Cognitive Science Association for Interdisciplinary Learning

August 1–5, 2002
Hood River Hotel
Hood River, Oregon

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PROGRAM

August 1 Evening

4:45   Appetizers

— POSTERS —

Steven Macramalla & Bruce Bridgeman, University of California, Santa Cruz
     Motor interference of imagined changes in egocentric orientation: Where are you now?

Jessica K. Witt & Dennis R. Proffitt, University of Virginia
     Effort and perception of near space

5:45   Opening Remarks

SYMPOSIUM ON LARGE-SCALE SPATIAL COGNITION

6:00-6:10   Symposium Opening Remarks (Ed Cornell)

— TALKS —

6:10-6:50
Barbara Tversky, Stanford University
     Navigating by mind and by body

6:50-7:30
Gary L. Allen, Department of Psychology, University of South Carolina
     Functional families of spatial abilities: Poor relations and rich prospects

7:30   Adjourn

August 2 Morning

8:30　　　　Morning Refreshments

— **TALKS** —

9:00-9:40
C. Donald Heth & Edward H. Cornell, University of Alberta
Going from how to where

9:40-10:20
David Waller, Miami University, Ohio
Does physical movement through an environment facilitate learning its layout?

10:20-11:00
Amy Lynne Shelton, Johns Hopkins University
Contrasting maps and navigation: Brain, behavioral, and psychological differences

11:00　　　　Break till 4:45

August 2 Evening

4:45　　　　Appetizers

— **POSTERS** —

Anna J. Wilson & Ed Awh, University of Oregon
The role of spatial working memory in numerical estimation

Brice Kuhl & Michael Anderson, University of Oregon
Semantic satiation: Diminished accessibility following prolonged repetition

— **TALKS** —

5:30-6:10
Steffen Werner, University of Idaho
Integration of spatial reference systems for wayfinding in natural and built environments

6:10-6:50
Alinda Friedman, University of Alberta
Reasoning with regions

6:50-7:30
Daniel R. Montello, Alex D. Keuper, & M. Violet Gray, University of California, Santa Barbara
Directly assessing regionalizations of geographic space: Relations to state boundaries and preference ratings

7:30　　　　Adjourn

August 3 Morning

8:30   Morning Refreshments

— **TALKS** —

9:00-9:40

Ed Vogel & Steven J. Luck, University of Oregon, University of Iowa
Quartering the spotlight of attention

9:40-10:20

Edward Awh, Harpreet Dhaliwal, Shauna Christensen, & Michi Matsukura, Department of Psychology, University of Oregon
Evidence for a postperceptual component of object-based selection

10:20-11:00

Bill Prinzmetal & Christin Hansen, University of California, Berkeley, University of California, Davis
Does automatic attention exist: Evidence from studies comparing reaction time and accuracy

11:00   Break till 4:45

August 3 Evening

4:45   Appetizers

— **POSTERS** —

Rebekah E. Smith & Ute J. Bayen, University of North Carolina at Chapel Hill
Determining the locus of age differences in prospective memory

Benjamin J. Levy & Michael C. Anderson, University of Oregon
Inhibitory control and the encoding of new associations

— **TALKS** —

5:30-6:10

Pierre Jolicoeur & Biljana Stevanovski, University of Waterloo
Encoding information into visual short-term memory requires central capacity

6:10-6:50

Douglas L. Hintzman, University of Oregon
Robert Hooke's model of memory

6:50-7:30

Charan Ranganath, Andrew P. Yonelinas, Christine J. Dy, Sabrina Tom, & Mark D'Esposito, University of California, Davis, Berkeley
A parametric analysis of prefrontal contributions to episodic memory encoding

7:30   Adjourn

August 4 Morning

8:30   Morning Refreshments

— TALKS —

9:00-9:40

Yonelinas, A.P., Kroll, N.E.A., Quamme, J.R., Lazzara, M.M., Sauvé, M.J. Widaman, K.F., & Knight, R.T., University of California, Davis

> *The neuroanatomy of remembering*

9:40-10:20

William P. Banks, Pomona College

> *A psychophysical analysis of recognition memory*

10:20-11:00

Dennis Proffitt & Jessi Witt, University of Virginia

> *Perceiving spatial layout: The role of effort and intent*

11:00   Break till 4:45

August 4 Evening

4:45

— POSTERS —

Christine Herman & Enriqueta Canseco-Gonzalez, Reed College

> *Semantics versus syntax: Event-related potentials (ERPs) and the role of discourse in the on-line processing of gender stereotype violations*

— TALKS —

5:30-6:10

Michael P. Sullivan & Catherine Macchi, Oregon Health and Science University, Portland VA Medical Center, Reed College

> *A dual-task study of lemma selection in the picture-word interference task: Is competition strategically or automatically minimized?*

6:10   Adjourn
6:45   Banquet

August 5 Morning

8:30   Morning Refreshments

— **TALKS** —

9:00-9:40

Robert B. Welch, Anthony C. Sampanes, Stephen R. Ellis, & Bernard D. Adelstein, NASA-Ames Research Center, University of California, Santa Cruz

> *The role of "kinesthetic cueing" in adaptation to visual rearrangement*

9:40-10:20

Paul Dassonville, Jagdeep Bala, Bruce Bridgeman, Paul Thiem, & Anthony Sampanes, University of Oregon, University of California, Santa Cruz

> *A new interpretation of Roelofs' effect based on distortions of the apparent midline*

10:20   Closing remarks

10:30   Adjourn for the year

ABSTRACTS

Alphabetical by first author

Gary L. Allen
Department of Psychology, University of South Carolina

Functional families of spatial abilities: Poor relations and rich prospects

Typically, empirical studies reveal poor relations between spatial abilities as assessed by psychometric tests and environmental learning and wayfinding skills as measured in field experiments. One approach for understanding these relations is to conceive of psychometrically assessed abilities and environmental learning skills as representative of different functional families of spatial abilities that are related only indirectly through mediating constructs. The utility of this approach is suggested by results showing that spatial-sequential learning is a mediator of relations between psychometrically assessed spatial abilities and environmental learning and wayfinding skills in two large outdoor environments and one extensive indoor setting. Closer examination reveals that this mediated relationship is significant only between a general psychometric spatial factor and a factor representing environmental knowledge based on landmark-to-landmark relations. Future efforts should be focused on differentiating the members of the various spatial families and identifying abilities that may link different families.

Edward Awh, Harpreet Dhaliwal, Shauna Christensen, & Michi Matsukura
Department of Psychology, University of Oregon

Evidence for a postperceptual component of object-based selection

Spatial selective attention allows an observer to bias visual processing towards specific locations, leading to relative enhancements of processing at attended relative to unattended locations. By contrast, it has been proposed that object-based attention allows processing to be biased towards specific objects, without regard to location. For example, Duncan (1984) demonstrated that when two objects were presented simultaneously, observers were better at reporting two attributes from a single object than one attribute from each of the objects. Because these objects were superimposed in space, Duncan interpreted this finding as an example of object-based selection. However, subsequent experiments have shown that spatial attention may be precisely allocated to the contours of the selected objects, raising the possibility that object-based effects can be accounted for by the flexible allocation of spatial attention. Our studies suggest that there are actually two separate components of selection in this task: (a) a spatial component that involves the selection of the specific locations where the cued objects appear, and (b) an object-based component that can still be observed even when the opportunity for spatial filtering is eliminated. The latter component can be demonstrated even when the relevant targets are cued after the offset of the target stimuli, suggesting a postperceptual locus of object-based selection.

William P. Banks
Pomona College

A psychophysical analysis of recognition memory

Memory strength has traditionally been treated as a unidmensional quantity. I will report some results from a research project that treats memory as a multidimensional quantity. This work shows that excellent predictions can be made under multidimensional assumptions, and many paradigms, such as false fame and exclusion testing, can be given intuitive and powerful representations. Furthermore, the relationship between source and item memory (old vs. new discrimination) has a simple and elegant representation that allows precise predictions. The presentation will show how to generate and use a multi-dimensional memory representation. The method will be applied to a number of topics, including source memory, face recognition, false fame, and effects of learning under subliminal or attention-diverted conditions. It would appear that recognition memory can be analyzed with the same tools used for other domains of perception, and with a precision and power not normally assumed possible in the field of memory.

Paul Dassonville, Jagdeep Bala, Bruce Bridgeman, Paul Thiem, & Anthony Sampanes
University of Oregon, University of California, Santa Cruz

A new interpretation of Roelofs' effect based on distortions of the apparent midline

Several investigations of visual abilities have used illusions to provide evidence for a dissociation of the visual processing required for "perception" and "action." In one series of studies (Bridgeman et al. 1997), the perception of a target's location was found to be distorted by a large frame offset from the subject's midline (the induced Roelofs effect), even though the subject could accurately indicate the target's location by pointing. A recent reinterpretation of this dissociation (Dassonville & Bala, CSAIL 2001) suggests that the Roelofs effect is caused by a frame-induced deviation of the subject's apparent midline. Furthermore, the distortion affected both perception and action, depending on the frame of reference used to make the report. In this presentation, Dassonville and Bridgeman will team up to explain this new hypothesis, confirm a non-intuitive prediction to further characterize this hypothesis, and discuss the implications for the psychophysical dissociation of perception and action from a common visual representation.

Alinda Friedman
University of Alberta

Reasoning with regions

People's representations of global geography are regionalized, and although geographers may define geographical regions as areas of homogeneous topography, laypersons use other criteria, including political borders, conceptual similarities, climate, etc. I will review data showing that psychological regions influence absolute location estimates, bearing estimates, and distance estimates. I will also review data showing that the regions into which Albertan university students divide up North America, including the particular biases observed, is well-established in Texan school children by 11 years of age. Finally, I will discuss cross-cultural similarities and differences in the representation of North America by Canadian, American, and Mexican university students.

C. Donald Heth & Edward H. Cornell
University of Alberta

Going from how to where

Path integration has been described as navigation that depends on continuous updating based on directed velocity and acceleration. We briefly summarize cladistic variation in the use of path integration; it is a mechanism adapted to particular environments and modes of travel. These considerations are used to evaluate its relevance to how people accommodate incomplete knowledge of large scale environments. Most demonstrations of human path integration are in rooms where the layout of walls can serve as a mental frame of reference. We present evidence of path integration by adults whose vision is restricted as they walk through an unfamiliar urban neighborhood. Humans may not automatically integrate rate and direction, but have methods of encoding and retrieving feedback from locomotion that allow navigation under conditions of uncertainty.

Christine Herman & Enriqueta Canseco-Gonzalez
Reed College

Semantics versus syntax: Event-related potentials (ERPs) and the role of discourse in the on-line processing of gender stereotype violations

The modular model of sentence processing proposes that when faced with sentences containing ambiguous structures, readers/listeners initially assume the preferred syntactic structure, and only when the less preferred structure emerges a reanalysis is triggered. It is during this reanalysis that we use semantic and discourse information. On the other hand, the interactive model claims that any type of information can be used any time during the sentence parsing process. Other research shows that violations of gender agreement between reflexive pronouns and their antecedents elicit a P600, a component sensitive to syntactic anomalies. Interestingly, violations of gender stereotypes also elicit the P600. An ERP study was conducted to determine whether biasing discourse could eliminate the P600 effect found in response to violations of gender stereotypes. While biasing discourse was able to eliminate the P600 effect, timing effects suggest that syntactic information was used before the discourse was able to take effect.

Douglas L. Hintzman
University of Oregon

Robert Hooke's model of memory

In 1682 the scientist and inventor, Robert Hooke, read a lecture to the Royal Society of London, describing a mechanistic model of human memory. Few psychologists seem to have heard of Hooke's memory model. The lecture addressed questions of encoding, memory capacity, repetition, retrieval, and forgetting-some in a surprisingly modern way. Hooke's model shares several characteristics with the theory of Richard Semon, which came more than 200 years later, but it is more complete. Among the model's interesting properties are that: (1) it allows for attention and other top-down influences on encoding; (2) it uses resonance to implement parallel, cue-dependent retrieval; (3) it explains memory for recency; (4) it offers a single-system account of repetition priming; and (5) the power law of forgetting can be derived from the model's assumptions in a straightforward way.

Pierre Jolicoeur & Biljana Stevanovski
University of Waterloo

Encoding information into visual short-term memory requires central capacity

Is encoding information into visual short-term memory (VSTM) automatic? In this talk, we show that taking in a "snap-shot" view of a simple visual display interferes with a concurrent speeded response to an auditory stimulus. We also show that memory for the visual display is disrupted by a concurrent speeded auditory task, and that the degree of disruption depends on the difficulty of that concurrent task. Both results show that encoding new information into VSTM requires central processing capacity, and hence show that the encoding processes leading to a representation in VSTM are not automatic.

Shlomo Kaniel
bar Ilan University, Israel

Analogy construction versus analogy solution, and their influence on transfer

This study compares transfer performed by subjects trained to solve verbal analogies to transfer by subjects trained to construct them. 123 seventh-graders attending a middle class Tel Aviv school were randomly assigned to two groups. The first (N = 57) received instruction in a strategy to solve verbal analogies and the second (N = 66) was trained in strategies for constructing such analogies. The strategies had similar central criteria for transfer and included domain-specific components and metacognitive elements (monitoring and control). Before and after intervention, all the subjects received three analogical tasks: verbal, figural and numerical. An effectiveness measure (percentage of correct answers divided by performance time) was used to measure the subjects success before and after the training program. Results showed that, even though both interventions (solution and construction) improved performance, the construction group scored higher in the numerical and figural analogy tasks, which were the targets for transfer. The constructors advantage is attributed primarily to greater internalization, which changes and redefines the strategy, assists in internal organization and catalyzes internalization processes of which one expression is transfer.

Brice Kuhl & Michael Anderson
University of Oregon

Semantic satiation: Diminished accessibility following prolonged repetition

Studies of semantic satiation suggest that prolonged vocalization of a word can actually result in the loss of meaning for that word. The present study investigated the accessibility of vocalized words (e.g., "sheep") and their close semantic associates (e.g., "wool") following various repetition durations. Subjects first completed a repetition phase during which they repeated words out loud for either 0 (baseline), 5, 10, 20, or 40 seconds. Next, subjects completed a semantic generation test that measured the accessibility of repeated words as well as their semantic associates. Short repetition durations served to increase the accessibility of vocalized words as well as their semantic associates, relative to baseline items. However, longer periods of repetition (i.e., 40 seconds) reversed, and effectively eliminated, the priming effects obtained with shorter repetition durations. Potential mechanisms underlying this effect are discussed.

Benjamin J. Levy & Michael C. Anderson
University of Oregon

Inhibitory control and the encoding of new associations

Both behavioral and neuroimaging studies strongly indicate a role for attention in encoding new experiences. However, the precise functions of attention during encoding remain unclear. The current experiment sought to determine whether one role of attention may be to resolve interference from semantic knowledge that arises in forming new associations. After studying word pairs (e.g., Thorn Ghost) either 0, 1, 6, or 12 times, subjects were given an apparently unrelated semantic generation task where some of the possible responses were strong associates to words studied earlier (e.g., "Flower R_____" could be completed by Rose). The more often these word pairs had been studied, the less often the related words were generated on the free association test, showing that these semantic associates were inhibited during the previous encoding session. These findings indicate that episodic encoding recruits mechanisms that suppress interfering semantic knowledge, suggesting the role of attention during encoding may be partly inhibitory in nature.

Steven Macramalla & Bruce Bridgeman
University of California, Santa Cruz

Motor interference of imagined changes in egocentric orientation: Where are you now?

The experiment investigates motor interference of conceptualized space. Subjects stood upright and were read a narrative describing a series of rotational egocentric perspective changes, in one of three levels of difficulty, within an imaginary room, containing a unique object in each corner. Subjects rotated left or right consistently during the full set of narrated perspective changes, control conditions involved performing the task while not rotating. Results suggest that a distortion of the conceptualized orientation is consistently shifted in the direction of the real motion.

Daniel R. Montello, Alex D. Keuper, & M. Violet Gray
UC Santa Barbara, Department of Geography

Directly assessing regionalizations of geographic space: Relations to state boundaries and preference ratings

Regions are pieces of earth surface that enclose fairly similar or homogeneous areas. Regionalization is the creation or identification of regions. It is a subset of categorization, and like categorization in general, regionalization is highly typical of human cognition, likely universal. The regional organization of space is important because it influences judgments people make about distance, direction, and other aspects of location; it also influences affective assessments of places, or place attitudes. In this paper, we present data from over 150 college students who were asked to perform a direct regionalization of the United States on outline map sheets by drawing region boundaries. The nature of the resulting regions are examined and compared to common "expert" regionalizations of the U.S., and are compared as a function of whether state boundaries and names were present on the response sheet. Respondents also performed ratings of their preferences for living in the various regions, which were compared to their patterns of regionalizations and their U.S. travel experiences.

Bill Prinzmetal & Christin Hansen
University of California, Berkeley, University of California, Davis

Does automatic attention exist: Evidence from studies comparing reaction time and accuracy

In the spatial cueing task, one location of a display is cued, and performance is often better if a target appears in the cued location (valid trial) than if it appears in an uncued location (invalid trial). The authors argue that there are two kinds of cueing: automatic cueing and strategic cueing. Strategic cueing occurs only when the cue location is correlated with the target location and the stimulus onset asynchrony (SOA) is long. Automatic cueing occurs even when the target and cue location are not correlated, and with very short SOAs. Six experiments demonstrate that strategic cueing affects both reaction time and accuracy whereas automatic cueing only affects reaction time. It is argued that strategic cueing reflects the effect of attention on the perceptual representation, but automatic cueing reflects non-perceptual decision processes.

Dennis Proffitt & Jessi Witt
University of Virginia

Perceiving spatial layout: The role of effort and intent

The spatial layout of the ground has two parameters, orientation and extent. Perceiving these parameters is not only a function of the optical variables to which they relate, but it is also a function of people's current physiological potential to perform intended actions. For example, as the effort associated with walking an extent increases, perceived distance increases if people anticipate walking the extent but not if they anticipate throwing a ball that distance. Conversely, as the effort associated with throwing increases, perceived distance increases if people anticipate throwing but not if they anticipate walking. In general, we propose that $P = F(W, E_f | I_f)$, where P is perceived layout, W is the world (the geometry of distal layout), E_f is the effort associated with behavioral function, F, and I_f is the intention to engage in behavior, F. Perceiving spatial layout combines the geometry of the world with our behavioral goals and the potential of our body to achieve these goals.

Charan Ranganath, Andrew P. Yonelinas, Christine J. Dy, Sabrina Tom, & Mark D'Esposito
University of California, Davis, Berkeley

A parametric analysis of prefrontal contributions to episodic memory encoding

Behavioral studies of human memory suggest that recognition judgments can be made on the basis of assessments of item familiarity or on the basis of recollection of associative information. Event-related neuroimaging studies have reported that activity in regions of prefrontal cortex during encoding is greater for items that are subsequently recognized than for items that are later forgotten. However, these items typically differ in both the amount of familiarity and recollection that they elicit. In the present study, we used a parametric approach to identify the contributions of prefrontal activity during encoding to subsequent familiarity and recollection. Activity was measured in four anatomical regions of interest (ROIs) corresponding to posterior (BA 44/45) and anterior (BA 47) sections of the inferior frontal gyrus (BA 44/45) in each hemisphere. During scanning, participants made animacy or size judgments on words, depending on the color that the word was shown in. After scanning, they were shown each word and were asked to make a recognition confidence judgment (1-6 scale) and an associative memory judgment (animacy vs size judgment) for each word. Behaviorally, recognition accuracy varied continuously across response confidence categories, but accurate associative memory judgments were only observed for the highest confidence recognition responses. Imaging data revealed that encoding activity in both left and right BA 44/45 predicted both subsequent familiarity and recollection. In contrast, activity in left, but not right BA 47 selectively predicted recollection. These findings suggest a functional dissociation between these two regions and provide behavioral and neural evidence for the distinction between recollection and familiarity.

Amy Lynne Shelton
Johns Hopkins University

Contrasting maps and navigation: Brain, behavioral, and psychological differences

In our everyday interactions with large-scale space, two common methods of spatial exploration are navigation and map reading. A series of behavioral and fMRI experiments were designed to identify the psychological differences between route level navigation and map-like aerial viewing. Participants learned large-scale virtual environments under various conditions that simulated visual navigation, visual map learning, or intermediate conditions that combined elements of both maps and navigation. Performance differences have provided clues to the nature of the information available during each type of learning, and brain activation differences have allowed speculation about the underlying processes that give rise to the subsequent performance differences. Together, these results have forged a foundation for thinking about the sub-processes of spatial learning, how these processes work together, and how they relate to larger questions about spatial reference systems, observer orientation, and the role of immersion.

Rebekah E. Smith & Ute J. Bayen
University of North Carolina at Chapel Hill

Determining the locus of age differences in prospective memory

Research interest in prospective memory has grown substantially, especially in the area of cognitive aging, following the publication of a study in which no age differences were found on a prospective memory task (Einstein & McDaniel, 1990). Although subsequent studies have found significant age differences (e.g. Maylor, 1996; Park, Hertzog, Kidder, Morrell, & Mayhorn, 1997; West & Craik, 1999), there remains a debate over what aspects of the prospective memory task are affected by age. The present experiment applies a new multinomial model of prospective memory (Smith & Bayen, 2002) to investigate the contributions of the prospective component (remembering that you have to do something) and the retrospective component (remembering what you are supposed to do and when you are supposed to do it) to age differences in prospective memory.

Michael P. Sullivan & Catherine Macchi
Oregon Health and Science University, Portland VA Medical Center, Reed College

A dual-task study of lemma selection in the picture-word interference task: Is competition strategically or automatically minimized?

In connectionist models of spoken language, selection at the lemma (i.e., semantic) and lexeme (i.e, phonological) levels is assumed to occur automatically. However, when it comes time for selection, if a competitor has a higher activation value than a target, correct selection must wait for the target to reach a higher level of activation than the competitor. This explanation has been applied to the slowing of naming latencies observed in picture-word interference tasks designed to experimentally induce competition for selection. In the present study, we tested whether this competition for correct selection requires top-down attentional control or is automatically minimized by feedback activation to the target. We asked participants to perform a speeded tone discrimination task followed by a picture-word interference task in which participants named pictured objects while listening either to semantically related or unrelated words. The results showed that as the stimulus onset asynchrony between the two tasks decreased from 1000 to 50 ms, response latencies in the tone task did not differ, whereas the overall naming latencies in the picture-word interference task increased. An underadditive SOA by prime interaction was obtained, which showed a significant interference effect (related minus unrelated) at the 1000 ms SOA, but not at the 50 ms SOA. These results contrast with previous studies that have proposed that competition for selection is minimized by top-down attentional control based on additive effects of SOA and Stroop-type interference.

Barbara Tversky
Stanford University

Navigating by mind and by body

Two research communities study spatial cognition. One community studies systematic errors in spatial memory and judgement, accounting for them as a consequence of and clue to normal perceptual and cognitive processing. The other community studies navigation in the wild, isolating the contributions of various sensory cues and sensori-motor systems to successful navigation. One group emphasizes error, the other, selective mechanisms, environmental or evolutionary, that produce fine-tuned correct responses. How can these approaches be reconciled? First, by showing why errors are impervious to selective pressures. The schematization that leads to errors is a natural consequence of normal perceptual and cognitive processes; it is elemental to the construction of mental spaces to make judgements in limited capacity working memory. Selection can act on particular instances of errors, but not on the general mechanisms that produce them. Next, in actual situations, there are a variety of correctives. Finally, closer examination of navigation in the wild shows systematic errors, for example, over-shooting in dead reckoning across species. Here, too, environments provide correctives, specifically, landmarks.

Ed Vogel & Steven J. Luck
University of Oregon, University of Iowa

Quartering the spotlight of attention

Can spatial attention be split to multiple noncontiguous locations? Some studies have found evidence for a unitary focus, while others have shown that attention can be split. One possibility for this discrepancy is that these studies may be examining different levels of selective attention. To test this, we compared the spatial distribution of attention in a working memory task with a perceptual task by using spatial precues that directed attention to either contiguous or noncontiguous locations. In the working memory task, performance was equivalent for both the contiguous and noncontiguous cues, indicating that working memory-level attention can be divided among noncontiguous locations with no cost. However, in the perceptual task, accuracy was significantly lower for noncontiguous cues than for contiguous cues, indicating that perceptual-level attention cannot be easily divided among noncontiguous locations. These results indicate that the spatial properties of attention are different for perceptual tasks versus working memory tasks.

David Waller
Miami University, Ohio

Does physical movement through an environment facilitate learning its layout?

Computer simulations of large-scale environments offer investigators an opportunity to conduct basic research on human wayfinding and navigation as well as to train people on tasks requiring knowledge of geographic spaces. In general, however, interfaces with these systems do not convey all of the non-visual information about self-motion (e.g., vestibular information) that would normally arise from users' movement through these spaces. In two experiments, we investigated the degree to which non-visual information about velocity and acceleration in a large-scale environment facilitates the learning of its layout. Participants were exposed to two previously unknown large-scale environments, either by being driven through it (Experiment 1), by walking through it (Experiment 2), or by watching a video of these drives and walks (both experiments). Results confirmed that information about acceleration is not necessary for learning large-scale environments; however, being able to walk through the environment actively, which provides additional information about velocity and acceleration, does result in a small but significant enhancement of spatial knowledge.

Robert B. Welch, Anthony C. Sampanes, Stephen R. Ellis, & Bernard D. Adelstein
NASA-Ames Research Center, University of California, Santa Cruz

The role of "kinesthetic cueing" in adaptation to visual rearrangement

We examined the role of "kinesthetic cueing" in adapting to a transformed relationship between stylus and cursor. With "kinesthetic cueing" subjects rely on the orientation of the non- dominant hand to remind them of the nature of the sensory rearrangement to which they are being exposed. In our first experiment we found a facilitative effect of this cue when adaptation was measured in terms of the "reduction of effect" (during the exposure phase), but insufficient postexposure "negative aftereffects" to determine if the same held for that adaptive measure. After follow-up experiments continued to produce only meager negative aftereffects, we hypothesized that the adaptation we were producing was based primarily on "visual-motor skill acquisition" rather than "perceptual recalibration." It is argued that only the latter is characterized by large negative aftereffects. Thus, in our next experiment we designed the exposure conditions to favor perceptual recalibration. As predicted, we now obtained substantial negative aftereffects which, however, were not influenced by the kinesthetic cue. These and the predicted results of proposed future experiments have important implications for human adaptation to the visual rearrangements that characterize many of our modern human-machine interfaces.

Steffen Werner
University of Idaho

Integration of spatial reference systems for wayfinding in natural and built environments

Recent research in spatial cognition has emphasized the importance of the perceived spatial structure of an environment for the organization of spatial memories. In a number of studies we were able to show that the imagined or actual alignment with salient axes of an environment (e.g., symmetry axes, gradient, functional relevance) leads to a decrease in error rate and retrieval time compared to misaligned conditions. These results suggest that human spatial memory uses salient geometrical features of the environment as a spatial reference system for encoding/retrieving positional information. In addition, spatial relations often have to be integrated across multiple learning episodes, requiring the specification of a global reference system. Using a stable environmental reference system across multiple episodes might be an efficient way to achieve a common reference system. These findings have important implications for the design of spatial interfaces, such as maps, and for the legibility and navigability of architectural design.

Anna J. Wilson & Ed Awh
University of Oregon

The role of spatial working memory in numerical estimation

Neuroimaging experiments and behavioral experiments on the distance effect have been used to argue for an analogical visuo-spatial coding of numerical information (e.g. Dehaene et al., 1999). This visuo-spatial representation system is proposed to be especially utilized in numerical comparison and estimation tasks. The current experiments tested this hypothesis using dual task methodology. Subjects carried out a visuo-spatial working memory recognition task, and in the retention interval for that task, they performed either an approximate (estimation) or exact addition task. The approximate task was shown to exhibit significantly greater dual task costs under spatial working memory load, but not under verbal working memory load. A third experiment replicated this effect, and showed that a numerical comparison task did not show a dual task cost. Results are discussed in reference to the involvement of visuo-spatial processes in numerical cognition.

Jessica K. Witt & Dennis R. Proffitt
University of Virginia

Effort and perception of near space

Perception of spatial layout is a function of distal layout, the perceiver's intentions to act, and the effort associated with that action (Proffitt & Witt). Spatial layout can be organized along egocentric coordinates into near and far space. Egocentric distance in far space allows for gross motor behaviors such as walking and throwing while egocentric distance in near space allows for behaviors such as reaching. Previous research has demonstrated that changes in anticipated effort associated with walking and throwing influence perceived distance in far space (Proffitt et al, in press; Proffitt & Witt). The current studies demonstrate that egocentric distance in near space is also influenced by anticipated effort. Participants reached to targets with their finger or with a baton and verbally estimated the distance to other targets within the same range. Distances that were beyond reach of the hand but within reach of the baton were perceived as closer when holding the baton. These results suggest that distances in near space are influenced by our potential to act on the objects with this space.

Yonelinas, A.P., Kroll, N.E.A., Quamme, J.R., Lazzara, M.M., Sauvé, M.J. Widaman, K.F., & Knight, R.T.
University of California, Davis

The neuroanatomy of remembering

Memory for past events can be based on recollection or on assessments of familiarity. These two forms of human memory have been long studied by philosophers and psychologists, but their neuroanatomical substrates are largely unknown. Here we identify the brain regions underlying recollection and familiarity by examining patients with damage to different regions of the temporal lobes. Hippocampal damage disrupts recollection but not familiarity, whereas lesions that extend into the surrounding temporal lobe cortex disrupt both recollection and familiarity. The results indicate that the hippocampus plays a critical role in recollection whereas the surrounding temporal lobe supports familiarity.

Name	email address
Gary Allen	allen-gary@sc.edu
Ed Awh	awh@darkwing.uoregon.edu
Bill Banks	WPB04747@pomona.edu
Ed Cornell	ecornell@ualberta.ca
Paul Dassonville	prd@darkwing.uoregon.edu
Dorn	dorn@wsg.net
Alinda Friedman	alinda@ualberta.ca
Christine Herman	Christine.A.Herman@directory.reed.edu
Don Heth	dheth@ualberta.ca
Douglas Hintzman	hintzman@OREGON.UOREGON.EDU
Reed Hunt	huntrr@uncg.edu
Pierre Jolicœur	pjolicoe@cgl.uwaterloo.ca
Shlomo Kaniel	kaniels@mail.biu.ac.il
Brice Kuhl	kuhl@darkwing.uoregon.edu
Brian Lathrop	steilskin@yahoo.com
Ben Levy	blevy@darkwing.uoregon.edu
Steven Macramalla	smacram@hotmail.com
Daniel Montello	montello@geog.ucsb.edu
Bill Prinzmetal	wprinz@garnet.berkeley.edu
Charan Ranganath	cranganath@ucdavis.edu
Dell Rhodes	Dell.Rhodes@directory.reed.edu
Chad Sampanes	acsampanes@yahoo.com
Amy Shelton	ashelton@jhu.edu
Rebekah Smith	rebekah@email.unc.edu
Michael Sullivan	sullivan@ohsu.edu
Barbara Tversky	bt@psych.stanford.edu
Ed Vogel	vogel@darkwing.uoregon.edu
David Waller	wallerda@muohio.edu
Bob Welch	rwelch@mail.arc.nasa.gov
Steffen Werner	swerner@pop.uidaho.edu
Anna Wilson	ajwilson@darkwing.uoregon.edu
Jessica Witt	jw2ex@cms.mail.virginia.edu
Andy Yonelinas	apyonelinas@ucdavis.edu

Conference home page:
http://www.ohsu.edu/csail