Configural Processing Consortium (CPC), 2015

Hilton Chicago

Wednesday, November 18, 2015

WHEN:	Wed., November 18, 8:30am – 5:00pm
WHERE:	Hilton Chicago, room 4L

WHAT:

8:30 - 9:00am	arrival & coffee
9:00 - 9:15	welcome (cpc president)
9:15 – 10:00	key note talk I (Franconeri)
10:00 -10:15	coffee break
10:15 - 12:15	morning session
12:15 - 1:30	lunch
1:30 – 2:15	key note talk II (Wagemans)
2:15 – 2:30	coffee break
2:30 – 4:30	afternoon session
4:30 - 5:00	conclusion
6:00pm ?	dinner

Website: **http://configural.org/**

Contact: **Ami.Eidels@newcastle.edu.au**

CPC 2015 key note talk by Prof. Steven Franconeri, Northwestern University

Steven Franconeri is a Professor of Psychology at Northwestern University, and Director of the Northwestern Cognitive Science Program. His undergraduate training was in computer science and cognitive science at Rutgers University, followed by a Ph.D. in Experimental Psychology from Harvard University, and postdoctoral research at the University of British Columbia.

Lab research:

Within both the natural world and constructed displays, our visual system transforms a raw image into objects and relations. Our laboratory explores this transformation: how we group objects together, how we count, how we know whether one object is larger, brighter or farther to the right than another, how we track objects over space & time, and why our visual system encounters limitations in how many things we can process at once.

Understanding graphs, in parts & wholes

For both adults and kids, graphs are powerful ways to understand patterns in data. Yet both groups often fail to understand them. I'll describe the variety of ways that the visual system can approach a graph, both at the level of individual parts and broader configural patterns, and show how this understanding can lead to better design and better pedagogy. We'll also examine some exciting new graphical formats – such as connected scatterplots and parallel coordinates – that beg for study by perceptual psychologists

CPC 2015 key note talk by Prof. Johan Wagemans, University of Leuven

Johan Wagemans is professor in experimental psychology at the University of Leuven. Current research interests are mainly in perceptual grouping, figure-ground organization, depth and shape perception, including applications in autism, arts, and sports (see www.gestaltrevision.be). He is one of the founding editors of Art & Perception, editor-in-chief of Perception and i-Perception, and associate editor of Cognition. He has recently edited the Oxford Handbook of Perceptual Organization.

Perceptual organization in the context of a dynamical and hierarchical visual brain

Mainstream vision science and visual neuroscience is characterized by a reductionist, analytical view on how visual experience is built up from visual stimulation at the retina by a sequence of hierarchical stages of feature extraction and computation of increasingly larger and more complex representations. This approach is strongly influenced by pioneering work in single-cell neurophysiology by Hubel & Wiesel and in computational vision by Marr. The heritage of Gestalt psychology remains quite difficult to integrate within this framework because of its inherent dynamical and phenomenological origin. In my view, progress within the mainstream approach has reached its limits. Consider, for instance, the huge mystery surrounding the principles of so-called "mid-level vision" in-between "low-level" and "high-level vision", although this is where all the interesting action is taking place. The major reason for this limited progress is not just a lack of refined methods (e.g., tools for neural recording at the most relevant level of analysis in terms of spatial and temporal resolution or the difficulty of mapping computational models to proper data sets from psychophysics or neuroscience). I believe there are two more serious problems. First, the terminology to describe perceptual organization is quite muddled (e.g., "local" versus "global" processing, all the different meanings of "perceptual grouping"). Second, to give perceptual organization its proper role in visual cortical processing requires a more dynamical view in which the different levels of representation are tightly coupled, and flexibly changing their couplings over time. I try to contribute to resolving these problems in two ways. First, I will distinguish different kinds of perceptual organization processes, each with their own modes of operation. For instance, instead of the general notion of perceptual grouping, I propose to use terms like clustering, texturing, patterning, linking, segregating, layering, and configuring. Second, I propose to rely on geometry and phenomenology as foundations for a revival of Gestalt ways of thinking about the role of perceptual organization in the context of a dynamical and hierarchical visual brain. I will illustrate the potential of this approach to put flesh on the bones of the key ideas of analysis-by-synthesis and vision as controlled hallucination.

Topological Clustering for Determining Structure in Perceptual Representation Space

Leslie Blaha, Air Force Research Laboratory

Brett Jefferson, Indiana University

Topological data analysis approaches have seen intriguing success in finding non-linear structures in large-scale data sets, like gene SNPs and images. We explore their application in psychological data sets, to see if they provide novel insight into the structure and dimensionality of psychological space. Simplicial complex clustering applied to (dis)similarity ratings maps the raw data into potentially overlapping clusters. Homology finds cyclical structures in those data, with the potential to capture structure in multiple dimensions simultaneously. We will illustrate the applications of these tools to color similarity ratings, where we finding some surprising high dimensional structures beyond the two-dimensional result typical in multidimensional scaling analyses. We will discuss some ideas for exploring configurality and integral dimensions, with an eye toward identifying candidate data sets that would be exciting to explore with these analytic approaches.

Hierarchical structure in the organization of Roman letters and their representations

Ami Eidels,

University of Newcastle Australia

Reading is a frequent and fundamental activity, yet little is known about the mental representation of letters. Unlike natural stimuli around us, for which the human visual system might have adapted in order to ensure accurate and efficient processing, alphabet letters are men-made, poetically designed for optimal legibility. Presumably, letters were shaped over the years to increase discriminability and minimize confusion. Therefore, they provide an intriguing test-bed for enquiries about confusion rate in general, and mental distances in particular. Recent advances in cognitive modelling (Kemp & Tenenbaum, 2008, *PNAS*) allow to infer about the structure and form of mental representations. I will present analysis and data supporting hierarchical organization of the representations of Roman alphabet letters.

Six Degrees of Separation: Exploring the Dynamic and Neurophysiological Aspects of Emergent Features

Olivia Fox, Assaf Harel, Kevin B. Bennet and Joseph W. Houpt

Wright State University

Configurality has played a prominent role in the historical development of principles for visual display design. The process of designing effective dynamic displays could be further aided by an understanding of the limits of emergent features. How much can you distort the configuration of graphical elements in a display before the emergent features are lost? In a visual search task, a manipulation of rotational angle was used to incrementally degrade the configuration of parts within stimulus arrays. The study was conducted within a Magnetic Resonance Imaging (MRI) scanner and participants were tasked with reporting the anomalous quadrant in each array. Behavioral results supported the hypothesis that reaction time would be faster for smaller angles of rotation than for larger angles of rotation. Reaction time data also indicate that performance begins to drop off at a relatively low rotational angle. Neurophysiological results indicate higher activation for smaller angles of rotation than for larger angles of rotation in early visual cortex (EVC) and in lateral occipital complex (LOC).

Perceptual Organization in Mental Arithmetic

Patrick Garrigan

Saint Joseph's University

Explicit rules for the evaluation of simple arithmetic expressions, like the rules of operator precedence, are enforced in part by perceptual processes like unit formation and attention. When perceptual organization competes with the rules of operator precedence, errors increase. However, there is evidence that “mental arithmetic” involves verbal representations that may not retain spacing information. Consequently, one might expect no visual-perceptual grouping effects when arithmetic expressions are evaluated after they have disappeared from view. In a series of experiments employing visual masking and overt articulation, we had participants mentally evaluate simple arithmetic expressions under conditions in which verbal recoding would be an obvious strategy. Contrary to expectations, we found perceptual grouping effects persisted, suggesting that visuo-spatial representations are involved in arithmetic expression evaluation even when the expressions are not continually available for visual inspection. The pattern of error types suggests that perceptual grouping by proximity influences operator precedence in all cases studied and symbol identification when viewing time is limited. These results, demonstrating the persistence of perceptual grouping effects in mental arithmetic, underscore the importance of perceptual learning in practical educational settings.

Perceptual organization and crowding

Ruth Kimchi and Yossef Pirkner

Haifa University

Identification of a peripheral target in the presence of nearby flankers is worse than when the target appears alone – a phenomenon known as crowding. Prevailing theories hold that crowding occurs because of integration or ‘‘pooling’’ of low-level features at a single, relatively early stage of visual processing. We examined whether crowding can occur at the object level in addition to the feature/part level. In several studies we measured target (a global, disconnected configuration made of elements) identification at varying eccentricities. The flankers that surrounded the target were similar either to the target parts or to the target configuration, and degree of feature similarity was controlled for. The results show both crowding by parts and crowding by configurations. The strength of crowding by parts or configurations appears to depend on the strength of the target's organization – the stronger the target is organized, the less likely it is to be crowded by flankers similar to its parts relative to flankers similar to its configuration. These results provide evidence that crowding can occur between configural representations of objects, and demonstrate the role of perceptual organization in crowding.

Two types of part-whole relationships and the Theory of Basic Gestalts

James R. Pomerantz

Rice University, Houston, Texas, USA

With some configurations, the parts seem to determine the whole (Asch's hierarchical patterns) whereas with others we find the opposite, where the whole dictates the parts (Duncker's wheel; Dalmatian photo; parenthesis pairs; arrows and triangles). In some configurations, swapping out the parts for an alternate set of parts changes the whole whereas in others it does not. Here I attempt to revive a distinction between two types of configurations, Type P and Type N, where Type N conforms more closely to our notion of a Gestalt in yielding configural superiority, Garner Interference, steeply negative search slopes, false pop out and displaced pop out (where, in a field of items that are all identical except for one, Ss predictably point to a region of empty space between two items when asked where the disparity in the display is located). These ideas will be connected conceptually with emergent features and the Theory of Basic Gestalts.

Distortions in shape perception due to configural processing

Karen B. Schloss*, Methma Udawatta**, and Francesca C. Fortenbaugh***

* Department of Cognitive, Linguistic, and Psychological Sciences, Brown University
** Department of Neuroscience, Brown University
***Boston VA

When shapes group to form a configuration they not only become members of a whole, but also they can become distorted by other constituent parts. Recent studies have considered this phenomenon with respect to illusions of elongation, in which the perceived length of a target is systematically increased by the presence of inducer elements in the configuration (e.g., the Occlusion Illusion, and the Configural Shape Illusion). Here, we present a new illusion, in which slanted inducers (e.g., parallelograms) distort the perceived profile of adjacent curved shapes (e.g. semi-ellipses) in a manner that depends on the grouping between the target and the inducer. When the shapes have the same lightness, the curve of a semi-ellipse appears compressed on one side and extended on the other, such that it assimilates with the slant of the inducer. However, when the shapes have different luminance, thereby weakening grouping, the compression/extension is reversed to reveal a contrast effect. Thus, these results provide new insights into how shape perception is influenced by configural processing.

Configural processing begins later than feature processing

Rich Shiffrin, Sam Harding, Denis Cousineau, Greg Cox

Indiana University

It seems necessary that higher level abstractions that represent configural properties of presented stimuli must be perceived after some sufficient number of lower level features are first perceived. This should hold in the common situations where the lower level features are members of many potential relevant objects and hence are not individually diagnostic. It is however not so common to include this timing difference in models of accuracy and response time for perception and memory tasks. We will describe two situations where models incorporating this conception produce informative accounts for data. One task is episodic memory, where one type of configural information is that associating two words arbitrarily paired for study. This situation has been modeled by Greg Cox and the late arrival of configural information illuminates several puzzling findings, and also helps discriminate two models for the word frequency effect in recognition memory. The second task is perception during visual search. For the condition in which a single object is presented, with the object features arriving simultaneously or sequentially, the model accounting for the findings posits accumulation of evidence as each feature is perceived, based on its diagnosticity, followed by strong evidence accumulation when enough features have been perceived to allow perception of the configuration.

Determining the Role of Spectral and Duration Cues in Vowel Perception

Gabriel Tillman, Rachael Vickery, Titia Benders, Scott Brown, and Don van Ravenzwaaij

University of Newcastle, Australia

Configural processes are often concerned with the way multiple elements, dimensions, or sources of information are integrated and combined. Here we investigate how humans extract information from multiple dimensions of a speech signal. These dimensions contain information about basic linguistic units, such as phonemes. When Dutch listeners categorize vowels as the long and open /a:/ versus the short and closed /A/, behavioral categorization data suggests that the frequency dimension is weighed more heavily than the duration dimension when classifying these phonemes. Unlike spectral information, duration information is only completely available at the offset of the stimulus. Therefore, listeners' processing of duration may be underestimated in behavioral categorization data. To disentangle the contributions of spectral information and duration information in vowel categorization, we use reaction time data from a vowel categorization task. We then model this data with a hierarchical Bayesian Linear Ballistic Accumulator model. Spectral information, but not duration information, appear to influence the speed of processing of individuals. However, duration information have a strong influence on non-decision processes.

SEPARABLE VS. INTEGRAL DIMENSIONS, DISSIMILARITY MEASURES AND METRICS: A DISSIMILAR PERSPECTIVE

Jim Townsend,

Indiana University

I claim, based on a long-ago , rather obscure chapter by Robin Thomas and myself, that the extremely influential distinction put forth by Roger Shepard ½ century ago, of the *city block vs. Euclidean metric* is not a very crucial or theoretically powerful distinction. This paper details the logic and puts forth more formidable criteria for an *integral metric.*