Configural Processing Consortium (CPC) 2010

Wednesday, November 17, 2010
Washington University
St. Louis, MO

LOCATION: The meeting will be held in **Danforth University Center (DUC), room 276.**
The building is #27 in this map: http://www.wustl.edu/community/visitors/maps/danforthmap.pdf
The closest Metrolink stop would be **University City/Big Bend** (marked "M" in map region F-1)
Further instructions are posted online: http://www.indiana.edu/~psymodel/CPC2010/index.html

Meeting's schedule:

08:30 – 09:00: Arrival & coffee
09:00 – 09:30: Welcoming (Ed Macias, Washington University provost)
09:30 – 10:15: General audience talk I (Jeff Zacks)
Title: "Events: Gestalts in Time."
10:15 – 10:30: Coffee break
10:30 – 12:30: Morning session (modelling, neurological damage, memory)
Presentations: Fific, van der Helm, Townsend, Peterson, Cacciamani, Bartlett, Pomerantz, Roddy [Discussants: Roddy, Heathcote, Stupina]
12:30 – 13:30: Lunch (provided)
13:30 – 14:15: General audience talk II (Rutie Kimchi)
Title: Faces as Perceptual Wholes: The Interplay between Component and Configural Properties in Face Processing
14:15 – 16:15: Afternoon session (shape perception)
Presentations: Palmer, Garrigan, Sawada, Kellman, Pizlo, Eidels, Greenberg [Discussants: Bartlett, Peterson]
16:30 – 16:45: Coffee break
16:45 – 17:45: General discussion (Discussants)
18:00 Closing
18:30 Banquet:
Eclipse restaurant (http://www.eclipsestlouis.com)

Organizing committee:
Roddy Roediger, Jeff Zacks, Leslie Blaha, Ami Eidels, Ruth Kimchi, Mary Peterson, Jim Pomerantz, Jim Townsend.

Participants (listed alphabetically):
Jim Bartlett, Devin Burns, Laura Cacciamani, Ami Eidels, Mario Fific, Patrick Garrigan, Tandra Ghose, Adam Greenberg, Andrew Heathcote, Drew Hendrikson, Joseph Houpt, Robert Hawkins, Arash Khodadadi, Hannah Leeper, Phil Kellman, Ruth Kimchi, Steve Palmer, Mary Peterson, Zygmunt Pizlo, Jim Pomerantz, Mary Portillo, Roddy Roediger, Tadamasa Sawada, Anna Stupina, Jim Townsend, Peter van der Helm, Anthony Wright, Haiyuan Yang, Jeff Zacks

Configurations and Conjunctions in Memory

James C. Bartlett, University of Texas at Dallas

Over the years researchers of memory have occasionally sought to distinguish associative from configural or "unitization" processes. I review some of these efforts, discussing their strengths and weaknesses, and suggest a new approach that might complement others based on a phenomenon of false memory known as "conjunction effect." Some data from an ongoing study are presented to illustrate the approach.

Holding Faces in Working Memory Interferes with Face Discrimination but not Object Discrimination

Laura Cacciamani & Mary A. Peterson, University of Arizona

Similar areas of the prefrontal cortex (PFC) are activated for face working memory (WM) and face perception, but not object perception. We used a face WM task to overload the PFC in healthy participants while they made difficult same-different discriminations for faces and cars. On face discrimination trials, subjects made more errors (FAs) with versus without a face WM load, whereas car discrimination was unaffected. It is known that PFC damage increases face recognition FAs. The presence of similar impairments in neurologically intact individuals with saturation of face-specific PFC provides behavioral evidence regarding the neurological underpinnings of face perception.

Defining Configural Processing via Ideal Observer Analysis (Are Pyramids special? They are for me)

Ami Eidels, University of Newcastle

In previous CPC meetings I attempted to define configural processing via ideal observer analysis. *Ideal observer* is a theoretical device that performs a given task in an optimal fashion, and thus serves as an 'information meter', or a gauge for tasks' difficulty. *Efficiency* in any given task is defined as the ratio of ideal to human threshold energy. Because comparison of the human threshold to the ideal observer controls for differences in available information, variations in efficiency across experimental conditions, tasks, and stimuli imply variations in the ability of the human observer to use available information. I propose that *configural figures* may be processed more efficiently, suggesting improvement in processing rather than in the amount of information available for processing. I shall present new analysis of data collected with Jason Gold, calculating efficiencies for individual items (3D objects, letters). I shall test whether certain forms (pyramids) are processed 'better', and, if time permits, discuss implications from Multi Dimensional Scaling analysis.

Information-Processing Architectures in Classification of Separable- and Integral-dimension stimuli: A Validation Test of the Systems Factorial Technology

Mario Fifić, Max Planck Institute for Human Development
Robert Nosofsky & James Townsend, Indiana University

A growing methodology, known as the systems factorial technology (SFT), is being developed to diagnose the types of information processing architectures (serial, parallel, or coactive) and stopping rules (exhaustive or self-terminating) that operate in tasks of multidimensional perception. Whereas most previous applications of SFT have been in domains of simple detection and visual/memory search, this research extends the applications to foundational issues in multidimensional classification. Experiments are conducted in which subjects are required to classify objects into a conjunctive-rule category structure. In one case the stimuli vary along highly separable dimensions, whereas in another case they vary along integral dimensions. For the separable-dimension stimuli, the SFT methodology revealed a serial or parallel architecture with an exhaustive stopping rule. By contrast, for the integral-dimension stimuli, the SFT methodology provided clear evidence of coactivation. The research adds to the list of converging operations for distinguishing between separable-dimension and integral-dimension interactions.

Principled Approaches to Studying Shape Representation

Patrick Garrigan, Saint Joseph's University

Sensory and perceptual systems extract and process information about the environment to inform decisions and guide behaviors. At each stage of processing, information is represented in increasingly complex formats, ultimately corresponding to percepts. Early visual representations are well described as an optimal solution to the problem of extracting as much visual information from the environment as possible, given biophysical constraints. I will discuss how this approach can be augmented for studying abstract, high-level visual representations, specifically the representation of shape. In early visual representations, information maximization makes sense without considering specific behaviors. If behavioral relevance were to constrain the information encoded in early representations, behaviors would not be modifiable when conditions changed and different information became important. Higher-level representations should be efficient, but they must also support specific behaviors. Shape representations, for example, must be appropriate for tasks like recognition and comparison. Consequently, besides efficiency, shape codes must also be concerned with concepts like viewpoint invariance, similarity, and partial occlusion. In order to understand the design of high-level visual representations, both task-based constraints and efficient coding principles must be considered.

Quantifying the Emergence of the Whole via Attention and Reverse Correlation

Adam Greenberg & Marlene Behrmann, Carnegie Mellon University

A major challenge of configural processing research has been devising a quantitative metric by which to relate fundamental principles that drive holistic perception. We have recently explored two such measures in the context of perceptual grouping, both of which possess the following critical characteristics: (1) a common scale can be used to compare directly the effectiveness of individual (or joint) Gestalt grouping principles, (2) the paradigms measure processes that are tightly coupled to those used in everyday scene perception, and (3) the stimuli are flexible enough to study a large array of object contexts. We will argue that these characteristics are vital to rigorous study of perceptual grouping and show examples of these two specific measures: one grounded in object-based attention and the other in reverse correlation techniques. We will present results demonstrating the use of these measures to quantify the comparative strength of a range of individual perceptual grouping cues in constructing perceived objects from their component structures.

From Early Visual Mechanisms to Contours and Objects: Challenges for Models of Contour Interpolation

Phil Kellman, University of California, Los Angeles

Crucial to object perception in ordinary seeing are processes that connect visible fragments across gaps created by occlusion. Perhaps the most important of these processes is contour interpolation. Neurally plausible models have been proposed for illusory contour interpolation but seldom for interpolation of occluded contours. The identity hypothesis (Kellman & Shipley, 1991) posits that an early interpolation mechanism is shared by interpolated contours that are ultimately perceived as either illusory or occluded. I will briefly describe a recent model of such a unified interpolation mechanism for illusory and occluded contours (Kalar, Garrigan, Wickens, Hilger & Kellman, 2010), building on the framework established in Heitger, von der Heydt, Peterhans, Rosenthaler, and Kubler (1998). A single, neurally plausible mechanism consistent with the identity hypothesis also generates contour interpolations in agreement with perception for cases of transparency, self-splitting objects, interpolation with mixed boundary assignment, and ‘‘quasimodal” interpolations.

While such models are useful for describing early interpolation mechanisms, they have severe limitations. Although it is sometimes overlooked, this and related models of perceptual organization do not produce symbolic descriptions -- descriptions that identify contour or object tokens as units or provide functionally useful shape descriptions for such units. I will use Kalar et al (2010) model to illustrate these limitations and discuss the crucial challenges of bridging the gap between subsymbolic and symbolic models of visual processing.

Faces as Perceptual Wholes: The Interplay between Component and Configural Properties in Face Processing

Ruth Kimchi, University of Haifa

The relative dominance of componential and configural information in face processing is a controversial issue. I will describe two studies that address this issue. The approach taken in these studies is derived from the notion that a face is a multidimensional visual object that has both component and configural properties, and the critical question is whether configural properties dominate component properties in object identification, discrimination, or classification. In the first study we systematically manipulated the discriminability of facial components (eyes, nose, and mouth) and examined whether the discriminability of components predicts the discrimination of faces with similar vs. dissimilar configural information (inter-eyes and nose-mouth spacing). The second study examined how componential information and configural information interact during face processing, using Garner's speeded classification paradigm. Taken together, the results of these studies provide strong converging evidence that componential information and configural information are integral in upright face processing, with no dominance of one type of information over the other. Processing of inverted faces is dominated by componential information. The results further demonstrate that facial components are processed independently.

CSI Berkeley, Episode II: The Case for Edge Assimilation

Stephen E. Palmer, Karen B. Schloss & Francesca Fortenbaugh
University of California, Berkeley

The Configural Shape Illusion (CSI) is a spatial illusion in which the shape of a rectangular target (T) is distorted by an attached inducer (I). In particular, the target's perceived aspect ratio is distorted toward the aspect ratio of the whole configuration, and the strength of the distortion increases with the strength of target-inducer grouping. We now show that CSI magnitude is an inverted U function of the inducer extent, that it scales with the size of the whole configuration, and that it is larger for two “split” inducers on opposite sides of the target than for a single inducer of the same total size. These results are consistent with an explanation in terms of edge assimilation: The extent of the target increases at each edge by an amount that is a function of the length of the inducer along that direction relative to the length of the whole configuration, and depends on the strength of the grouping between the target and inducer.

Familiar Configuration Effects on Figure-Ground Perception Are Impaired By Perirhinal Cortex Damage

Mary A. Peterson, University of Arizona

Which brain regions are involved in processing familiar configurations? There is some evidence that the perirhinal cortex is involved in discriminating stimuli with many overlapping features. Thus, it may be involved in discriminating configurations made up of the same parts arranged in different spatial relationships. Morgan Barense and I tested whether two patients with damage to the perirhinal cortex and hippocampus (HC) of the medial temporal lobe showed normal effects of familiar configuration on figure-ground perception. We compared their performance to that of two types of control subjects: 17 age-matched controls without brain damage, and 2 control subjects with focal HC damage (perirhinal cortex intact). Both types of control subjects showed normal effects of familiar configuration on figure assignment in that they reported that the perceived figure lay on the side of a border where an intact familiar configuration (e.g., a portion of a lamp, a sea horse, a pineapple, etc.) lay significantly more often than they reported that the perceived figure lay on the side of a border where the same parts were sketched, but in a spatially rearranged ("scrambled") order. In contrast, patients with perirhinal cortex damage showed effects of familiar *parts* rather than familiar *configuratio*n; they reported seeing the figure on the critical side of a border on a large percentage of trials regardless of whether it depicted a familiar configuration or a scrambled version of a familiar configuration; this percentage was reduced by stimulus inversion which rendered the parts less familiar. We interpret our results as evidence that the intact perirhinal cortex discriminates familiar from novel configurations; when it detects a novel configuration composed of familiar parts, it reduces part familiarity responses in lower-level brain regions. Damage to the perirhinal cortex impairs discrimination of novel versus familiar configurations, consequently lower-level part familiarity responses are not reduced; they can still drive figure-ground perception. These results show that the perirhinal cortex, a memory structure, formerly thought to be involved in declarative memory only, is involved in representing familiar configurations of parts.

Any 2D Image is Consistent with a 3D Symmetric Interpretation

Zygmunt Pizlo, Purdue University

Symmetry has been shown to be a very effective *a priori* constraint in solving a 3D shape recovery problem. Symmetry is useful in 3D recovery because it is a form of redundancy. There are, however, some fundamental limits to the effectiveness of symmetry. Specifically, given two arbitrary curves in a single 2D image, one can always find a 3D mirror-symmetric interpretation of these curves under quite general assumptions. We formally stated and proved this observation for the case of one-to-one and many-to-many point correspondences. I will show several demos illustrating this theoretical result and will discuss the role of degenerate views, higher-order features in determining the point correspondences, as well as the role of the planarity constraint. When the correspondence of features is known and/or curves can be assumed to be planar, 3D symmetry becomes non-accidental in the sense that a 2D image of a 3D asymmetric shape obtained from a random viewing direction will not allow for 3D symmetric interpretations.

Organization in Perception and in Memory

James R. Pomerantz, Rice University

Research in perceptual organization aims to identify the effective units in perception, but a comparable challenge is to identify those effective units in memory. Are configurations of items (wholes) remembered as the sum of their individual items (parts)? Does the grouping of items into larger memory chunks change the strength and nature of their memory? Are the basic units of memory the same as those in perception? I will try apply some of what we have learned from findings in perceptual organization (where arguably we have better control over the stimulus) to visual memory, looking for configural superiority effects in recall.

The Role of 3D Symmetry in Figure-Ground Organization

Tadamasa Sawada, Purdue University

Most objects in our environment are symmetric and volumetric. In contrast, the spaces between objects, representing the background, are not volumetric and are almost never symmetric. These two constraints, symmetry and volume, have already been shown to be effective in figure-ground organization. Note, however, that 3D symmetric shapes rarely produce symmetric retinal images. I examined whether a 2D asymmetric image of a 3D symmetric shape is more likely to be perceived as figure compared to the 2D asymmetric region representing the background. We tested human performance on a shape-matching task using signal detection experiment. If the observer perceives a given region in a stimulus as a figure (object), then she should be able to recognize its shape. Note that in the case of the background, the subject perceived a 2D shape, but in the case of the image of a 3D symmetric shape the subject perceived a 3D shape. Preliminary results suggest that a given region in the 2D image is more likely to be perceived as figure, if it is a projection of a 3D symmetric shape.

Toward a Taxonomy for Holistic Classification

James Townsend, Indiana University

Abstract: From the time when the paradigm-shifting gestalt engine appeared on the scene in the early 19th century, an amazing quantity of results and knowledge has accrued concerning configural aspects of perception. However, it seems fair to say that the information processing revolution, underway since the 1960s, largely neglected the evident goal of working out the subsystems responsible for configural perception. We earlier proposed a set of working axioms concerning how gestalt concepts might be incorporated in quantitatively precise information processing systems involved in classification (e.g., identification; categorization; search). The overall plan is to provide a useful taxonomy as well as an adjoined meta-theory which can help propel new methodologies and individual for specific perceptual and cognitive issues. This presentation expands and refines this new meta-theory.

Multidisciplinary Modeling of Perceptual Organization

Peter A. van der Helm, Radboud University Nijmegen, The Netherlands

The Gestalt motto "the whole is something else than the sum of its parts" is taken to hold that a perceived whole emerges from a nonlinear interaction between percepts of available stimulus parts. Such a nonlinear interaction can be modeled in terms of both dynamic systems theory, connectionism, and representational theory. These three modeling approaches highlight different aspects, but they can also be said to run parallel to David Marr's levels of description. The question therefore is: Do these three different modeling approaches exclude each other, or do they rather give complementary descriptions? The idea of complementarity is illustrated by sketching a representational account of the dynamic phenomenon of neuronal synchronization in the brain's visual network.

Events: Gestalts in Time

Jeff Zacks, Washington University

Objects are (in part) spatial gestalts, and events are (in part) spatiotemporal gestalts. In this talk I will explore the analogy between objects and events in perception, describe a theory of how events are individuated, and describe behavioral and neuroimaging data characterizing how discontinuities in the perceptual stream can cause events to be segmented from the stream of behavior.