

THE 8TH ANNUAL WORKSHOP ON OBJECT PERCEPTION AND MEMORY

Abstracts



Thursday, November 16, 2000

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Organized by:
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Schedule Overview

8:00	REGISTRATION
8:25	OPENING REMARKS
8:30	TRANSSACCADIC IDENTIFICATION OF SACCADE TARGET AND FLANKER OBJECTS (Germeys, De Graef, & Verfaillie)
8:50	CONSTRAINED FORMATION OF OBJECT REPRESENTATIONS (O'Connor)
9:10	REAL OBJECTS VERSUS THEIR PICTURES PRESENTED ON A FLAT SCREEN: HOW DIFFERENT MODES OF PRESENTATION INFLUENCE THE PERCEIVED DIFFERENTIAL STRUCTURE OF OBJECTS (Willems, B., van Doorn, A., J., & Wagemans, J.)
9:30	DOES VIEW INTERPOLATION OCCUR WITH OCCLUDED AND NON-OCCLUDED OBJECTS? (Wong & Hayward)
9:50	BREAK
10:00	THE ROLE OF ATTENTION IN HOLISTIC FACE PROCESSING (Palermo & Rhodes)
10:20	THE CARICATURE EFFECT ACROSS VIEWPOINT CHANGES IN FACE PERCEPTION (Cheng, Knappmeyer, & Bühlhoff)
10:40	DYNAMICS OF EXPRESSIONS (Spencer-Smith, Innes-Ker, & Townsend)
11:00	IS INFORMATION ABOUT GENDER AND EXPRESSION PROCESSED INDEPENDENTLY FROM INFORMATION ABOUT IDENTITY WHEN JUDGING FACES? (Mangini & Biederman)
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11:30	REPRESENTATION OF BRIEF, AFFECTIVE SCENES (Dawson)
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3:50	THE ROLE OF GRADIENTS IN LIGHTNESS (Economou, Annan, & Gilchrist)
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- 8:00 REGISTRATION
8:25 OPENING REMARKS

OBJECT PERCEPTION AND REPRESENTATION SESSION

- 8:30 **TRANSSACCADIC IDENTIFICATION OF SACCADIC TARGET AND FLANKER OBJECTS**

Germeys, F., De Graef, P., & Verfaillie, K.
University of Leuven, Belgium

To account for location-dependent and location-independent preview benefits in transsaccadic object perception, Henderson (1994), and Henderson and Anes (1994) proposed a dual-route model in which both episodic object representations and long-term memory representations store information across a saccade. Five experiments are reported in which the dual-route model was assessed. Preview benefits for saccade target objects were found to be location-independent, whereas preview benefits for flanker objects were location-dependent. These results support a single-route, two-stage model instead of a dual-route model of transsaccadic object perception. First, preattentive object files are set up to parse a set of attentional and/or saccade targets from peripheral vision, causing location-dependent preview benefits. Second, one object is attentionally selected for further processing, activating long-term memory representations, and resulting in location-independent preview benefits.

- 8:50 **CONSTRAINED FORMATION OF OBJECT REPRESENTATIONS**

Kevin J. O'Connor
Massachusetts Institute of Technology

Viewers were presented with a rapid sequence of very brief stimulus pairs consisting of a pictured object followed by a word. Different forms of relatedness between picture and word were manipulated across experiments (identical concept, related concept, ink color of picture). After the sequence, subjects performed an object recognition memory test. Test results suggest that integration of sequential inputs into stable object representations is not only facilitated by semantic relatedness, but also by words that name an irrelevant image feature. The results are discussed in relation to priming and mechanisms of selective attention.

- 9:10 **REAL OBJECTS VERSUS THEIR PICTURES PRESENTED ON A FLAT SCREEN:
HOW DIFFERENT MODES OF PRESENTATION INFLUENCE THE PERCEIVED
DIFFERENTIAL STRUCTURE OF OBJECTS**

Willems, B. (1), van Doorn, A., J. (2), & Wagemans, J. (1)
University of Leuven (1) & Technical University of Delft (2)

In order to resolve the ambiguity that is inherent in retinal images, the visual system can constrain the set of possible interpretations by taking advantage of additional depth information, by means of a priori assumptions about what is perceived, or both. In this study we investigated whether the mode of presentation of the additional information about depth has an influence on the perceived shape of objects (i.e., ellipses slanted in depth). We presented this additional depth information in two different ways: 1. The shapes were projected on the surface of a real sphere and 2. The shapes were



projected on the surface of the same sphere but then projected on a monitor. The orientation of the shapes could then be derived using the shading pattern on the perceived surface. We found that presentation mode influenced the way the ellipses were perceived: Both the deviation from veridicality and the uncertainty about exact orientation were affected.

9:30 **DOES VIEW INTERPOLATION OCCUR WITH OCCLUDED AND NON-OCCLUDED OBJECTS?**

Chun-Nang Wong & William G. Hayward
Chinese University of Hong Kong

This study probed the nature of interpolation mechanisms for view generalization in human object recognition. The present experiment investigated whether experience with two views (-20° and 20°) of an object facilitates subsequent recognition of novel views in between (0°). Thirty university students participated in a sequential matching task. They had to first study one or two views of an object, and then decide whether the object subsequently presented was the same as the one just studied. Computer-generated objects with and without self-occlusion across a range of viewpoint changes (80°) were compared. Results showed facilitation of novel views in between the studied views for both occluded and non-occluded objects. The presence of interpolation mechanisms, which integrate unique features from familiar object views and recover transformation of object features across viewpoint changes, may account for these results.

9:50 **BREAK**

FACE PROCESSING SESSION

10:00 **THE ROLE OF ATTENTION IN HOLISTIC FACE PROCESSING**

Romina Palermo & Gillian Rhodes

Department of Psychology, University of Western Australia

There is evidence that upright, but not inverted, faces are encoded holistically. The role of attention in encoding holistic representations was examined in three experiments. In Experiment 1, participants in a divided attention condition were asked to match two upright flanker faces while encoding a centrally presented upright target face. Although holistic coding was evident in the full attention conditions, dividing attention disrupted holistic coding of target faces. In Experiment 2, we found that while matching upright flanker faces disrupted holistic coding, matching inverted flanker faces did not. Experiment 3 demonstrated that the differential effects of flanker orientation were not due to participants taking longer to match upright faces. The findings emphasize the differences in processing upright and inverted faces and suggest that there are limitations on the number of faces that can be holistically coded by the face recognition module in a brief time.



10:20

**THE CARICATURE EFFECT ACROSS VIEWPOINT CHANGES
IN FACE PERCEPTION**

Yi D. Cheng, Barbara Knappmeyer, & Isabelle Bühlhoff

Max Planck Institute for Biological Cybernetics

The finding that caricatures are recognized more quickly and accurately than veridical faces has been demonstrated only for frontal views of human faces (e.g., Benson & Perrett, 1994). In the present study, we investigated whether there is also a “caricature effect” for three-quarter and profile views. Furthermore, we examined what happens to the caricature advantage when generalizing across view changes. We applied a 3D caricature algorithm to laser scanned head models. In a sequential matching task, we systematically varied the view of the target faces (left/right profile, left/right three-quarter, full-face), the view of the test faces (left/right profile, left/right three-quarter, fullface) and the face type (anticaricature, veridical, caricature). The caricature effect was replicated for frontal views. We also found a clear caricature advantage for three-quarter and profile views. When generalizing across views, the caricature advantage was present for the majority of view change conditions. In a few conditions, there was an anticaricature advantage.

10:40

DYNAMICS OF EXPRESSIONS

Jesse Spencer-Smith, Åse Innes-Ker, & James T. Townsend

Indiana University

Researchers into the recognition of facial expressions have long remarked that the dynamical nature of expressiveness is of great importance for understanding emotional facial expressions. In the present study, we examined the contribution of dynamics to the perception of emotional expressions with images of life-like 3-dimensional computer-animated characters. Participants viewed two images with differing intensities of an emotional expression, presented serially. Images were presented either with intervening noise, resulting in the perception of two static images, or with no noise, resulting in the perception of movement and increasing or decreasing emotional intensity. Participants were most accurate in labelling expressions in the apparent motion/increasing intensity condition ($M=0.61$, $SD=0.03$), less accurate in the noise condition ($M=0.32$, $SD=0.04$), and least accurate in the apparent motion/decreasing intensity condition ($M=0.29$, $SD=0.06$), $F(2,8) = 22.93$, $p<.001$. Apparent motion/increasing intensity was significantly higher than the latter conditions, $F(1,9) = 22.46$, $p=.001$; $F(1,9) = 51.6$, $p<.001$ respectively.

11:00

**IS INFORMATION ABOUT GENDER AND EXPRESSION PROCESSED
INDEPENDENTLY FROM INFORMATION ABOUT IDENTITY
WHEN JUDGING FACES?**

Michael C. Mangini & Irving Biederman

University of Southern California

A prosopagnosiac, MJH, evidences a severe deficit in identifying faces but is able to perform discriminations of gender, race, attractiveness, and affect. Are these abilities due to spared independent processing streams, or is the preserved capacity based on the greater response uncertainty and stimulus similarity of individuation compared to gender and expression judgments. 2-dimensional “face spaces” were generated by pairwise morphings of four faces. The spaces consisted of one dimension in which identity *and* gender or expression varied, while the other varied only in identity. Error measurements were collected and analyzed for the two dimensions



independently. The data indicate that gender and expression information is utilized to a greater extent than that predicted by their stimulus energy alone. With faces chosen to minimize the between-gender differences the benefit for the gender dimension was eliminated. Surprisingly, emotional expression increases distinctiveness even between faces expressing the same emotion.

11:20 BREAK

SCENE PERCEPTION AND REPRESENTATION SESSION

11:30 REPRESENTATION OF BRIEF, AFFECTIVE SCENES

A. Dawson

University of Arizona, Psychology Dept.

Affective representations can serve as important intermediate representations in object and scene recognition. This study sought to investigate whether affective representations can be derived outside of scene recognition processes that lead to conscious visual awareness. Complex, affective scenes were presented to subjects at varying rates of exposure. Subjects were unable to choose the previously presented stimulus in a forced-choice recognition task when the stimulus was presented at 33-milliseconds with masking. Subjects were also unable to choose very briefly presented stimuli based on indirect memory tasks such as simple preference. Subthreshold affective scenes were then paired with suprathreshold, neutral Japanese kana characters; subjects exposed to these pairs rated the emotional value of the Japanese kana. Subjects' ratings of the kana significantly reflected the valence of the affective scene primes, regardless of whether the prime was above or below visual recognition thresholds. This effect occurred only for threat-associated negative primes. Further, three exposures to a negative subliminal prime produced the strongest concurrent ratings of paired kana (without increasing recognition above chance). These results are described within the frameworks of LeDoux's (1996) subcortical emotion pathway and Kanwisher's (1987; 1991) repetition blindness paradigm.

11:50 SWITCHING BETWEEN ENVIRONMENTAL REPRESENTATIONS IN MEMORY

James R. Brockmole & Ranxiao Frances Wang

University of Illinois

In everyday life we accomplish tasks that require the storage and access of mental representations of different environments, which are organized hierarchically. Past research has shown that judgements of spatial relationships within a particular level of a hierarchy are influenced by higher levels. Three experiments tested whether this combination of spatial information across levels results from the simultaneous activation of adjacent levels or a serial process. Using a cued task-set switching paradigm, subjects judged spatial relationships between target locations in two familiar environments representing adjacent levels of a hierarchy. Response times were longer when successive trials probed different environments, an effect not due to switching between semantic categories, suggesting the combination of information stored at different levels occurs after representations are accessed individually. Implications for models of hierarchical representations will be discussed.



12:10 **THE ROLES OF OPTIC FLOW AND BODY SENSES IN HUMAN PATH INTEGRATION**

Melissa J. Bud, William H. Warren, Andrew P. Duchon, & Michael J. Tarr
Brown University

We examined path integration from optic flow alone and in combination with vestibular and proprioceptive information using a triangle completion task. The contribution of optic flow in specifying translation and rotation was tested by manipulating texture on the floor and/or walls of a circular virtual environment. In the first experiment, subjects used a joystick to steer while wearing a head mounted display (HMD). In the second experiment, participants actively walked in a large virtual environment while wearing the HMD. Results indicate that path integration can be performed by integrating the optic flow, but when information from the body senses is available it appears to dominate. To dissociate visual information and body senses in the same environment, we are manipulating the gain of the optic flow during walking. This allows us to test whether optic flow plays a role in path integration when information from body senses is simultaneously available.

12:30 LUNCH

1:00- 3:00 POSTER SESSION (**abstracts on pages 10-17**)

3:00 KEYNOTE ADDRESS

CAPACITY LIMITATIONS IN OBJECT RECOGNITION

Pierre Jolicoeur
University of Waterloo, CANADA

3:40 BREAK

EARLY PERCEPTION AND ATTENTION SESSION

3:50 **THE ROLE OF GRADIENTS IN LIGHTNESS**

Elias Economou, Vidal Annan, & Alan Gilchrist
Rutgers University

When a luminance edge between two surfaces changes from sharp to fuzzy (gradient) the lightness of the surfaces changes as well. Traditionally gradients were thought to produce lightness constancy by either allowing the observer to "take the illumination into account" (1), classify the edge as an illumination edge and successfully separate the reflectance from the illumination layers (intrinsic image models), (2 - 4), or by simply amplifying the contrast between two surfaces (5). Here we



present a hypothesis that treats gradients as factors that insulate (segregate) regions that do not share the same illumination.

4:10 **THE ROLE OF STRATEGIC SCANNING IN OBJECT-BASED ATTENTION**

Sarah Shomstein & Steven Yantis
Johns Hopkins University

Evidence has accumulated over the past decade suggesting that visual attention is often object-based (e.g., Egly et al., 1994). However, some recent studies have suggested that strategic effects such as scanning can contribute to object-based effects. In the present study, we manipulated the probability with which the target would appear in each of two uncued locations in order to influence the scanning order. In Exp. 1a, 92% of the invalidly cued targets were presented within the cued object while the remaining 8% were presented in a different object; the reverse was true for Exp. 1b. An object-based advantage was observed in Exp. 1a, but it was eliminated in Exp. 1b. In Exp. 2, 92% of the invalidly-cued targets appeared consistently in a prespecified absolute spatial location. Half of the time the high probability target appeared within the cued object. A 30 ms object-specific advantage was observed for both high and low probability locations. A simple scanning strategy cannot account for these object-based effects, providing further constraints on the mechanisms of object-based selection.

4:30 **PARALLEL RESPONSE-SELECTION IN DUAL-TASK SITUATIONS**

Scott Watter & Gordon D. Logan
University of Illinois at Urbana-Champaign; Vanderbilt University

Cross-task semantic and motor-response priming was studied with the PRP paradigm to investigate the potential parallel nature of dual-task response-selection processes. In three experiments, both tasks of a dual-task pair simultaneously primed, and were influenced by, response-selection information from the other. RT1 and RT2 were both faster when the finger used respond to Task1 was also used to respond to Task2. This effect was observed at all SOAs for Task2, and at short SOAs for Task1. This suggests Task2 processing had progressed sufficiently to produce response-related information which could prime Task1 response-selection. Priming of Task1 response-selection from Task2 response-selection information requires Task2 response-selection to begin before Task1 response-selection is complete – that is, for Task1 and Task2 response-selection processes to operate in parallel. This is direct evidence against the concept of a Response-Selection Bottleneck.

4:50 **TIME COURSE OF PERCEPTUAL GROUPING BY COLOR**

M.F. Schulz & T. Sanocki
University of South Florida

Does grouping of objects in spatial layouts operate early or late in visual processing? The present study addressed this question by examining grouping by color before and after chromatic color constancy had been established. Participants were asked to group elements in ambiguous stimulus arrays by chromatic color similarity. Elements could have been grouped by retinal wavelength (pre-constancy information available from the retinal mosaic) or perceived hue (information available only after color constancy operations). The stimuli were masked to limit processing time to 200, 500, 1100,



or 2000 ms. Participants grouped elements by retinal wavelength in shorter exposure times, and gradually switched to group by perceived hue in longer exposure times. These results are the first demonstration that grouping can operate on both a pre-constancy, retinal representation and a post-constancy representation. The results explain and integrate both the Preconstancy and Postconstancy theory of perceptual grouping.

5:10

EFFECTS OF DIVIDED ATTENTION ON THE REPRESENTATION OF A VISUAL SCENE

Sang Chul Chong & Anne Treisman

Department of Psychology, Princeton University

The question what properties emerge when attention is distributed over a global array is an intriguing one that has not been much studied. One set of properties that may become accessible are the general statistical properties of the array. We manipulated the deployment of attention using a dual task paradigm in which the secondary task required either global or focused attention. We then compared the accuracy with which participants could identify the mean of the array while simultaneously performing each of the two secondary tasks. We found lower thresholds for judging the mean size of discs in the array in combination with each of two global tasks – tracking three randomly moving squares, or judging whether the whole array was vertically or horizontally oriented – than in combination with the corresponding local tasks – tracking a single moving square, or judging the orientation of a small central rectangle. Global attention seems to be more effective than focused attention for extracting statistical properties, even when the difficulty of the secondary tasks is closely matched.



POSTERS

1. A TEST OF VIEWPOINT CONSTRAINTS ON PERCEPTION OF SPATIAL RELATIONS

Jennifer Perone & Thomas Sanocki
University of South Florida

This research examines a new prediction that falls out of viewpoint-dependent models of perception: That perception should be efficient for objects that conform to a single viewpoint and less efficient for objects that break this constraint: mixed-viewpoint objects. We generated mixed-viewpoint objects (which do not occur naturally) by taking pairs of cubes at varying orientations and reassembling them. The mixed viewpoint objects were constructed to break either metric property (MP) constraints on inter-edge relations or non-accidental property (NAP) constraints on inter-edge relations. Viewpoint-dependent theories predict that either type of violation in mixed-viewpoint objects will be disruptive. On the other hand, viewpoint-invariant models predict that perception will be disrupted only when NAP constraints are violated. We measured the speed of processing spatial relations within objects and, consistent with viewpoint-dependent models, we found that perception was disrupted by viewpoint mixing and equally so for MP and NAP violations.

2. OBJECT RECOGNITION FROM CANONICAL VIEWS: IMPLICATIONS FROM CASE STUDIES OF OBJECT RECOGNITION IMPAIRMENT

Jules Davidoff (1), Volker Thoma (1), Adriana Angeli (1) & Elizabeth Warrington (2)
(1) Goldsmiths College, University of London (2) National Hospital for Neurology and Neurosurgery

The primary aim of our study was to present neuropsychological data that clarified three issues concerning the central representations allowing the recognition of objects presented in conventional but not unconventional views. The first issue concerned whether excellent recognition of the whole object can take place without recognition of its parts; it can. The second issue concerned whether the representations that subservise recognition from conventional views are rich in detail concerning the surface qualities of objects and also of their precise shape; they are not. The third issue considered the extent to which representations for the recognition of conventional views are insensitive to orientation. We report a particular difficulty with the discrimination between mirror images. A patient with impaired recognition from both conventional and unconventional views was, paradoxically, only able to discriminate between mirror images of an object if she was unable to identify the object.

3. VIEWPOINT DEPENDENCE IN DISSOCIABLE SPECIFIC AND ABSTRACT VISUAL-FORM SUBSYSTEMS

E. Darcy Burgund
Washington University

Participants learned names for unfamiliar object categories, displayed from a single viewpoint, and then named objects presented directly to the right hemisphere (RH) or the left hemisphere (LH) and appearing in each of the following four conditions: same exemplar-same viewpoint, same exemplar-different viewpoint, different exemplar-same viewpoint, and different exemplar-different viewpoint, compared to training. When test objects were presented to the RH, changes in exemplar and changes in viewpoint had similar costs on performance. In contrast, when test objects were presented to the LH, changes in viewpoint had greater costs on performance than changes in exemplar. Results indicate that a specific subsystem operates more effectively than an abstract



subsystem in the RH and stores objects in a manner that is sensitive to exemplar and viewpoint information, whereas an abstract subsystem operates more effectively than a specific subsystem in the LH and stores objects in a manner that reflects its training history.

4. USING ATTENTIONAL CUEING TO EXPLORE PART STRUCTURE

Manish Singh (1) & Brian J. Scholl (2)

1) MIT & 2) Harvard University, Cambridge, MA

This study attempts to join two traditionally separate fields: object-based attention, and studies of perceptual structure which have typically relied on perceptual reports. Here we employ an attentional cueing method to explore part structure. The display on each trial consisted of a rendered 3D object embedded in a natural scene. On each trial, observers had to discriminate a target whose location on the object was cued in the presence of distractors. On invalid-cue trials, observers were faster to discriminate targets which appeared on the same part of the object compared to a different part, where 'parthood' was defined by negative minima of curvature. Furthermore, this effect was modulated by the salience of the parts. A specific conclusion we draw is that rigorously-defined 'parts' of single objects can function as units of attention. More generally, we stress the utility of this method as a tool for exploring perceptual structure in an objective manner.

5. INVESTIGATING THE FACTORS PRODUCING CP EFFECTS IN THE PERCEPTION OF FACE IDENTITY

Adriana Angeli, Jules Davidoff, & Tim Valentine

Goldsmiths College – University of London

The factors underlying the Categorical Perception (CP) of face identity were investigated in three experiments. Experiment 1 replicated the Beale and Keil's (1995) findings. Morphed faces from the same continuum were shown to familiar and to unfamiliar observers: only the former perceived the stimuli categorically. Experiment 2 failed to replicate the Levin and Beale's (2000) results. We tested 4 continua between unfamiliar faces: 3 of them were not perceived categorically. One continuum produced the CP effect but this result could be accounted for by the exceptional distinctiveness of one of the continuum end-points. In Experiment 3, a continuum between two typical faces and a continuum between a typical and a distinctive face were compared. The CP effect was found only on the typical-distinctive continuum. Familiarity is thus a sufficient but not necessary condition for perceiving face continua categorically. We claim that distinctiveness can also contribute in producing the CP effect.

6. HEMISPHERIC DISSOCIATION OF SHAPE AND TEXTURE PROCESSING DURING ENCODING AND RECOGNITION OF HUMAN FACES

Nikolaus F. Troje & Markus Hausmann

Ruhr-Universität-Bochum

The information contained in the image of a human face can be subdivided into components attributed to visual texture ("texture") and components attributed to configural relations ("shape"). Here, we present evidence for a dissociation of texture and shape processing in a same-different face recognition task by showing that hemispheric laterality is different for those two domains. Ten students participated in two experiments. In both experiments the two images of one trial differed only in their visual texture or they differed only in their shape. In Exp. 1 the first image was shown 6.3 degrees either to the left or to the right of a fixation point and the second image was shown centrally



(lateralized encoding). In Exp. 2 the first image was shown centrally whereas the second was presented peripherally (lateralized retrieval). In Exp. 1 shape processing shows a left-hemispheric dominance whereas texture processing shows a right-hemispheric dominance. In Exp. 2 the opposite is the case.

7. EYE MOVEMENTS AND THEIR FUNCTION IN HUMAN FACE LEARNING AND RECOGNITION

Richard J. Falk, John M. Henderson, Sridhar Mahadevan, & Fred C. Dyer
Michigan State University

This study examined the nature of eye movements during the learning and recognition of human faces. In Experiment 1, upright faces were studied during learning, and both upright and inverted orientations were presented during recognition. Participants freely moved their eyes during both learning and recognition. The eyes, nose, and mouth were selected for fixation with equal frequencies during learning and recognition, and inversion had little effect on the selection of these features during recognition. In Experiment 2, the necessity of eye movements during face learning was tested by requiring participants to maintain fixation the center of each face. The results suggest that the selection of diagnostic features via eye movements is important in face learning.

8. PHYSIOLOGICAL CORRELATES OF SCENE SIMILARITY IN RAPID VISUAL PERCEPTION

**Alexa I. Ruppertsberg*, Jochem W. Rieger*, Michael Deelwater*,
Bosco S. Tjan[§], & Heinrich H. Buelthoff***

*Max-Planck-Institute for Biological Cybernetics, Germany; [§] NEC Research Institute, USA

Previously, we found that local structure of a picture is used in early scene recognition (ARVO 1999, ECVF 2000). How specific does local structure information in a scene have to be to provide useful information for the recognition of the scene itself? By varying the degree of similarity of a scrambled picture to a scene we asked subjects in an RSVP-task to recognize parts of the presented scene. During the presentation we recorded the EEG from their scalp. Subjects' performance increased as similarity of the scrambled picture to the scene increased, indicating increasing information transfer from the processing of local structure to the processing of global configuration. In the EEG we found stronger positivity the more similar the scrambled picture was to the scene for sensors in the parietal central region. This suggests that early availability of local structure is needed for the proper encoding of the stimulus.

9. PICTURE PREFERENCE HABITUATION OF FULL COLOR SCENES

Edward A. Vessel & Irving Biederman
University of Southern California

We investigated the relationship between preference and repeated exposure for full color scenes. Subjects rated their preference for images presented for one second during a sequence which ultimately repeated each image ten times. Images which had high initial preferences (as determined by a pretest) were also initially rated high by the experimental subjects and declined moderately with repetition, approaching an asymptotic value that preserved the initial ordering. Those pictures which were highly preferred were natural vistas, in accordance with Kaplan's (1992) environmental preference theory. Habituation of picture preferences can clearly be demonstrated even over relatively brief (1 sec.) exposures distributed over a number of other pictures. Despite the



habituation, initial preferences over a set of pictures are highly predictive of their ordering after an equal number of repetitions.

10. EXPLORING THE DISTANCE-DENSITY MODEL USING ARTIFICIAL STIMULI

Daniel M. Weiskopf & James W. Tanaka
Oberlin College

Krumhansl's distance-density model predicts that the geometric, or Euclidean distance between objects in a similarity-space is not equal to the psychological distance between objects. According to the distance-density model, objects lying in denser regions of Euclidean space are shifted away from the origin towards sparser regions of psychological space. The current experiments further test the distance-density model by using simple artificial stimuli to create a similarity-space. The three experiments show that morphs of equal contribution from typical and atypical exemplars, thereby lying at the mid-point in Euclidean space, appear to be more similar to the atypical parent. These results are consistent with Krumhansl's prediction that objects are shifted away from dense regions of space.

11. OBJECT-BASED SELECTION: THE ROLE OF ATTENTIONAL SHIFTS

Dominique Lamy & Howard Egeth
Johns Hopkins University

The objective of this paper was to investigate under which conditions object-based effects are observed. Recently, Watson and Kramer (1999) used a divided attention task and showed that when top-down factors do not bias towards selection at higher levels, object-based effects are obtained only when targets belong to the same uniformly connected (single-UC) region. We claim that this framework does not suffice to delineate the boundary conditions of object-based selection. We propose that object-based effects are observed only when shifts of attention are required. The results of four experiments support this hypothesis. Stimuli and displays were similar to those used by Egly, Driver and Rafal (1994). Subjects made size judgments. Using several different paradigms, we obtained object-based effects when the task required shifts of attention (spatial cuing, same vs. different judgment with asynchronous target onsets), not when attention remained either broadly distributed (same vs. different judgment with simultaneous targets) or tightly focused (response competition).

12. OBJECT-BASED EFFECTS AND ATTENTION TO SPATIAL FREQUENCY

Alexandra List & Lynn C. Robertson
University of California, Berkeley

To investigate object influence on spatial attention, Egly et al. (1994) modified the Posner cueing paradigm using two rectangles. A predictive peripheral cue appeared at one end, and targets followed at one of three positions: cued (VALID), uncued within the same rectangle (INVWI) or uncued in the other rectangle (INVT). VALID responses were faster than INV responses. Importantly, although invalid distances from the cue were equal, the speed to respond to INVWI was faster than to INVT targets. This cost difference was interpreted as an object-based advantage. We have shown that certain stimulus parameters (e.g. luminance contrast, closure, density) modulate the object-based advantage. When local elements are more easily grouped together, object-based advantages disappear; as local elements are more easily parsed, object-based advantages strengthen. We test



the hypothesis that attention to relatively high or low spatial frequency contributes to these grouping effects and relate them to observed hemispheric differences.

13. OVERT AND COVERT OBJECT-BASED ATTENTION
Jason S. McCarley, Matthew S. Peterson, & Arthur F. Kramer
University of Illinois at Urbana-Champaign

Two experiments employed a modified object-cuing paradigm to examine the role of perceptual objects in control of overt and covert attention. Stimuli were displays of two side-by-side rectangles. Observers were asked to respond to a target appearing either at a cued location within one rectangle, at an uncued location within the same rectangle, or at an equidistant uncued location within the alternate rectangle. Gaze-contingent displays ensured that eye movements were necessary for target identification. Experiment 1 found that gaze shifts were more likely within than between objects following initial fixation on an invalidly-cued location, but were not reliably faster. Correspondingly, Experiment 2 found no evidence that covert processing of stimulus identity was facilitated within a fixated object. Results indicate a within-object bias in saccade target selection, but not in the allocation of covert attention during a fixation.

14. OBJECT-BASED ATTENTION REQUIRES OBJECTS: A COMMENT ON LAVIE AND DRIVER (1996)
Ming-Chou Ho, Paul Atchley, Ateshi Shellourne, & Lesa Hoffman
University of Kansas

While numerous studies have reported that attention can be object-based, some have suggested that spatial attention is the most basic form of visual attention (Lavie and Driver, 1996). In this study, we examined attention with a cueing paradigm across three conditions: a) a purely spatial case (no objects) b) and intermediate object case in which the cue preceded the objects and the target and c) an object case in which the objects preceded the cue and target. Consistent with Lavie and Driver, there was no evidence for object-based attention in the second case. However, clear evidence for object-based attention was found in the third case and in comparisons of performance in conditions (a) and (c). The results suggest that the primacy of spatial attention may be an artifact of the absence of objects. When objects are present, object-based attention may be the primary attentional allocation process.

15. WHAT YOU SEE IS WHAT YOU SET: THE ROLE OF ATTENTIONAL SET IN EXPLICIT ATTENTIONAL CAPTURE
Steven B. Most, Erin Clifford, Brian J. Scholl, & Daniel J. Simons
Harvard University

Studies of attentional capture have traditionally measured involuntary diversions of cognitive resources by relying upon "implicit" measures. For example, unnecessary eye-movements and slowed response time on a primary task have been used to infer attentional capture by task-irrelevant items. However, one aspect of attentional capture that has been far less studied has been its "explicit" component-when are unexpected items consciously detected? Using a newly developed technique, our studies reveal that explicit attentional capture largely depends on the observer's attentional set. Observers attended to a subset of items in a computer display and then were asked if they had detected an additional, unexpected item that had been present for 5 seconds. Consistent with work on "contingent capture," observers flexibly established a task-specific attentional set that



determined which stimuli were detected. Observers failed to detect with surprising frequency even extremely salient, novel stimuli that did not fall within these parameters.

16. THE ROLE OF COMPETITION BETWEEN SPECIFIC FEATURES OF TARGETS AND MASKS IN THE ATTENTIONAL BLINK

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We examined the effects of manipulating the featural similarity of targets and their masks in an RSVP display. Target and mask items could belong to either of two sets of letters, diagonal (V, W, X, Y) and rectilinear (E, F, H, T). Round letters (O, G, etc) were used for the other RSVP items. When a target and its mask were from the same set, attentional blink (AB) was much greater than when the two items came from different sets. This effect held for both the first (T1) and second (T2) targets, although a higher degree of similarity was required between T2 target-mask pairs. Lag-1 sparing was also reduced by similarity between T2 and its mask. The similarity of T1 to T2 had little effect. These results suggest that the process of disambiguating both targets from their masks is a key factor in creating the AB.

17. DETECTING GRADUAL CHANGES TO SIMPLE DISPLAYS.

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Harvard University

Recent research on induced change blindness suggests that less information is stored in conscious visual memory than our experience leads us to believe. Change detection experiments typically induce change blindness by presenting a visual disruption between an original and an altered display. We have developed a new technique that introduces a change via a gradual dissolve, eliminating the need for a disruption. With natural scenes this technique produces substantial change blindness even though observers actively look for the changing object. In this paper, we present a new set of studies using simple displays that explore gradual change detection performance under variations in set size, change luminance range, change area, and attentional focus. We find that the detection of change signals is more difficult with larger set sizes, suggesting that attending to a changing item improves detection. Surprisingly, neither the physical area of the change nor varied distances between possible change locations appears to influence detection rates.

18. WITHOUT EXPLICIT DETECTION, CHANGE LOCALIZATION IS CHANCE LOCALIZATION.

Stephen R. Mitroff & Daniel J. Simons

Harvard University

Several recent papers find implicit change detection even in the absence of explicit awareness, suggesting that implicit detection might guide explicit localization. Yet, we find that changes are not localized in the absence of explicit detection. In several experiments, we show that when observers do not explicitly detect a change, localization performance is as inaccurate as when there is no change present (Mitroff & Simons, submitted). In measuring the presence of implicit detection, chance performance is often considered to be $1/n$, where n equals the number of potentially changing objects. In determining what constitutes chance performance, the ability of observers to eliminate those objects they know did not change should be considered. Given both empirical and theoretical estimates of the number of items that can be eliminated, we find no evidence for implicit detection or for better than chance localization in the absence of explicit awareness of the change.



19. LESS ATTENTION IS MORE IN THE PREPARATION OF ANTISACCADES

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We report three experiments where saccades were to be made to a displaced target (prosaccades), or saccades of equal size in the direction opposite to the stimulus (antisaccades), while a secondary discrimination task was also to be performed. While prosaccade latency was increased irrespective of when the secondary task was presented, antisaccade latency decreased to well below baseline performance when the secondary task was presented 100 to 300 milliseconds before the saccade target moved, but increased if the task was presented simultaneous to, or 100 to 200 milliseconds afterwards. While the results appear counterintuitive they accord well with the hypothesis that antisaccades require the suppression of a reflexive saccade towards the stimulus, as well as the generation of an antisaccade away from it. We propose that the secondary discrimination task interferes with the reflexive prosaccade allowing faster antisaccades than otherwise. Possible neural correlates of such a process are discussed.

20. PERCEPTUAL INHIBITION AND RESPONSE COMPETITION AT SMALL SEPARATIONS

Larence Becker & Howard Egeth

Johns Hopkins University

Perceptual processing of a pair of object locations was investigated by having subjects identify two briefly presented and masked letters. When only the targets were present, identification performance increased as spatial separation between targets increased. When the target letters were shown in displays crowded with distractor letters of a different color, performance improved with separation, but not monotonically; it was worst when a single distractor letter intervened between the targets. When distractors were numbers, performance again improved monotonically with separation distance (similar to when there were no distractors). These results support a center-surround model of processing for tasks requiring focused attention (Bahcall & Kowler, 1999). In addition, the extent of attentional interference was unaffected by different levels of crowding (see also Mounts, in press). It was also shown that performance deficits at small separations, which might appear to be the result of inhibited processing, really are evidence of response competition

21. PERCEPTION OF CONE STRUCTURE FROM MOTION

Baoxia Liu & James T. Todd

Ohio State University

Observers viewed a rotating cone monocularly and were asked to change the curvature of the cone in one dimension to make it appear as a circular cone. The axis of rotation and the direction of the adjustment were varied systematically to investigate whether there is an anisotropy in the perception of the curvature of a curved surface with different rotation axes. The results show that the rotation axis (vertical or horizontal) did not affect the perception of the surface curvature. However, the perception was more accurate when the curvature of the cone could be adjusted in a diagonal direction rather than the vertical or horizontal. The result did not replicate the anisotropy found in previous research on the perception of the slant of planar surfaces under different moving conditions.



22. WHAT DETERMINES VISUAL SENSITIVITY TO HUMAN MOVEMENT?

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Humans are exquisitely sensitive in their visual analyses of human movement. What accounts for this sensitivity? The visual analysis of human movement may differ from other motion analyses because observers have extensive experience watching other people move. However, since humans both produce and perceive human movement, visual analyses may benefit from motor system input. To test these alternatives, participants viewed sequentially presented point light walkers and reported which walker would fatigue first. In Experiment 1, walking gait was either efficient and frequent or inefficient and infrequent. Observers easily discriminated between efficient and inefficient gaits of the same walking speed. In Experiment 2, walking speed varied and gait frequency remained constant. Sensitivity to walker speed was independent of gait frequency. These results did not hold for inverted walkers. Thus, the visual perception of human movement appears to depend upon perception-action coupling rather than visual experience.

23. CHANGES IN DRIVING STYLE WITH ADAPTATION TO VISUALLY DELAYED FEEDBACK

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Max-Planck-Institute for Biological Cybernetics

It is well known that even a small delay between an action and its consequences can impair or disrupt a number of perceptual processes. Previously, we have shown that while a 250 ms delay initially disrupts action-perception coupling (e.g., it impairs performance on motor skill tasks like obstacle avoidance or driving), the proper training improves performance in a manner that is consistent with sensorimotor adaptation to intersensory temporal delays. Here we extend these findings to a larger range of time delays, and quantitatively analyze changes in control style. Overall, larger feedback delays resulted in a greater initial impairment. However, training improved performance for all levels of delay, and returned subjects' control style to a more normal, skillful steering behavior.

24. APPROXIMATE ARITHMETIC WITH LARGE VISUAL AND CROSSMODAL SETS

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Our previous studies suggest that non-numerical stimulus properties, such as density or area, are used in the formation of a quantity representation that is independent of the modality or format of the stimulus (Barth, Kanwisher, and Spelke, submitted). Here we assessed adults' ability to manipulate these abstract quantity representations by performing approximate addition operations on large sets (dot arrays and tone sequences). We found that performance on an addition task that involved both summation and comparison was no worse than performance on the comparison task alone. Further, there was no cost for adding sets across modalities. These findings provide additional evidence for the abstract nature of approximate representations of large numbers; adults can perform approximate arithmetic operations quite easily, even when the modalities of the addend sets differ. We will discuss possible explanations of the nearly identical performance on approximate addition relative to comparison tasks.