Configural Processing Consortium (CPC), 2012

University of Minnesota

Wednesday, November 14, 2012

WHEN: Wed., November 14th, starting at 9am.

WHERE: **Mississipi room** (3rd floor, room 321) in **Coffman Memorial Union**

HOW to get there: Maps are attached at the end of this program

From the Psyx hotel it is recommended to take a taxi (2.3 miles)

WHAT:

9:00-9:15am Arrival & welcome

9:15-10:00 Talk 1 (Steve Palmer)

10:00-10:15 Morning break

10:15-11:45 Session I (Eidels, Viemeister, Ruggles, Schloss, Sarris, Biederman)

11:45-12:30 Lunch break

12:30-1:15 Talk 2 (Jim Townsend)

1:15-2:45 Session II (Peterson, Overliet, Orsten, Little, Kellman, Herzog)

2:45-3:00 Afternoon break

3:00-4:45 Session III (Goldstone, Garrigan, Kimchi, Jiang, Franconeri, Fific, Enns)

4:45-5:00pm Conclusion

6:00pm dinner? (dinner plans to be discussed during the meeting)

Website: http://www.indiana.edu/~psymodel/CPC/

Contact: Ami.Eidels@newcastle.edu.au

Les mains sales: An applied perspective on configurality (T 1, 4)

Kevin Bennet

Wright State University

Configurality has played a prominent role in the historical development of principles for visual display design. While the presence of salient, higher-order visual properties (i.e., emergent features) is necessary for effective design, it is not sufficient. These emergent features must also be well-mapped to the properties of the work domains that they are designed to represent. Substantial challenges are introduced by virtue of the fact that these work domains are complex and dynamic. As a result, the representations must also be complex: domain semantics are hierarchically-nested across multiple levels of abstraction (e.g., goals, functions, physical resources). The challenge is to match the relative salience of representations at various levels with the relative importance of the underlying information. The representations must also be dynamic. This further complicates the challenge: the relative salience of emergent features has been shown to vary widely with the rearrangement of its contributing parts. From an applied perspective, the most important part of configural processing is meaning. Meaning is established in computer-mediated work by mutually constraining interactions between humans, ecologies, and representational forms.

The Neurocomputational Basis of Configural Effects

Irving Biederman

University of Southern California

The configural representation of faces is reflected in their enhanced recognition among alternatives differing in the shape of a single part, e.g., the nose, than that part in isolation. What could be the neurocomputational basis of such configural effects? If faces are represented as an array of their relative Gabor filter values, then the low and medium spatial frequency kernels within a cortical column with their receptive fields all centered at the same point in the visual field (termed a "Gabor jet"), will have r.f.s covering large regions of the face, with their activation values affected not only by the shape of a part near the center of their r.f., but the image variations produced by the shapes and spacing of other face features. Consequently, the original activation values of the kernels in a jet centered, say, on the nose in the context of a face can be markedly different from the activation produced by that face part when it is surrounded by empty space. The "configural" representation of objects does not retain the Gabor signatures but, instead, specifies the nonaccidental (vs. metric) attributes of the edges composing the parts, a neurocomputational basis quite different from that for individuating faces.

Uncovering configural processes: structural form modelling of human and ideal observers (T 1, 4)

Ami Eidels, Peter Casey, and Scott Brown

University of Newcastle, Australia

Eidels and Gold collected identification data from human- and ideal-observers in two identification experiments, with 3D computer-rendered objects, and with the Roman alphabet letters. Both human and ideal observers were presented with a signal (object, letter) embedded in static Gaussian noise, and identification thresholds, efficiencies (human-to-ideal threshold ratio), and confusion data (confusion matrices) were recorded.

The ideal observer sets the benchmark for performance given a set of stimuli and the demands of the task, whereas human observers' data reflects also psychological constraints and biases. In past CPC meetings I used Multi-Dimensional Scaling and proposed that Configural Processes can be considered by examining if and how confusion patterns obtained by human observers differ from that of the ideal.

In this talk I will demonstrate another way to look at the data, by using Structural Form Modeling. Kemp and Tenenbaum (2008, PNAS) developed a computational modelling techniques that finds the best structure and form for a given dataset. We use this technique to explore (dis)similarities between human and ideal observers.

Human listener sensitivity to synergy in jazz duets

James T. Enns, Ana Pesquita, and Timothy Corlis
University of British Columbia

Humans are exquisitely sensitive to social signals and interactions (Merker, 2000; Panksep, 2009). One of the evolutionarily oldest and still popular modes of social interaction is the live musical performance. Listeners often claim to be able to hear when a musical ensemble is 'in the groove,' 'tight,' 'really rockin'. In our study we defined synergy using the gestalt construct of configurality, namely, the value added to experience when musicians produce music in cooperation that could not be obtained independently. Musical duets by elite jazz musicians playing 12-bar blues standards were recorded under three conditions, varying in the opportunity for cooperation: (1) Live duets – musicians could both hear and respond to one another in real-time, (2) Dubbed duets – one musician played to a pre-recorded song without knowledge that the other musician was a recording, (3) Studio duets – two tracks from separate live recording sessions were combined post hoc to create a duet recording. Participants (n=70) listened to these selections, taken randomly from 6 different songs, and rated their experiences on dimensions of synergy, creativity, emotionality, and engagement. The results showed considerable sensitivity to musical synergy, with sensitivity varying with social intelligence and musical training of the participant.

A snake wiggle of reaction time functions to indicate holistic perception (T 2)

Mario Fific

Grand Valley State University

We analyzed the underlying fundamental processes engaged in forming holistic perceptual representations. The subjects participated in a face categorization task over multiple sessions. We applied the systems factorial technology (SFT) to analyze the properties of the observed response time (RT) distributions. The key statistic was a survivor interaction contrast function (SIC). Over the course of extensive practice, the observed SICs exhibited a specific pattern of shape transformations that could be described as a "snake wiggle". The observed SIC signature indicated that the processing mechanism behind holistic perception relies on strong positive facilitation between feature detectors, within the parallel mental network. The converging evidence is provided by the additional qualitative RT test (Fific, Little & Nosofsky, 2010).

A mechanism for similarity grouping (T 1)

Steve Franconeri

Northwestern University

Existing work suggests that connectivity and similarity grouping rely on dissociable processes. Using both visual search and rapid enumeration tasks, I will show evidence that while connectivity groups are available in parallel, similarity grouping is a serial operation that constructs only a single group at a time, via feature selection of a single color, shape, or orientation. Given two pennies and two dimes on a table, one can group only the pennies or the dimes at a single instant, by selecting either color. I will also argue that common fate motion is a type of similarity grouping, via feature selection of a single motion vector. Although similarity grouping cues can be powerful, this account can explain their limitations and flexibility, and makes new predictions about their limitations. Finally, I will show links from such basic research on perceptualorganization to current hurdles in information visualization.

The ubiquity of configural processing in visual cognition   (T 1, 4)

Yuhong Jiang

University of Minnesota

Perceptual grouping is traditionally grounded in stimulus properties: similarity, proximity, common fate, and so on. Yet the cognitive system also exerts organization on seemingly unrelated sensory input. In this talk I discuss several findings that exemplify top-down, yet largely automatic, relational coding, including configural processing in visual short-term memory, contextual processing in visual search, and temporal yoking in dual-task processing. I conclude that when defined broadly, configural processing is a basic principle of human information processing.

Stimulus-driven attentional capture by 'objecthood'

Ruth Kimchi

University of Haifa, Israel

The Gestalt organization factors are likely to arise from environmental regularities, probabilistically implying objects in the environment. Presumably, favoring a perceptual unit that conforms to Gestalt factors is a desirable characteristic for a system whose one of its major goals is object identification and recognition. In this talk I will present a series of studies that address the following questions: (1) When some elements in the visual scene are organized by Gestalt factors into a coherent perceptual unit (an "object"), is visual attention automatically deployed to the object? (2) Which Gestalt organization factors suffice for an "object" to capture attention? (3) Does the strength of perceptual organization affect the ability of the "object" to capture attention? The results demonstrated that an "object" per se can capture attention, provided the presence of colinearity or closure but not symmetry alone, and that this attentional capture depends on the strength of the organization. I suggest that automatic, stimulus-driven capture of attention by an "object" may provide (a) a single account for a variety of 'object-advantage' effects reported in the literature, and (b) insights into the nature of "objecthood".

Formation of Contour Shape Representations (T 4)

Patrick Garrigan

Saint Joseph's University

Shape representations form quickly, but behavioral evidence shows different access to information at different processing times. Measuring simple shape-related judgments at short time scales may tell us much about how configural processing affects performance, and ultimately about shape representation itself. Here I will first present evidence of how relational information that is available for efficiently representing shapes viewed for 1000ms is not available at 500ms. Next I will present a novel paradigm (actually a hybrid of the change blindness and gradual change blindness paradigms) in which subjects view a single, flickering movie of one shape morphing into another. This paradigm induces change blindness for single, attended shapes even when the type of change that will occur is known. It is useful for investigating the formation of shape representations. Our experiments suggest that participants continuously update their representations of viewed shapes. This updating appears unavoidable. Even when participants are explicitly instructed to remember the initial frame of a shape morphing sequence, their memories of the first frame presented are still altered by subsequently viewed frames. The approach used here may help us better understand the formation of representations underlying configural processing.

Gestalt principles of perceptual organization in mathematical reasoning (T 1)

Robert L. Goldstone, Indiana University

David H. Landy, University of Richmond

Gestalt principles of perceptual organization are potentially applicable to mathematical reasoning tasks because a considerable proportion of mathematical cognition involves perceptual processing. This proportion is greater than might initially appear because perceptual processing of symbolic notation tends to be underemphasized. In an attempt to dissolve the dichotomy between symbolic and perceptual processing, we report empirical evidence that Gestalt laws of proximity, closure, connectedness, and similarity play a powerful role in algebraic and arithmetic reasoning tasks. We also report ways in which mathematical structure influences perceptual objecthood. Mathematical ability both influences, and is influenced by, the perceptual organization of mathematical notation. We describe applications of these ideas to the development of an interactive algebraic tutoring system.

The emergence of good Gestalt (T 3,2)

Michael H Herzog

EPFL, Switzerland

Visual processing is usually thought to proceed in a feedforward fashion from low level to high level, from the analysis of simple features, e.g., edges and lines, to complex features such as shapes and form. Gestalt processing is often assumed to occur somewhere in between these steps. However, there is a well-known paradox. A Gestalt's individual elements often appear very different when presented in isolation: the whole determines the perception of its parts. Hence, visual processing is unlikely to proceed in a feedforward fashion only. First, I will show that not only is the appearance of the Gestalt's parts changed during visual processing but low-level processing itself is changed as well. For example, in crowding, inhibitory Gestalt-Gestalt interactions can undo inhibitory low-level interactions. Vernier offset discrimination deteriorates when the vernier is embedded in a square. Adding further squares should further deteriorate performance. However, performance is almost on the same level as in the vernier alone condition. Hence, high level processing precedes low level processing. Second, I will present a Wilson-Cowan type model showing how good Gestalts emerge in a dynamic fashion, paving the way for a new understanding of visual processing in the next century of Gestalt research.

Modeling Spatiotemporal Boundary Formation (T 2, 1, 3)

Philip J. Kellman and Gennady Erlikhman

University of California, Los Angeles

Spatiotemporal boundary formation (SBF) describes perception of continuous boundaries, complete shapes, and global motion from sparse, spatially separated, local element transformations (Shipley & Kellman, 1994, 1996). The two paradoxes of SBF are that 1) no local oriented edge fragments are given to trigger interpolation processes, and 2) both the presence of a global shape and its motion must somehow be recovered from sparse local events. Earlier we derived an intersection-of-constraints result that local edge orientation and global motion could be recovered from three non-collinear sequential events. Global shape might then be constructed from interpolation processes utilizing these synthesized local edge fragments. We report a computational model incorporating these ideas, along with two kinds of noise: noise in registration of the relative positions of the elements, and noise in the velocity of the virtual object. In three experiments, we measured orientation discrimination thresholds of SBF edges as a function of element number (Exp. 1), element density (Exp. 2) or rate of element change (Exp. 3). In all experiments, black circular elements on a white background disappeared whenever they came into contact with an illusory edge and reappeared when the edge moved beyond. Noise estimates were obtained by fitting the model to data from Exp. 1. Threshold estimates in other conditions were obtained by treating the model as a subject using the same staircase procedure on a trial by trial basis. The model predicted average thresholds with high precision across all three experiments. These results offer a plausible account of how local element changes are used by the visual system to produce object boundaries, shape and global motion in basic SBF displays. We present more recent displays in which the virtual figures in SBF are rotated, scaled, or deforming. These displays appear to robustly produce SBF but pose additional challenges for models of the processes involved.

Logical-rules and the classification of integral and configural stimuli (T 1, 2)

Daniel R. Little

University of Melbourne

A fundamental question in the study of perception and decision making is how information from multiple stimulus dimensions is processed in basic tasks such as detection, visual search, recognition and categorization. Recent work suggests that when dimensions are separable, the processing of each dimension occurs in its own processing channel (Fifić, Little & Nosofsky., 2010; Little, Nosofsky & Denton, 2011). By contrast, the separate dimensions of integral stimuli, such as colors varying in brightness and saturation, which are processed holistically, are pooled into a single, common coactive processing channel (Little, Nosofsky, Donkin and Denton, 2012). This talk addresses the relationship between integral stimuli (like Munsell colors varying in saturation and brightness) and configural stimuli (like faces) and discusses similarities and differences in their processing and some difficulties in diagnosing processing.

Pop out, true and false. (T 1, 3)

Orsten, K. & Pomerantz, J. R.

Rice University

Pop out occurs in singleton displays where one item (the target) differs from all the other items, which all are identical to each other (the distracters), e.g., a single tilted line pops out from a field of verticals. Pop out is usually said to occur because the odd item activates a single area on a feature saliency map. We pursue an alternative notion whereby pop out occurs because the distractors group by virtue of similarity and proximity, leaving the target ungrouped and so isolated. Thus pop out should occur whenever the distractors group on the basis of *any* emergent feature. We demonstrate that items breaking any regularity will pop out robustly even when the other items are heterogeneous. We describe recent experiments on false pop out, where one of the homogeneous distracters competes to be seen as the odd one out (think of a white sheep popping out of a flock of many white plus one black sheep). We discuss our efforts to find a case of pure false pop out, wherein a distractor dominates all the other distractors plus the actual target to pop out perceptually. We discuss these issues in the context of the Theory of Basic Gestalts Version 2.0.

Configural processing and Gestalt formation in haptic perception (T 4)

Krista Overvliet, Ralf Krampe & Johan Wagemans

University of Leuven, Belgium

In this presentation I will discuss the importance of investigating configural processing in other sensory modalities than vision, for instance, in the haptic modality. Quite a few differences exist between the visual and haptic modality. Not only the sensors are different, also the way in which an object is explored is quite different: in vision one samples huge parts of the visual world in short snapshots, but in haptics spatial information is limited and has to be gathered and integrated over time, in a serial manner. The work we do in haptics aims to answer the question whether Gestalt formation takes place in similar ways across modalities. If Gestalt formation takes place in a similar fashion in haptics and visual perception we can assume that it is not simply a product of the proximal information at the senses, but a high level mechanism. After a brief discussion of the goals of the overall project, I will present an update on the work we have done since the last meeting; configural effects in haptic numerosity perception and grouping in haptic search.

Perceptual Organization and Aesthetic Preference: The Role of Good Fit

(key note)

Stephen E. Palmer, Psychology Department,

U. C. Berkeley

I will review a series of findings from my laboratory about visual aesthetics (15 journal articles and still counting) from the perspective of their relation to perceptual organization. I will argue that the dominant factor in people's aesthetic preferences for visual displays is goodness-of-fit to a context provided by the task and/or inferred by the viewer. The domains in which this hypothesis will be examined will include preferences for individual colors in different contexts (e.g., "context-free" judgments of colored squares, the same squares considered as colors of particular objects, and the same squares considered as colors for album covers of different bands), preferences for spatial compositions in different contexts (e.g., "context-free" judgments of pictures of meaningful objects versus judgments of the same pictures with different titles), and individual differences in aesthetic style (e.g., differences in people's degree of "preference for harmony" when measured across several domains, including color, spatial composition, shape, and music). In every case there seems to be a close relation between people's average judgments of goodness-of-fit and average judgments of aesthetic preference. The fact that individuals seem to vary considerably in their degree of preference for canonical "good fit" is considered in light of the possibility that they infer a different context within which their preferences fit well.

Familiarity of Parts versus Wholes: The Role of the Perirhinal Cortex

Mary Peterson

University of Arizona

Recent research implicates the perirhinal cortex (PRC) in complex configuration discrimination. Barense et al. (2011) proposed that it does so partly by modulating part familiarity responses in visual areas. Using fMRI we measured PRC and V2 activation in response to Familiar Configurations that portrayed portions of real-world objects; Part-Rearranged Novel Configurations created by spatially rearranging the parts of the familiar configurations; and Control Novel Configurations (novel configurations composed of novel parts). Stimuli were presented in the left or right visual field. For RVF presentation, BOLD responses in bilateral PRC were highest for Familiar Configurations, next highest for Control Novel Configurations, and lowest for Part-Rearranged Novel Configurations. Left hemisphere V2 mimicked PRC activation, and was significantly higher for Familiar Configurations than for Part-Rearranged Novel Configurations. We attribute V2 activation to feedback from the PRC because receptive fields in V2 encompass parts but not configurations. Thus the PRC (1) is sensitive to the congruency between the familiarity of object configurations and the parts comprising them and (2) likely modulates familiarity responses in visual area V2.

The auditory continuity illusion in perceptual organization and object searches

Dorea Ruggles and Andrew Oxenham

University of Minnesota

Listening for messages within mixtures of maskers is both challenging and relevant to daily communication. One aspect of this listening challenge is that masked, or obscured, portions of messages are often perceptually "filled in" to create a continuous stream of information, following the Gestalt principle of good continuation. This auditory continuity illusion has been studied primarily with the stimuli presented in isolation, and it is unknown whether the continuity illusion occurs in more complex situations when attention is not directed towards the interrupted stimulus. Young normal-hearing participants listened for target tones in "clouds" of masking tones and noises with pseudo-random spectro-temporal locations. The basic experimental task was to listen for a long (300ms) tone in a cloud of short (100 ms) tones, and its counterpart condition was to listen for a short tone in a cloud of long tones. These two conditions have previously illustrated perceptual asymmetry in auditory object searches and were compared to listeners' ability to detect illusory long tones, created by interspersing a 100-ms noise between two short (100-ms) tones within a cloud of other short tones and noise. Individual thresholds for perceiving the continuity illusion in the absence of other stimuli (pulsation thresholds) were also measured. Detection of physical long and short tones confirmed previously reported perceptual asymmetry based on tone length. Illusory long tones were more readily detected than the short tones, but produced statistically significantly poorer performance than the physical long tones. Individual pulsation thresholds for the illusion alone were not found to be related to ability to detect the illusion within a cloud of masking tones and noise. The results suggest that the continuity illusion can occur to some extent in the presence of a complex acoustic background, and in the absence of focused auditory attention towards the target tone. Previous reports have attributed perceptual asymmetry of long and short tones to the relatively greater number of duration-specific midbrain and cortical neurons tuned to long tones. If so, our results suggest that the illusory long tones may also activate some proportion of the neurons tuned to long-duration stimuli, suggesting a relatively early, and possibly pre-attentive locus for the continuity illusion.

Transposition and gestalt psychophysics: a comparative-developmental approach (T 2)

Viktor Sarris,

J.W. Goethe University, Frankfurt a. M., Germany

Transposition (TP), a basic type of perceptual transfer, is a key concept of gestalt theory since its beginning. This idea is illustrated by the comparative-developmental psychophysics of human and animal choice behavior. Thereby, the interest is focussed on the crucial intra- und interindividual *variability* of the infant-chicken´s experimental data. The findings – with its huge amounts of intraindividual variation - are decribed and discussed in the light of classical gestalt theory and modern psychophysical research, with an eye on the mathematical models for such TP effects (e.g., Ehrenstein et al., 2003; Sarris, 2010, 2012; see also Nesselroade & Ram, 2004; Stamps et al., 2012).

The Effects of Perceptual Organization on Memory, Search, and Aesthetic Judgment (T 4)

Karen B. Schloss and Madeline McComb

U. C. Berkeley

The role of perceptual organization in human learning and memory was a fundamental question of great interest to early Gestalt Psychologists. According to Köhler (1947; 1958), the organization within a stimulus can powerfully influence memory, as long as that organization is perceived. Much of their early work was concerned with issues like shape recognition, given its contextual elements, and item recall, given the sequential organization of the item list. The question remains of how perceptual grouping among elements in a visual display influences memory. We observed that people are better at recalling paired associations when the associated information is more strongly grouped by proximity (Wertheimer, 1932) and common region (Palmer, 1992). To test the idea that this grouping effect occurred because the more strongly grouped displays were easier to process, we conducted a visual search experiment in which participants were asked to find one element and report a feature about its paired associate. Indeed, participants were faster and made fewer errors for the more strongly grouped displays. Participants also aesthetically preferred the displays that were easier to organize. These results indicate that there are important interactions between configural processing (e.g., perceptual grouping) and higher-level cognition (e.g., memory and aesthetic judgments).

Assessing the Information Processing Characteristics of Configural and Holistic Perception through Mathematical Meta-Theory (key note)

Jim Townsend

Indiana University

The gestalt psychologists originated a class of experimenta demonstranda to convince the psychological audience that analytic strategies, at that time, the contemporary structuralists, but soon to be the behaviorists, fall woefully short in capturing the holistic way in which the brain perceives and interacts with the world. On the theory dimension, Wertheimer's prescient field theory failed to make much headway with regard to actual experimentation. Since then, there have been many individual models which make holistic types of predictions. A general, quantitative framework within which broad processing characteristics of holistic mechanisms (no longer an oxymoron), can be posed, has been lacking. Our information processing meta-theory provides this framework. I review our nascent primitive concepts, definitions, hypotheses, theorems and experimental predictions and what we have begun to learn over the past decade or so.

Auditory Grouping and Segregation: Source enhancement by spectral change (T 1, 4)

Neal Viemeister, Andrew Byrne, and Mark Stellmack

University of Minnesota

When a new spectral component is introduced into an otherwise continuous background sound that component "pops out". A classic example is "cancelled harmonics": when a cancelled harmonic is reintroduced into an equal-amplitude harmonic complex, it initially becomes highly salient, as if there are two sound sources, the background and the new harmonic. Various explanations have been offered for this striking phenomenon including Gestalt good continuation. Our psychophysical research and recent physiological research indicates that such source enhancement reflects, at least partially, low level processes, possibly occurring in the auditory periphery. This presentation will briefly summarize the psychophysical and physiological data and will speculate on implications for auditory source segregation in real-world listening situations.