teaching as well as outreach programmes. The objectives of the academic programme are to provide

comprehensive training and prepare the students for a professional/research/academic career, to develop a richer understanding of mental processes and neural mechanisms underlying cognition using behavioural, computational and neurophysiological techniques. All aspects of behavioural and cognitive sciences are explored to understand the nature of cognitive and information processing system as well as to explore possible applications for the individual and the society. The faculty and students at the Centre are involved in research programmes pertaining to vision, attention, perception, linguistics, cognitive neuroscience, consciousness, cognitive disorders, cognitive modelling and human computer interaction. There is a strong emphasis on research projects and exposure to various theoretical and experimental studies in cognitive science. The Centre and the University provide an ideal environment for study and research in cognitive science.

The International Conference on Cognitive Science was held on 16–18 December 2004 at the CBCS. The conference was the first of its kind in focussing on all aspects of cognitive science. The mission of the conference was to explore the truly inter-disciplinary nature of cognitive science and create awareness of cognitive science among the interested students and researchers. The conference served as the meeting point for scientists from interfacing disciplines like psychology, neuroscience, computer science, linguistics and philosophy. The conference elucidated current research on significant areas interfacing cognitive science such as language processing, culture and cognition, perception, cognitive disorders, consciousness, computational neuroscience, memory, social cognition and so on. The technical programme comprised six keynote lectures, 59 oral presentations and 22 poster presentations. The keynote lectures were presented by six prominent experts in cognitive science like Prof. Aravind K. Joshi, University of Pennsylvania, USA, Prof. Jyotsna Vaid, Texas A and M University, USA, Prof. Ype Poortinga, University of Tilburg, Netherlands, Prof. Avi Chaudhuri, McGill University, Canada, and Prof. John W. Berry, Queen's University, Canada. In addition to faculty members from various Indian universities and abroad, research scholars from various Indian and foreign universities attended the conference.

Based on the initial submissions of papers and abstracts for the conference, the editors requested the authors to submit full papers for the volume. All the editors reviewed the papers and 27 contributions were selected for publication in the current volume. Some contributions had to be excluded due to the stringent review process. The contributors are senior leading as well as young talented cognitive scientists from various countries including the USA, Canada, the UK, Germany, the Netherlands, Belgium, Switzerland, Denmark, Australia, New Zealand, Lebanon, Japan and India. The volume contains research articles addressing the challenges faced in cognitive science requiring cross-linking of different interfacing disciplines like psychology, neuroscience, computer science, linguistics and philosophy.

The recent findings from cognitive science presented in the volume will serve as a useful resource for scientists working in the area of cognitive science. The volume represents a

good sample of the current trends in major sub-disciplines in cognitive science. The book contains six sections: (1) Cognitive processes (2) Cognitive neuroscience (3) Computational modelling (4) Culture and cognition (5) Cognitive development and intervention, and (6) Consciousness. The first section contains eight chapters and focuses on the study of various cognitive processes ranging from vision and social cognition. The second section on cognitive neuroscience contains three chapters on cognitive neuroscience of vision and language as well as brain-behavioural asymmetry. The third section on computational modelling has four chapters spanning computational neuroscience and computational linguistics. The fourth section focuses on culture and cognition. This section has seven chapters discussing methodological and theoretical issues as well as related set of cross-cultural studies on spatial development. The fifth section on cognitive development includes four chapters discussing abnormal cognitive development and cognitive rehabilitation. The final section appropriately concludes with a chapter by Prof. K.R. Rao on consciousness with an Indian perspective.

The editors would like to acknowledge the efforts of many people who have contributed so much to the conference and preparation of this volume. Our colleague Dr Bhoomika R. Kar helped tremendously in organizing the conference and without her dedication the conference would not have been such a success. We would like to thank all the CBCS staff and students as well as research scholars from the Department of Psychology who worked very hard for the conference. The editors thank SAGE Publications for bringing out this volume.

Narayanan Srinivasan
A.K. Gupta
Janak Pandey

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