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Abstract

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Grant Number:	2P01MH047566-070004
PI Name:	BEHRMANN, MARLENE
PI Email:	behrmann+@cmu.edu
PI Title:	ASSOCIATE PROFESSOR
Project Title:	ADAPTIVE INTERACTIVE PROCESSING IN PERCEPTION AND ATTENTION

Abstract: Selecting visual information from complex, multi-object scenes for further analysis and action is necessary because of the imitations of the human visual system. Recent accounts of visual attention acknowledge that preferential processing may be afforded to information selected on the basis of its physical location (space- based) and/or on the basis of its shape or object properties (object- based). Our hypothesis is that both spatial and object attentional effects emerge in a unitary model from competitive and cooperative interactions between representations, and that these representations are significantly influenced by interactions with task demands. In this mechanistic account, then, attention which is defined as the selection of a small set of active units, arises as part of the process of scene interpretation in conjunction with fulfilling the demands of a particular task. We adopt two complementary experimental paradigms: an object cost paradigm that reveals the difficulty attending to two objects simultaneously, and a distractor paradigm that reflects the inability to ignore elements grouped together with relevant information. Simulations and experiments will address three main issues: (1) We will explore the nature of the representations derived from perceptual experience, how these representations transfer and generalize to novel stimuli and how they serve to complete patterns that are impoverished or degraded (including occlusion and amodal completion). We will also explore how varying sources of perceptual information combine and become grouped, and how grouping might bread down in neuropsychological patients. (2) The emergence of space- and object based effects. In simulation work, we will evaluate the differences between architectures with modular or distributed space and object representation, and assess whether they can account for a range of empirical data that reflect the simultaneous contribution of space- and object- processes. We will also examine how object representations modulate location based attention in patients with a spatial deficit and simulate the effect of a spatial bias in the ~lesioned~ network to provide comparisons between the network and the empirical data. (3) Modulation of visual selection by task demands. We will explore how task requirements interact with space and location based representations, how task knowledge is learned and how the visual representations are reshaped or reconfigured under the pressure of differing task demands. Moreover, we map

out the time course of processing and evaluate whether the standard time course can be reversed by manipulating task complexity. Finally, the three-way interaction between space-based, object based and task based influences are explored in patients with brain damage to reveal the full interactivity of the selection process.

Thesaurus Terms:
attention, cognition, computational neuroscience, model design /development, neural information processing, neuropsychology, visual perception
brain injury, learning, psychological adaptation, psychomotor reaction time, space perception, stimulus generalization
behavioral /social science research tag, clinical research, human subject, neuropsychological test

Institution:	CARNEGIE-MELLON UNIVERSITY 5000 FORBES AVE PITTSBURGH, PA 15213
Fiscal Year:	1998
Department:	
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Abstract

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Grant Number:	5R29MH054246-04
PI Name:	BEHRMANN, MARLENE
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PI Title:	ASSOCIATE PROFESSOR
Project Title:	PSYCHOLOGICAL AND NEURAL BASES OF SPATIAL COGNITION

Abstract: The representation of space is critical for the coordination of many forms of human perceptual and cognitive behavior. The overarching question addressed in this project is, what psychological and neural mechanisms underlie the process of spatial representation? While there is general acceptance in the animal and human literature that spatial information is neurally instantiated in the parietal lobe, there is little agreement on the frame of reference within which spatial representations are defined. Indeed, findings from single cell studies in animals, psychology experiments with normal subjects and neuropsychology investigations with patients all yield somewhat contradictory results. Three major issues are addressed in the current work: (a) whether spatial information is represented with respect to coordinate frames defined by the viewer and/or coordinates independent of the viewer; (b) what factors (task demands, stimulus characteristics and strategies) influence the strength of a particular representation, and (c) whether a 'context' spatial frame of reference serves to coordinate information across perception and action. The primary methodology involves the detailed analysis of the behavior of neurological patients who, following a lesion to the parietal lobe, have a selective deficit in spatial behavior (neglect). Through evaluating the pattern of their impaired and intact performance on a range of tasks that require access to internal spatial representations, we can obtain evidence for the mechanisms underlying spatial behavior. The first set of experiments compare the performance of the patients on tasks requiring eye movements, visually guided reaching and visual target detection. In these experiments, the contribution of individual spatial frames of reference are partialled out to permit an analysis of their unique contribution to behavior. The second set of experiments compare performance on tasks which manipulate variables thought to be crucial to spatial representation, including symmetry, principal axes, and motion. The final experiments evaluate the preferential reliance on a particular representation through manipulating stimulus expectancies and strategies. The results of these studies will provide evidence for two central issues. The first concerns the way in which spatial information is normally represented and organized. The ease with which sensory information is located and coordinated across modalities for action belies the complexity of the process of spatial representation. Findings from these studies promise to provide important insights into the mechanisms underlying this process. The second issue

concerns the function of parietal cortex and its breakdown in patients with cortical lesions. An improved understanding of what gives rise to neglect might lead to better diagnostic and remediation procedures for this fairly common neurobehavioral disorder.

Thesaurus Terms:
cognition, nervous system disorder, neuropsychology, space perception
chronic brain damage, eye movement, parietal lobe /cortex, psychomotor tracking, visual tracking
behavioral /social science research tag, human subject, neuropsychological test

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Department:	PSYCHOLOGY
Project Start:	01-APR-1995
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IRG:	PEC