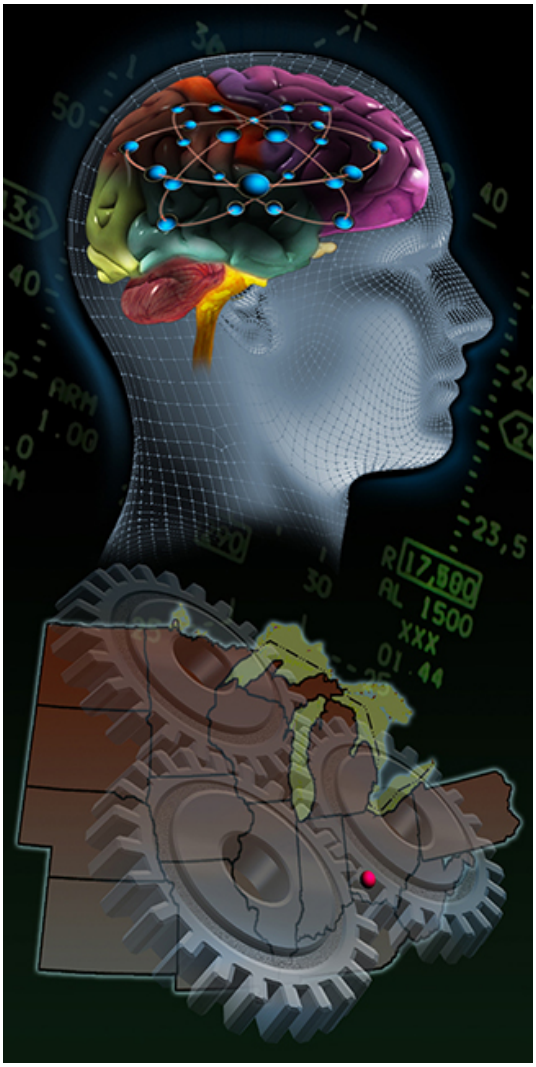

Fourth Annual Midwestern Cognitive Science Conference

May 30–31, 2014
Wright State University
Dayton, Ohio

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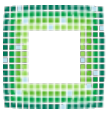

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Also thank you to Jason Bickford, Kathy Robey, Lee Ann Bradfield, Elizabeth Fox, Gary Douglas and Joseph Glavan for their efforts in organizing the conference.

Schedule Overview

Friday, May 30

5:30–8:00	Apollo Poster Session and Reception	

Saturday, May 31

7:30–8:30	Breakfast	
8:30–9:30	Endeavour Attention & Perception	Discovery Group and Social Processes I
9:30–9:45	Coffee Break	
9:45–10:45	Endeavour Learning & Memory	Discovery Complex Systems
10:45–11:00	Break	
11:00–12:00	Endeavour Keynote: Gary Klein	
12:00–1:00	Apollo Lunch	
1:00–2:30	Endeavour Perception Modeling	Discovery Judgment and Decision Making
2:30–3:00	Coffee Break	
3:00–4:30	Endeavour Methodology	Discovery Group and Social Processes II
4:30–6:30	Poster Session	
7:00–	Apollo Banquet featuring talk by Mica Endsley	

Proceedings of the Fourth Midwestern Cognitive Science Conference

Joseph Houpt, Wright State University
Leslie Blaha, US Air Force Research Laboratory
Ion Juvina, Wright State University
Aaoron Miller, Wright State Research Institute

May 30–31, 2014

Conference Program

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

The Lightbulb Moment

Gary Klein (MacroCognition and Applied Research Associates)

Abstract

Three years of a research project collecting and analyzing 120 instances of insights largely drawn from natural settings, has resulted in a new account of the nature of insight, which is defined as a discontinuous shift from one mental model or linked set of beliefs to another that is more accurate, comprehensive, and useful. Insights alter our understanding and also change the actions we consider, the cues we notice, the emotions we experience, and the goals we pursue. The talk is divided into two parts: how insights arise, and the factors that get in the way of insights.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Spatially-global interpolation of closed curves

Tae Kwon (Purdue University)
Kunal Agrawal (Purdue University)
Yunfeng Li (Purdue University)
Zygmunt Pizlo (Purdue University)

Abstract

Most previous methods focused on spatially local interpolation using rules such as proximity, co-linearity, co-circularity and relatability. We propose a spatially global model based on finding the shortest path in the log-polar representation of the image which is a good approximation to the topographical map of the retina in the area V1. The shortest path in a log-polar representation corresponds to a smooth, convex and closed curve in the retinal image. As such, our method implements three fundamental rules of Gestalt perceptual organization: closure, convexity and good continuation. Producing a shortest path is computationally simple. At the same time the shortest path interpolates missing parts of contour and ignores pieces of contours that are likely to represent noise. The subject was shown a fragmented convex polygon (target) embedded in noise consisting of 300 line segments. A random polygon was generated as a convex hull of 10 randomly generated points. To minimize spatially local cues, the pairwise distances and the length of the target and noise fragments were approximately constant. Furthermore, the orientation of each contour fragment of the target was randomly perturbed by +/- 10 to 30 deg. The subjects were asked to trace (reconstruct) the target on a touch screen by drawing a continuous line that represented the perceived curve. The shortest path model was applied to the same stimuli. Both the subjects and the model reconstructed the targets reliably. We conclude that the human visual system uses not only spatially local but also spatially global interpolation mechanisms.

Metabolomics Approach for Identifying Urinary Markers of Cognitive Performance under Conditions of Sleep Deprivation-Induced Fatigue

Nicholas Reo (Wright State University)
Isaie Sibomana (Wright State University)
Nicholas DelRaso (Wright Patterson AFB)
Michael Raymer (Wright State University)
Donald Harville (Wright Patterson AFB)

Abstract

Cognitive performance and fatigue are well-known to be inversely related. Insufficient sleep can lead to fatigue and cognitive deficits in performance, and poses an occupational hazard in both military and civilian operational environments. Consequently, there is a recognized need for real-time detection technologies that could minimize fatigue-induced mishaps. In the current study, 23 human subjects were subjected to 36 h of sleep deprivation. Cognitive psychomotor vigilance and automated neuropsychological assessment metric tests were conducted from 12 - 36 h, and urine was collected prior to (t=0) and at 12, 20, 28, and 36 h during the course of the study. Cognitive/neuropsychological tests identified a subset of poor performers (fatigue susceptible; n=6) and another subset of superior performers (fatigue resistant; n=6). Multivariate data analysis of urinary metabolites, measured using 1H NMR (600 MHz), showed unique profiles for susceptible and resistant groups. Bioinformatics analysis identified 20 urinary metabolites that are important for group classification. A majority of these metabolites appeared to be associated with nutritional status and suggested that observed increases in dietary protein intake prior to cognitive testing leads to increased cognitive performance when sleep deprived. A cursory examination of the data suggests that tyrosine, tyramine and homovanillate are among the significant features that may correlate with, or be predictive of, cognitive performance under conditions of sleep deprivation-induced fatigue. Taken together, our results indicated that urinary metabolomics may be useful as a noninvasive screen for predicting cognitive performance in demanding operational environments.

Are the effects of an acute bout of physical activity on inhibitory control consistent across days?

Anthony G. Delli Paoli (Michigan State University)
Matthew B. Pontifex (Michigan State University)
Alan L. Smith (Michigan State University)

Abstract

A growing body of literature suggests that single bouts of physical activity may have transient benefits for inhibitory control (Lambourne & Tomporowski, 2010). However, the extent to which these benefits occur consistently across multiple acute bouts of physical activity remains unclear. Accordingly, the purpose of this study was to assess if the effects of an acute bout of physical activity on inhibitory control are consistent across days. Using a within-subjects design, 48 college-aged adults were randomly assigned to a counterbalanced sequence of two identical physical activity conditions and one sedentary condition across three days. In the physical activity conditions, participants walked on a treadmill at 60% of their max heart rate for 20 minutes. In the sedentary condition participants rested for 20 minutes. Inhibitory control was assessed using a flanker task immediately prior to and immediately following heart rate returning to 10% of resting baseline for each condition (Pontifex & Hillman, 2007). Only the first exposure to physical activity resulted in increased response accuracy and decreased variability of response time, $p < .001$, partial eta $= .16$. The sedentary and subsequent physical activity conditions did not show pre-post change in behavioral performance. Findings suggest that the effects of physical activity on inhibitory control are inconsistent. Further examination of this relationship is warranted to explore factors that may underlie these inconsistencies such as the duration, intensity, and type of physical activity.

Examining the Span of Control of Remote Computer Agents in a Simulated Cyber Task

Vincent Mancuso (United State Air Force Research Laboratory)
Gregory Funke (United State Air Force Research Laboratory)
Monika Eckold (United State Air Force Research Laboratory)
Adam Strang (Air Force Research Laboratory)

Abstract

In todays adversarial cyber operations centers, operators participate in the supervisory control of multiple remote agents across multiple networks. This task consists primarily of sending commands to the remote agents, monitoring their status, and reviewing returned information. Previous research on the supervisory control of multiple remotely piloted aircraft (RPAs) suggests that pilots start to reach a state of cognitive saturation, increased mental workload, and decreased performance when controlling around twelve vehicles simultaneously. While this offers a good starting point for cyber operations, the inherent differences between the domains may result in differences in the total number of remote agents a single cyber operator can control before reaching work overload states. Due to the lack of research in this area and the increasing proliferation of cyber operating environments, the goal of this research is to identify the maximum number of remote computer agents a cyber-operator can control, without displaying signs of, or experiencing, task overload or performance degradations. Using the BotNet Operator Agent Radio Determination (BOARD) 1.5 simulation environment, we identify the point at which the operators cognitive workload has become too intense to perform adequately at their task. The present study is a mixed-factorial design, with the within-subjects manipulation being the number of active remote agents within a trial (4, 8, 12, or 16 agents, counterbalanced across participants), and the between subjects variable being whether participants were categorized as expert or novice cyber operators. Results are discussed and future research trajectories are proposed.

Effects of Training Regime on Learning Decision-Support Tools

Christine Covas-Smith (Air Force Research Lab)
Christina Kunkle (Leidos)
Robert Patterson (AFRL/RHXM)
Lisa Tripp (AFRL/RHAS)

Abstract

In complex dynamic environments, human decision making can be overwhelmed by exceptionally large amounts of data and inherent uncertainty. Under these circumstances, the use of decision-support tools can significantly decrease workload. To leverage these tools requires training, and the best training regime is unclear. This effort investigated the effect of three types of training regimes (analytical, intuitive, or storyboard) on development of expertise using a decision-support tool. The decision-support tool consisted of a computational model of the interactions among social, cultural, economic and demographic variables of a society. The analytical group was trained using a series of questions about the variables within the tool and feedback on their inputs, followed by practice with the tool. The intuitive group was trained by practice with the tool without explicit feedback or direction. The storyboard group was trained by reading a description of an earthquake scenario containing pictures and background on the variables, followed by practice. Results indicated that the intuitive training regime was superior: participants learned to use the decision-support tool with the intuitive regime but not with the analytical or storyboard regime. Participants were able to implicitly learn to use the tool with no feedback and minimal instruction; thus, the evidence suggests that a training regime based on our intuitive methodology may be best for training on the use of decision-support tools.

Integrated Learning Mechanisms

Vladislav Veksler (United State Air Force Research Laboratory)
Christopher Myers (United State Air Force Research Laboratory)
Kevin Gluck (United State Air Force Research Laboratory)

Abstract

Accounting for diverse learning phenomena and making a priori predictions about learning profiles in new domains requires the integration of a diverse set of computational learning processes. We present a framework integrating three learning mechanisms widely supported in the psychological literature – reinforcement learning, associative learning, and perceptual chunking. The integrated learning mechanism (ILM) framework successfully accounts for a wide range of behavioral phenomena, including empirical results from preference reversal, choice-repetition, base-rate neglect, paired associates, probability matching, category inference, and even/uneven stimulus presentation experiments. Additionally, ILM provides performance advantages over standalone Machine Learning techniques in complex, uncertain, dynamic, persistent environments.

Bayesian Hierarchical Adaptive Estimation of Post-training Effects in Visual Psychophysics Experiments

Hairong Gu (Ohio State University)
Zhong-Lin Lu (Ohio State University)
Woojae Kim (Ohio State University)
Mark Pitt (The Ohio State University)
Jay Myung (Ohio State University)

Abstract

The adaptive design optimization (ADO) method seeks to optimize the choice of experimental stimuli by learning from responses from earlier trials of an experiment, for the purpose of gaining maximal information about model parameters in the fewest possible trials. Bayesian hierarchical adaptive design optimization (HADO) further improves the efficiency of ADO by making use of information learned from previous experiments about the same cognitive process of interest. To demonstrate the feasibility and advantages of HADO, in the present investigation we apply the method to the domain of visual psychophysics, in which a challenge is the requirement of a large number of trials to acquire accurate estimation of the contrast sensitivity function (CSF). In a clinical experiment, patients diagnosed with amblyopia received training to improve their vision and were tested before and after the training session. The interest lies in how to fast estimate the post-training CSF with the knowledge of the pre-training data. HADO provides a natural framework in which to incorporate the pre-training data and the training effect in a large dataset as the prior knowledge for post-training experiments. Our simulation results show that HADO requires a much fewer number of trials to obtain accurate post-training estimation compared to the standard ADO as well as non-adaptive experimental design methods.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

A Bayesian Sequential Sampling Model of Choice Reaction Time Incorporating Stimulus Onset/Duration Uncertainty

Jordan Meyer (University of Michigan)
Jun Zhang (University of Michigan)

Abstract

We propose a Bayesian sequential sampling model of choice reaction time (RT) that incorporates uncertainties about stimulus identity, onset, and duration. The model is the now-standard random-walk/drift-diffusion model, with a threshold-based response mechanism. The 'substance' of the drift, however, is the posterior probability (belief) that a participant updates on a moment-to-moment basis during a trial. The update is done by combining the likelihood function on the evidence (modeling trial-dependent perception) with prior probability about stimulus identity, onset time, and duration (modeling trial-independent task knowledge). Response thresholds, which equal the probability of correct response in choosing each alternative conditioned on prior knowledge and accumulated evidence, modulate speed-accuracy tradeoff. While sequential Bayesian updating without temporal uncertainty (regarding stimulus onset/offset) is well-understood, we overcome the hurdle of incorporating the temporal prior into the dynamics of belief updating to derive an analytic expression for Bayesian belief. This framework allows for the natural modeling of a broader class of experimental paradigms than many other previous sequential sampling models. In general, the advantage of the Bayesian formulation is to allow full control of where and how many free parameters appear: in likelihood functions, priors, or response thresholds. Comparison of computer simulation of our model with human performance data (Smith, 1995) will be reported.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

New Techniques Enabling The Use of Large-Scale MindModeling@Home Resources

Jack Harris (Air Force Research Laboratory)
Thomas Mielke (The Boeing Company)

Abstract

Large-scale computational resources are frequently used to accelerate the execution of scientific models in many fields ranging from physics to meteorology to aerospace engineering and now it is becoming increasingly popular in the field of cognitive science. MindModeling@Home is an infrastructure designed to provide a conduit for cognitive modelers to easily take advantage of an extremely large pool of computational resources consisting of thousands of computers from around the world (Harris, 2008). In recent years many enhancements, including support for additional programming languages and modeling formalisms, have been added to the architecture, which has led to an increase in the number of modelers using the system and thus an increase in the number of cognitive simulations executed in the system. This increase of usage has introduced the problem of how to both maximize the utility of the system for different types of models (e.g., large/small, slow/fast) as well as most effectively utilize the MindModeling@Home resources. To this end, we have developed a novel genetic algorithm capable of efficiently utilizing distributed heterogeneous resources in order to intelligently explore and optimize multiple cognitive models concurrently. In this paper we will discuss the new advances in the MindModeling@Home system developed in the last few years that have brought about the increase in demand, as well as detail our novel integrated genetic algorithm designed to more efficiently explore and optimize models of human cognition.

Is sustained attention important for the testing effect?

Maria Almoite (MNSU-Mankato)
Jessica Kay (MNSU-Mankato)
Karla Lassonde (MNSU-Mankato)

Abstract

The Testing Effect is known to enhance learning and long-term retention through repeated-testing (Roediger & Karpicke, 2006). Additionally, it has been shown to improve the long-term retention of a related but untested subset of learned material (Chan, McDermott, & Roediger, 2006). One variable that has yet to be considered is the role of sustained attention (e.g., students ability to focus on lecture content for long periods of time) on the efficacy of the testing effect. The goal of this study is to combine a measure of sustained attention (i.e., the Sustained Attention Response Test-SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) with repeated quizzing of video lecture content to determine if sustained attention is important for the testing effect. Participants will be given the SART assessment and based on their score, as determined to be either high or low sustained attention, will be assigned to one of the following conditions: repeated testing, restudy, or control. All participants will be shown a video lecture with the testing and restudy groups lecture being divided into four parts. After each lecture section, participants will answer basic mathematical questions as a distractor task. The study group will then be provided a study guide for the content covered in the lecture section, while participants in the testing condition will be quizzed on the content. The control group will watch the video in full with no tasks splitting up the content. Finally, all participants will complete the same cumulative test using questions that differed from the quiz questions in one way; they are bidirectional to account for the near transfer effect (see McDaniel, Thomas, Agarwal, McDermott & Roediger, 2013). We are most interested in how participants with high sustained attention compare to those with low sustained attention on the video lecture tests. Specifically, we wonder whether or not high SART scores will influence the testing effect; that is, could participants with high attention do as well on the cumulative test as low sustainers who are in the repeated testing condition. Implications for teaching and learning will be discussed as well as inferring how results might be applied to populations diagnosed with attentional disorders.

Modeling Touch Interactions on Very Large Touchscreens

M. Trent Schill (Air Force Resarch Laboratory)
Leslie Blaha (United States Air Force Research Laboratory)

Abstract

Touchscreens are quickly becoming pervasive platforms for human-computer interaction, and large dimension touchscreens (over 50 inches in diagonal) pose interesting ergonomic challenges to human users. Touch interaction requires users to position themselves close enough to the screen that they are able to interact with the entire surface. This near proximity narrows the field of view causing display elements to fall outside the focal range of the user as they scan the display from its borders to the near center. Ergonomic challenges arise from the exaggerated body and limb movements required for direct touch interaction, which is more physically demanding than typical mouse, stylus, or keyboard interactions. The present effort characterized touch-based interactions on a very large, 82-inch diagonal touchscreen display, using standard input device testing methods based on Fitts and Steering Laws. These laws model movement time against an index of difficulty manipulation, which is a function of the distance between targets and width of the targets or paths. Movement time was measured in a series of tasks including tapping, constrained straight and curved path tracing, and unconstrained and constrained object dragging. Regression analysis of the movement times against the index of difficulty conformed to Fitts and Steering Laws. Within each task, cumulative hazard functions were ordered by the index of difficulty, confirming the efficacy of the difficulty manipulations. Hazard analysis provides a novel, functional measure of information throughput in this domain. Juxtaposition of these two analyses provides additional insights into the notion of efficiency for human-computer touchscreen interactions.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Process based feedback improves rare target detection

Chad Peltier (Michigan State University)
Mark Becker ()

Abstract

When performing visual search tasks, observers miss a higher proportion of targets when the target is rare compared to when it is frequent. Previous research has shown that observers search for a shorter duration and inspect a smaller portion of the display in low target prevalence search tasks, resulting in an increased proportion of misses. We hypothesized that providing participants with feedback about the areas of the display that have been searched may reduce the prevalence effect, leading to more accurate low-prevalence searches. In this experiment, observers searched for Waldo from Wheres Waldo? books while their eye movements were tracked. Waldo only appeared in 10% of the displays, making the task a low-prevalence search task. Control participants searched for Waldo without any form of feedback. Experimental subjects were given process based feedback; each part of the scene that had been visually fixated was highlighted to inform participants about the regions that they had inspected and those that they had not. This feedback system is meant to guide attention to unsearched areas and increase the proportion of the display that was searched before making a target absent judgment. Comparing performance between the feedback and control groups showed that a process based feedback system can be an effective tool to improve rare target search. This finding may have implications for real-world searches with rare targets, such as radiology and baggage scanning, where targets can be extremely rare.

Interference in a Modified Recognition Task: An Evaluation of the Changed-trace and Multiple-trace Hypotheses

Anne Cybenko (AIS)

Abstract

The changed-trace and multiple-trace theories of interference are tested in a set of six experiments. The changed-trace hypothesis attributes interference to a rewriting of an initial memory trace. The multiple-trace hypothesis attributes interference to a competition between separate memory traces. Experiments 1 and 2 replicated the modified recognition test used by Chandler (1989, 1991) and provide support for the changed-trace hypothesis due to the strong evidence of retroactive interference, but lack of evidence for proactive interference. The rest of the experiments modify the basic paradigm by changing the type of stimuli (Experiments 3 and 4 introduce words as stimuli instead of images) and the number of presentations of stimuli (Experiments 5 and 6 increase the number of times the interfering stimuli are shown). These changes resulted in evidence for both proactive and retroactive interference. Proactive interference was found in the experiments that used a modified version of Chandler's methodology, supporting the multiple trace hypothesis. If a memory trace is changed, proactive interference will not occur. The lack of evidence for proactive interference in the original task could be due to a recency effect and a large difference in the strength of the original memory trace as compared to the strength of the memory trace for the interfering information.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Differentiating Cognitive Effects of Sleep Deprivation with the Digit Symbol Substitution Task

Tim Halverson (United State Air Force Research Laboratory)
Michael Krusmark (L3 Technologies)
Glenn Gunzelmann (United State Air Force Research Laboratory)

Abstract

Sleep loss drastically affects performance in many tasks. These declines are usually explained as general declines (e.g., slowing or lapsing), independent of specific cognitive processes. In contrast, this research investigates the differential effects of sleep deprivation on different cognitive processes. Five variants of the Digit-Symbol Substitution Task were utilized, each tasking different subsets of cognitive processes, including spatial localization, associative memory, visual search, and motor action. Participants performed all variants during fifteen sessions across six days. Half of the participants did not sleep the second and third nights, resulting in a maximum of 61 hours awake. The results show differential effects of sleep deprivation on cognitive processes. Response times increased across all variants. However, error rates only increased when associative memory was isolated as a critical process for performance. There was no evidence for an effect of sleep loss on visual search. Prior to 48 hours of sleep deprivation, involvement of associative memory improved performance relative to visual search alone, after which memory provided no benefit. Spatial regularity provided a constant performance improvement, across levels of sleep deprivation. Which mechanisms people brought to bear to accomplish the tasks seemed to be determined, in part, by the level of sleep deprivation. A primary contribution of this research is the investigation of cognitive processes utilized in a task by using multiple task variants, and identification of tradeoffs in the utilization of those processes as a function of sleep deprivation.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Better Data Lead to Better Learning: How Embodied Attention Shapes Childrens Language Experiences

Meagan Barnhart (Indiana University)
Umay Suanda (Indiana University)
Chen Yu (Indiana University)

Abstract

Young children learn their first words in a highly cluttered learning environment. This clutter should make determining a words referent a difficult problem to solve. Much of the previous research on how children solve this problem has focused on childrens ability to deploy their top-down conceptual, linguistic, and social knowledge. Recent work has examined a more bottom-up solution to the reference problem: childrens own bodies and actions create moments of learning that are much less cluttered and much more suitable for learning than once thought. These studies of bottom-up processes, however, have all been conducted in controlled laboratory settings, bringing into question whether the results apply to learning in childrens natural habitat. We addressed this issue by observing four children (20 months of age) and their mothers playing with objects in their own living rooms. Each child was equipped with a head-mounted first-person view camera that provides a window into the learning environment from the childs perspective. Frame-by-frame coding of head camera images around the moments of object labeling revealed that indeed children appear to experience language in a way that is less referentially ambiguous than scholars have argued. Consistent with previous laboratory work, parents were more likely to label objects when their children or parents themselves were holding the referents. Furthermore, childrens holding of objects created views in which the referent was visually dominant and centered. These results highlight that even in highly cluttered environments characteristic of their everyday experiences, bottom-up processes may help shape childrens language learning.

Frontal midline EEG dynamics as a potential index of listening effort

Matthew Wisniewski (Air Force Research Laboratory)

Abstract

Listening effort has often been quantified as decreased performance in a secondary task while the difficulty of a primary task, like speech recognition, is systematically varied in difficulty (e.g., by increasing background noise). The underlying assumption is that changes in performance on the secondary task are due to competition for domain-general resources. Given that electroencephalographic (EEG) studies have identified frontal midline theta (4-8 Hz) oscillations as a correlate of such domain-general processing, theta may be able to index listening effort. In this study, participants listened to 5-word sentences (e.g., Sue bought three blue socks) in silent, speech-shaped noise, single-talker, or multi-talker (babble) backgrounds while EEG was collected from a 128-channel electrode montage. Speech recognition was far above chance (¿85% correct) in all conditions, although recognition in silence was significantly better than in speech-shaped noise and babble. Theta power at frontal electrodes was greater when listening to speech in babble and speech-shaped noise than a silent background. These effects were largely accounted for by a cluster of independent processes (identified by independent components analysis) localized at or near the anterior cingulate cortex (ACC) and nearby frontal areas. Results suggest that frontal midline theta does correlate with listening effort, and support neuroimaging work showing that effortful listening recruits non-auditory frontal cortical networks.

Ethical and Behavioral Effects of Processing Stimuli Perceptual Information Bottom-Up; Does this Give Better Access to the External Mind-Independent World?

Kaylie Provenzano (Northern Illinois University)

Abstract

Illusionary states occur when cognition routes information incorrectly due to faulty assumptions. Knowing this occurs, can we truly make claims about the external world according to information we obtain through our sensory modalities? Perceptual Epistemologists have formulated an argument for how illusionary states question our confirmation of properties and interactions of substances in the external mind-independent world. Experimentation on an illusionary hollow mask with schizophrenic participants and non-schizophrenic participants has given insight as to how we can alter our cognitive processes to recognize the actual properties as they present themselves as opposed to assumptions which mislead. Bottom-up processing in the schizophrenic patients appears to be the reason the sensory information was interpreted correctly whereas the other participants engaged in top-down processing. How can cognition be rewritten to perform bottom-up sensory perceptual processing as opposed to top-down processing? Will such alteration cause naivety because the cognition will no longer seek previously known memories and information? Is this beneficial for safety of the body; will peoples behaviors in bottom-up processing cause dangerous behavior? Will this type of cognition allow a new revolutionary understanding of the world? Answering these questions requires not only scientific research and analysis, but also ethical analysis. This essay will explore the realms of neuroscience, behavioral psychology, and neuroethics in relation to altering perceptual cognition and its effects.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Computational Modeling of Switch Keyboards

Xiao Zhang (Purdue University)
Kan Fang (Purdue University)
Gregory Francis (Purdue University)

Abstract

People with motor control difficulties often communicate with a computer by using a switch keyboard where user responses guide a scanning cursor to type text elements. This kind of keyboard requires a trade-off between typing speed and accuracy. Important factors in this trade-off include the cursors speed, the path of the scanning cursor, and the layout of characters along that path. We show how to optimize these properties of a switch keyboard by casting the design problem as a mixed integer programming (MIP) problem. Identifying an optimal design requires a model of the probability of an entry error. We developed such a model based on data gathered from well-practiced subjects using various types of switch keyboards. We show that the MIP algorithm produces optimal assignments of characters to locations along the cursor path. We further show how to extend the design process to identify the fastest cursor speed that satisfies a desired accuracy rate. Finally, we show how to further extend the design process to consider different types of cursor paths. We show that for the text used in this study, there is an optimal cursor path that trades-off the speed of the cursor against the number of required user-interactions. Each interaction risks an error, but it also reduces the number of cursor steps. The resulting algorithms are valuable for identifying optimal designs in many situations, and can be further elaborated to consider predictive keyboards and different types of input mechanisms.

A Processing Ghost in a Tank Machine

Mario Fific (Grand Valley State University)

Abstract

Two major contrasting models of visual working memory (WM) have been prevalent in recent cognitive literature. The discrete-slot model proposes that WM operates on the all-or-none principle: holding only high-resolution item representations stored in a limited number of memory slots. Items exceeding a storage capacity limit have zero-resolution representations. According to the variable-resources model, WM operates on the all-get-some principle: a pool of limited resources is dynamically allocated across a set of memorized items representations. WM can potentially hold an unlimited number of items by lowering their resolution. The most recent advancements in the theory have amassed evidence supporting the all-or-none discrete-slot WM model, while providing little evidence to support the variable-resource model. These findings could be use to imply that underlying neural representations need to be all-or-none. The results of the present study indicate that when given certain instructions, subjects in the experiment adaptively allocated a limited amount of resources and shared them across memorized item representations. The study furthermore demonstrates that the cognitive system operates under the principle of resource conservation: Allocating more resources to some item representations led to allocating fewer resources to the other item representations. In turn, each memorized item representation could show a gradual change from low to high-resolution states. The computational modeling results support the idea that a simple linear function could be used as a proxy to the underlying resource allocation across memorized item representations, very much as the water level in a tilted tank behaves.

The Effect of Practice on Default Mode Network Deactivation (Withdrawn)

Sebastien Helie (Purdue University)
Farzin Shamloo (Purdue University)

Abstract

The default mode network (DMN) refers to a set of brain regions in which BOLD signal is suppressed during attentional focus. Because automatic task processing requires less attention, development of automaticity in a perceptual categorization task may result in less deactivation of the DMN. We tested this hypothesis by analyzing the functional magnetic resonance imaging (fMRI) data of 25 participants that were each trained in perceptual categorization for 20 sessions on consecutive workdays (Helie, Roeder, & Ashby, 2010; Waldschmidt & Ashby, 2011). Each participant was scanned during category learning (CL), and in the 4th day (after 1,680 trials of practice), 10th day (after 5,160 trials of practice) and 20th day (after 11,040 trials of practice). The results show deactivation of the following DMN regions: orbitomedial prefrontal cortex (CL, days 4 & 10), superior frontal gyrus (CL), inferior parietal lobule (CL & day 4), and middle temporal gyrus (CL & day 20). In addition, analysis of variance shows a statistically significant decrease in orbitomedial prefrontal cortex deactivation between CL and days 4, 10, and 20 (typically the most robust DMN region), and in the precuneus between CL and days 4 and 10. These results suggest that automatic perceptual categorization does not inhibit DMN regions as much as perceptual category learning. These results provide preliminary evidence that DMN inhibition is reduced when the categorization task becomes more automatic, consistent with the hypothesis that automatic task processing requires less attentional focus.

The Evaluation of Orexin-A and Vigilance Performance

Regina Shia (711 HPW/RHCP)
Josh Hagen (711 HPW/RHXB)
Chuck Goodyear (Infoscitex)
Kyle Traver (711 HPW/RHCP)

Abstract

The objective of this effort was to investigate relationships between Orexin-A (Hypocretin-1) and performance on a sustained attention task. Nineteen subjects performed a simulated UAV task. The critical signal for detection occurred when a pair of UAVs appeared to be on a collision path. This task was administered for 40 consecutive minutes with performance averaging every 10 minutes. Blood draws were performed intravenously at baseline and every 10 minutes during the task (Time 0, 10, 20, 30, and 40 min). Repeated Measures ANOVA revealed a significant decrease in Hits ($F = 2.84$, $p < .05$), an increase in False Alarms ($F = 4.64$, $p < .01$), and an increase in Reaction Time ($F = 14.21$, $p < .001$). Overall, Orexin-A levels did not significantly change ($F = 0.56$, $p = .69$). Bivariate correlations were performed on changes in performance and changes in Orexin-A levels. Early increases in Orexin-A (-10-20min) were positively correlated with later changes in False Alarms (- 30-40min) with all subjects (r - .70, p $< .01$). Correlation results were compared between a high hit and low hit group. The high hit group alone exhibited this relationship ($r = .77$, $p < .01$) as well as other supporting relationships between increases in Orexin-A and later decreases in performance (False Alarms and Reaction Time).

Cognitive Modeling of the Vigilance Decrement

Bella Veksler (United State Air Force Research Laboratory)
Glenn Gunzelmann (United State Air Force Research Laboratory)

Abstract

Fatigue and vigilance literatures have largely been separate in the past. Fatigue researchers have studied how prolonged time awake impacts performance, while vigilance researchers have studied how alert individuals decline in performance during the course of a prolonged monotonous task. While a lot of empirical work has been done to demonstrate under what circumstances performance degrades, far less cognitive modeling has been done to both explain and predict performance changes. Computational cognitive architectures such as ACT-R have been used to model and make both quantitative and qualitative predictions about human performance in a variety of tasks. However, they primarily model expert behavior and do not typically degrade in performance. In recent years, a fatigue mechanism has been introduced into ACT-R in order to account for the changes seen in performance due to sleep deprivation or restriction (Gunzelmann et al, 2009). The current work strives to extend these mechanisms to reflect the changes in performance seen in the context of vigilance tasks. Our modeling work has demonstrated that the same mechanism can account for both forms of degradation. This mechanism effects the central cognitive processing system resulting in microlapses in attention which simultaneously affect both accuracy and response times. Data from an extended Psychomotor Vigilance Task, typically used in fatigue research, was modeled in conjunction with the Mackworth Clock Task, a classic vigilance task.

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Toward a Social Psychological Theory of International Relations

Vaughn Shannon (Wright State University)

Abstract

As a survey of international politics textbooks reveals, political psychology is notably absent from the collection of paradigms shaping discussions in international relations. At most, it appears briefly in foreign policy chapters in contrast to rational choice. But without the insights of psychology, the understanding of world politics is incomplete. This paper makes the case for a psychological paradigm of international politics on footing with realism, liberalism and constructivism. I sketch out the key tenets of the paradigm, emphasizing particularly strands from social cognition and social identity theory, for explaining conflict and cooperation, as well as hypocrisy and the prospect for change.

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National and Shared Identities: Unity or Rivalry?

Caitlyn Banis (Wright State University)

Abstract

As supranational institutions like the European Union (EU) attempt to cultivate aggregate transnational identities, the relevance of nationalism to individuals within the EU becomes an important consideration. I hypothesize that higher levels of nationalism correspond with low levels of support for shared identity, and examine surveys within EU member countries for evidence of both national and transnational identity. I will also be studying the phenomenon of multiple identities and how they relate to the support for unified understandings of self. Multiple identities are held by individuals, though it remains unseen how these identities interact with one another. What importance does the role of nationalism hold and how is that affected by the introduction of a more encompassing identity? Is it possible for an individual to consider oneself a certain nationality while identifying equally with the larger multinational region they are from? I will supplement the survey research with comparative cases to illustrate the evolution of nationality from World War I to the present day in Britain, France, and Germany.

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Testing the role of political psychology upon rule of law compliance within United States counter-terrorism operations.

Jonathan Maze (I.C.P program)

Abstract

Rule of law compliance, in relation to United States counter-terrorism policy and operations, is complex and continually changing paradigm. This paper will examine the Clinton-Bush-Obama administrations compliance with international law, domestic law, both, or neither when enacting counter-terrorism strategies, pre and post September 11, 2001. I will engage in an in-depth case study analysis to ascertain the effects of political psychology in regards to utilizing existing judicial or extra-judicial frameworks. Specifically, I will test the role of cognitive, political psychology within the decision making process to determine the affect upon rule of law compliance.

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Is early information used preferentially in mate-choice copying?

Robert Bowers (Indiana University)
Peter Todd (Indiana Univesity)

Abstract

Information about the mate choices of others is abundant and available for use by observers making their own mate choices. In humans and several other studied species, preference is often shown for mates that are apparently preferred by others (mate-choice copying). Humans have access to a great deal of social information from multiple models choosing and rejecting mates. Such information is generally received serially, with a specific temporal order. Hypotheses regarding the functional value of mate-choice copying are hard to differentiate, but differ in how they expect temporal order of information to affect the way it is used. In particular, views that stress time pressures predict that earlier observations of mate choice will be used disproportionatelya primacy effectfor quick decisions. In contrast, for views that stress other costs of active mate assessment or informational benefits of copying, later and earlier observations should be treated similarly, assuming they are equally informative and equally cheap. Memory decay may predict later instances having greater impact, a recency effect. To test these possibilities, we had female subjects view sets of real speed-dating videos each featuring a focal male with a series of three female models. Observed order effects support views that stress pressures on quick decision making. Discerning the effects of order is important not only for a complete description of the function of mate-choice copying, but furthermore such analyses begin to address questions about mechanism, helping to differentiate among models of cognitive processing.

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Theories of Informativeness: A Comprehensive Empirical Investigation

Ronaldo Vigo (Ohio University)
Basawaraj Basawaraj (Ohio University)
Charles Doan ()
Derek Zeigler (Ohio University)

Abstract

In a recent study, Vigo & Basawaraj (2013) found evidence in support of the hypothesis that peoples intuitions as to the quantity of information an object conveys about a category of objects to which it belongs (i.e., its degree of representational informativeness) is predicted more accurately and explained more satisfactorily by Representational Information Theory (Vigo, 2011, 2013) and its core models than by the well-known models of prototypicality. However, in their study, the aforementioned researchers focused on a small set of six structures defined over three binary dimensions (a.k.a., the SHJ family of structures; Shepard et al., 1961). Furthermore, only group level data analysis was conducted with respect to the model predictions. In our current study, we address both of these limitations and show to what extent these results generalize to simpler and more complex categories at both the group and individual level of analysis. We do so by testing model performance with respect to 41 category structures from six structure families.

Make Learning Stick: Instructional Design Using Real-Time Polling for improving student Levels of Engagement and Participation

Sheri Stover (Wright State University)
Dan Noel (Wright State University)

Abstract

Instructors in five different undergraduate classes designed their classes using real-time polling to increase their students levels of engagement and participation to help make learning stick.. This mixed methods research study examines the results of those efforts by querying students perceptions of how the use of real-time polling had an effect on 1) their understanding of the course content, 2) their levels of participation in the classroom, 3) their levels of engagement in the classroom, and 4) whether the students saw value in using real-time polling that transferred to use in other environments outside the classroom after the class. Instructors used Poll Everywhere to incorporate the real-time polling in classes where 98% of students had suitable cell-phones to respond to the polls. Results from this survey indicates that students perceive that the use of real-time polling overwhelmingly increased their understanding of course content and also increased their level of participation and engagement. Moreover, students also saw the value of using real-time polling transfer to other environments outside their current classroom.

Contagious Memories: Changes in Recall Accuracy Following a Discussion

Ryan Rush (Wabash College)
Steven Clark (University of California Riverside)

Abstract

When people share remembered information in a social setting, their memories may become contagious: One person may come to remember something only because it was remembered by another person. The present studies address three questions largely overlooked in the literature on social contagion and memory conformity. How accurate is the information people are exposed to when they discuss an event with another person? To what extent do people incorporate correct versus incorrect information into their own recall following exposure? What is the net gain or loss in accuracy due to the exposure to information from another person? Pairs of participants viewed photographs of common household scenes. All participants first recalled the scenes individually. Participants in the discussion group then discussed their recall with their partners, while participants in the no-discussion group engaged in a filler task (Solving math equations in Experiment 1 and reporting initial recall to a recording device in Experiment 2). All participants then recalled individually again. The results showed that exposure information was accurate, although not as accurate as individuals initial recall; the rate of recall for correct exposure items was higher than for incorrect exposure items; there was little or no net change in the accuracy of recall following exposure to the recall of the other person. Comparison to a non-discussion group showed that the discussion effects were not due to repeated testing or re-exposure to ones own recall. Additionally an accuracy redistribution effect was observed within each pair of participants. That is, post-discussion recall accuracy increased from initial to final recall for the initially less-accurate participant and decreased for the initially more-accurate participant. Comparison to a no-discussion control suggests that the effect is not merely a result of regression to the mean, but rather the accuracy redistribution is due both to discussion, and to reporting and self-exposure to ones own recall. The results suggest that collaborative recall can have both positive and negative consequences within a pair, and that people may wish to exercise caution when deciding with whom to exchange information.

The neural representation of location in remembered experience

Troy Smith (Ohio State University)
Vishnu Sreekumar (Ohio State University)
Simon Dennis (Ohio State University)
Dylan Nielson (Ohio State University)
Per Sederberg (Ohio State University)

Abstract

In a series of studies, we track the neural correlates of different dimensions of remembered personal experience in order to understand the representation of autobiographical memory in the brain. In this paper, we focus on the location in which events occur as a key dimension of experience. Nine participants used android phones equipped with custom lifelogging software to collect data about their everyday events for a period of 4 weeks. The phone automatically captured images, GPS, time and other sensor based data. Participants were brought into the lab 7-14 days after the data collection phase for a reminiscence task in an fMRI scanner. Each participant viewed his/her own images and mentally relived the corresponding events. We employed representational similarity analysis (RSA) to identify the regions that represent location by preserving spatial distance relationships. Spatial distances (calculated based on GPS recordings) correlate with patterns of neural activity during memory search in regions that are involved in manipulation of spatial attention (e.g. right superior parietal lobule), representation of affect-laden autobiographical information (e.g. right middle temporal gyrus) and other language processing regions (e.g. left angular gyrus). Other highly significant regions include the left insula which has previously been found to exhibit distance based fMRI adaptation effects and the left callosal cortex which is connected to the hippocampus, DLPFC and OFC and is implicated in Alzheimers disease. Together these regions provide us with a way to reconstruct the location and other related aspects of events.

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Action switching in embodied, dynamical agents

Eran Agmon (Indiana University)
Randall Beer (Indiana University)

Abstract

The dynamical systems approach in the cognitive and behavioral sciences studies how systems made of many coupled components across brain, body, and environment, self- organize to generate behavior. This approach has mostly focused on models of single actions and has not addressed how a dynamical system can engage in multiple different directed actions. In this research, we introduce a family of dynamical models that were evolved using genetic algorithms to demonstrate how agents can engage in multiple different actions and autonomously switch between them. These described agents engage in a food foraging task that requires them to gather different resources in order to maintain their nutrient levels above zero. The agents are driven by both internal, metabolic variables and external sensory variables. The analysis of one of these agents demonstrates how different actions can arise through transient modes of sensorimotor coordination, in which a subset of the available sensors and effectors become engaged while others are ignored. Transitions between actions are analyzed and shown to correspond to rapid movements through the agents state space. In these transitions, some of the previously controlling sensors and effectors disengage, and new sets of sensors and effectors are engaged.

Getting a Grip on Extended Cognition

Luis Favela (University of Cincinnati)
Anastasia Jinks (University of Cincinnati)
Anthony Chemero (University of Cincinnati)

Abstract

Extended cognition, unlike embodied cognition, is not a well-established part of current cognitive science. Some proponents and opponents of extended cognition believe the issue to be an empirical one. Not only do we agree that the issue is an empirical one, but we think there is already empirical evidence for extended cognition. In order to demonstrate this, we present evidence from within an empirically based theoretical and methodological framework for investigating extended cognition, which we call radical embodied cognitive science. This framework has ecological psychology as its theoretical basis and dynamical systems theory as its methodology. We present findings from two perception-action tasks, both of which utilized a sensory-substitution device called the Enactive Torch. These experiments demonstrated that sensory-substitution devices could become parts of interaction-dominant, extended cognitive systems. Participants used haptic tools to substitute for vision in two different tasks: Maze walking and making judgments about aperture passability. Following previous investigations of interaction-dominant cognitive systems (Dotov, Nie, & Chemero, 2010), we utilized detrended fluctuation analysis, a type of fractal analysis, to demonstrate 1/f scaling at participant-tool interfaces. Sometimes called pink noise or 1/f noise, 1/f scaling is associated with the behavior of complex systems that are interaction-dominant, due to the interaction of components at multiple time scales (Holden, 2005). Results from both experiments indicate that the Enactive Torch was a component of interaction-dominant, extended systems, thereby bolstering our claim that there is already empirical evidence for extended cognition.

Studying the Dynamics of Cyber-War through Instance-Base Learning and Multi-Agent Modeling

Noam Ben-Asher (Carnegie Mellon University)
Prashanth Rajivan (Arizona State University)
Nancy Cooke (Arizona State University)
Cleotilde Gonzalez (Carnegie Mellon University)

Abstract

Cyber-war is a growing form of threat that involves multiple nations executing simultaneously offensive and defensive operations in the cyber space. In such hyper dimensional and dynamic environment, agile and adaptive human decision making processes are crucial. We propose a novel approach to study the decision making processes that drive the dynamics of cyber-war using a multi-agent model comprising of cognitive agents that learn to make decisions according to Instance-Based Learning Theory (IBLT). In our paradigm, the CyberWar game, assets and power are two key attributes that influence the decisions of agents. Assets represent the key resource that an agent is protecting from attacks while power represents technical prowess of an agents cyber security. The agents in the game learn from experience to attack other agents and defend themselves in order to maximize their own assets. Importantly, the agents do not learn by using predefined strategies, as many multi-agent models do, but instead they learn from experience according to the situation and actions of others. The results of simulated cyber-wars reveal how power influenced the behavior agents adopt overtime. Powerful agents learned to become aggressive in attacking other agents, contrary to agents with low power that became defensive. This study proposes a novel approach to study the dynamics of cyber-war, using cognitive agents in a multi-agent setting that can provide understanding of the decision making processes as well as support for a decision maker in complex and dynamic environment.

Eye Tracking and Physiological Measures: an Alternative to Mirror Imaging Bias Detection

Caroline Salchak (Wright State University)

Abstract

The Mirror Imaging Bias is gaining attention as a prominent quality factor in analysts performance. Mirror Imaging is an irrationality in which analysts perceive and process information through the filter of personal experience; including situation, generation, society, and culture differences. Mirror Imaging and Theory of Mind are understood to be tightly interwoven; both occur when judging or predicting the actions of a third party. As a result, when looking at a situation that another is experiencing, you unconsciously prioritize the options, predict, and report what you would do in their place. As evidenced by notable historical events - such as Pearl Harbor or the 9-11 World Trade Center attacks - the consequences of this bias injected into planning and decision-making can be dramatic. A way to determine and detect Mirror Imaging in humans is sought. How analysts analyze data, are trained, and interact with biases is also explored. A literature review identified three reasons for the bias: failure of Theory of Mind, mindreading, and a cultural bias. An experiment to test for the appearance of Mirror Imaging was designed and completed. It used an off-body eye tracker as well as five different physiological measures: galvanic skin response, heart rate, respiration, skin temperature, and electromyography of the medial frontalis and orbicularis oculi. Preliminary results show a correlation between galvanic skin response and the appearance of Mirror Imaging. Future analysis will test for significance between other physiological measures and the bias as well as how it applies to cognitive processes of analysts.

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Black or White: An Investigation into Two Dimensions of Racial Judgements

Brett Jefferson (Indiana University)
Devin Burns (Indiana University)
James Townsend (Indiana University)

Abstract

Face shape and skin tint are two fundamentally distinct sources of information for distinguishing people we encounter everyday. Racial judgments, in particular, rely heavily on the accurate processing of these dimensions. This study ask participants to distinguish African American and Caucasian faces that vary in their shape and color, uncovering the processing structure for these dimensions with regard to architecture, stopping rule, workload capacity, and interactions. This is done by utilizing the theory driven methodology of Systems Factorial Technology, In addition, we study how these processing characteristics are modulated with systematic shifts in attention. Data is collected in control conditions where one dimension is held at a fixed level, a Garner filtering task where the second dimension varies but is irrelevant to the response, and a divided attention task where both dimensions must be processed to respond. With this novel design, we can not only identify how these two important dimensions interact when making racial classifications, but how those interactions are modulated by the attentional demands of the task.

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Predictable sequences promote the learning of visual statistical regularities

Joshua De Leeuw (Indiana University)
Robert Goldstone (Indiana University)

Abstract

Previous research on visual statistical learning has established that humans are able to learn transition probabilities between sequentially presented simple shapes in an implicit, unsupervised manner. In this experiment, we tested the influence of contextual statistics on this learning process by manipulating the overall randomness of the sequence of shapes. Participants were shown one of two different kinds of sequences. Half of the participants saw a sequence generated by combining predictable triples together in a random order, making the only unpredictable elements of the sequence the transitions between triples. The other participants saw a sequence that consisted of one triple embedded in an otherwise random stream of shapes, making most transitions relatively unpredictable. After five minutes of exposure, participants had learned to recognize triples in the mostly regular stream, but they generally failed to do so in the mostly random stream, despite the fact that the triple in the mostly random stream was presented exactly the same number of times as the triples in the regular stream. Thus, the likelihood that someone learns a specific statistical regularity is increased if its in the context of other regularities.

Salience As An Emergent Property Of A Computationally Rational Perceptual System

Christopher Myers (United State Air Force Research Laboratory)
Andrew Howes (University of Birmingham)
Richard Lewis (University of Michigan)
Joseph Houpt (Wright State University)
Nicole Jardine (University of Iowa)
Xiuli Chen (University of Birmingham)

Abstract

Selective attention is critical for understanding not only perception, but also other cognitive processes (e.g., decision making, planning, etc.). Research has demonstrated that intention affects selective attention processes (Yarbus, 1967), and how it may be combined with processes hypothesized to occur early in visual processing, such as feature integration, salience, and object recognition. This dichotomous perspective of selective attention is well established. It is based on the assumption that early visual information processes such as feature integration, salience, and object recognition, construct representations that are then subject to selective attention that is under the control of top-down intentional processes. Many instantiations of the dichotomous perspective first calculate salience and then weight the results given intentional priorities. However, a problem with this approach is a premature commitment to the calculation of salience, rather than to its emergence, leaving theories unable to explain the importance of salience, as instead theories merely redescribe the phenomena. In contrast, we propose a computational model in which, salience-like effects, rather than being programmed into the model, emerge as a consequence of intentional requirements and very low level information processing limits. Through empirical investigation and modeling simulations, informed by a theory of computational rationality (Lewis, Howes, & Singh, 2013), we demonstrate perceptual pop-out, selective saccadic effects in a distractor-ratio task, and parafoveal target detection. The results of this work suggest that salience is an emergent consequence of attention, not an input to attention.

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Evidence for Parallel Processing in the Identification of Shape and Color During Visual Search

Joseph Glavan (Wright State University)
Joseph Houpt (Wright State University)

Abstract

In his 1998 review paper, Wolfe failed to find evidence of bimodal distributions in over 2,400 pairs of visual search slopes (the relationship between search time and the number of distractors) and concluded that any effort to divide tasks into serial and parallel search on the basis of search slope alone will be futile. Additionally, search slope alone confounds the serial/parallel distinction with cognitive workload. Systems Factorial Technology (SFT; Townsend & Nozawa, 1995) is specifically formulated for measuring architecture and workload without confusing the two. In this study, participants searched for a target (a red circle) in a field of distractors that differed from the target in shape, color, or both. Search times were evaluated using the Capacity Coefficient and Survivor Interaction Contrast (SIC) from SFT. Results provide strong evidence against serial processing while suggesting either independent parallel or coactive processing of shape and color.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

A test of speech-specific and domain-general auditory grouping principles

Adam Thomas (The Ohio State University)
Mark Pitt (The Ohio State University)

Abstract

Spoken phrases such as plus sign are typically produced as a single /s/, but listeners hear two sequential /s/ phonemes. Double /s/ perception provides a unique opportunity to study the contribution of general auditory and speech-specific grouping principles to the perceptual organization of speech. The perception of synthetic speech analogues (sine wave replicas) of two-word phrases containing a double /s/ was contrasted with perception of acoustically similar nonspeech versions. In Experiment 1, participants made judgments about the number of fricatives (or in nonspeech, hisses) heard in the middle of the stimulus. This test confirmed that the /s/ in each phrase was grouped as two fricatives in speech sinewaves, but the same segment was only perceived as a single hiss in nonspeech. In Experiment 2, double /s/ phrases were continuously repeated to induce auditory streaming. Speech sinewaves were initially grouped using linguistic information, but the perceptual organization became dominated by general grouping principles as the phrases repeated. The data from both experiments suggest that perceptual grouping of speech deviates from that of nonspeech sounds when linguistic knowledge is able to influence grouping. Results will be discussed in terms of competing theoretical accounts of perceptual organization of speech.

Using LBA to model RTs collected in the GRT paradigm

Noah Silbert (University of Cincinnati)
Joseph Houpt (Wright State University)

Abstract

General recognition theory (GRT) provides a powerful framework for modeling interactions between perceptual dimensions in identification-confusion data. The linear ballistic accumulator (LBA) model provides powerful methods for analyzing multi-choice (2+) response time (RT) data as a function of evidence accumulation and response thresholds. We extend (static) GRT to the domain of RTs by fitting LBA models to RTs collected in a number of auditory GRT experiments. Although the mapping between the constructs of GRT (e.g., perceptual separability, perceptual independence) and the components of the LBA (e.g., drift rates, response thresholds) is complex, the dimensional interactions defined in GRT can be indirectly addressed in the LBA framework by testing for invariance of drift rates and response thresholds across appropriate subsets of the data. The present work focuses on correspondences between (invariance of) drift rates and response thresholds in LBA and perceptual separability and independence in GRT.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

The Strength and Weight of Evidence in Choice and Confidence

Peter Kvam (Michigan State University)
Timothy Pleskac (Michigan State University)

Abstract

Although in computational models evidence is generally assigned a single value denoting its quality, in many tasks evidence can be dissociated into its extremeness or sample proportion (strength) and its reliability or sample size (weight). We show that by independently manipulating each of these dimensions, we can examine how each one contributes to decisions and judgments. In doing so, we challenge two major assumptions made by sequential sampling models: 1) that evidence accumulated, reflected in response times and confidence, is a multiplicative function of strength and weight; and 2) that decision rules within a trial are pre-determined and static. Using two simple perceptual tasks, we show that people tend to overemphasize the strength of incoming evidence relative to its weight when making confidence judgments. In a choice task, though, it seems that they are giving strength and weight equal credence (as reflected by choice response times). However, by gauging the amount of information that participants gathered during each trial from trial histories, we find that participants are willing to wait and gather more evidence before making a decision when strength, and to a lesser extent weight, is increased. This suggests that the evidence people use to make their decisions and judgments is based more on strength than on weight, but that this effect is masked in choice response times because people also change their stopping rules within a trial based on this information. We discuss this change in threshold over time in the context of both diffusion and accumulator models.

Decision Outcome and Decision Process in Intertemporal Choice: a Revisit of Trait and Context

Jiuqing Cheng (Ohio University)
Claudia Gonzalez-Vallejo (Ohio University)

Abstract

In the field of intertemporal choice, people make decisions between receiving a small gain sooner and a large gain later. In recent decades, studies have overwhelmingly concentrated on decision outcomes of intertemporal choice (which option is chosen); how such decisions are generated remains largely unclear. The present study investigates the impact of context on decision outcome and decision process. The decision contexts included whether the outcomes were gains or losses, whether they were large or small in magnitude, and whether the options were similar or not. In addition to recording traditional decision outcomes, this study measured participants decision-making processes via mouse trajectory and response time. The measurements of mouse trajectory included mouse movement distance, back-and-forth movement and the degree to which that the mouse deviated from a straightforward choice path. The response time was divided into movement time and idle time. These measurements were used to index the experience of hesitation when making choices. Using two experiments, we demonstrated that participants displayed more hesitation (e.g., less direct trajectory) when making choices in the loss domain than in the gain domain, in the small magnitude context than in the large magnitude context, and when the options were more similar. Participants also showed more hesitation when choosing larger, later gains over sooner, smaller ones, but only when the intertemporal choice task contained non-immediate options with varied magnitude and delay. Such a task was able to better capture the tradeoff process between money and time. This study highlights the importance of decision process.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Allais from Experience: The process of reducing Allais reversals in repeated decisions

Jason Harman (Carnegie Mellon University)
Cleotilde Gonzalez (Carnegie Mellon University)

Abstract

The earliest challenge to rational choice theory was the Allais Paradox, a well-known bias in which peoples preferences result in contradictory choices between two objectively identical gamble pairs. Attempts to de-bias participants have focused on presenting information in a more intuitive manner, which reduces the effect but does not eliminate it. In the current study, we used a repeated choice paradigm of Decisions from Experience (DFE), where information about the outcomes is gained from repeated selections of one of the two gambles represented as blank buttons on the screen. An outcome is the result of a draw from the distributions of outcomes in the gamble selected. Predictions from a cognitive model derived from Instance-Based Learning Theory (Gonzalez, Lerch, & Lebiere, 2003) indicated that the Allais Paradox would disappear when decisions are made from experience. These predictions are verified in an experiment in which we compare the Allais Paradox problems presented in the traditional descriptive format, table (Savage) format, and repeated choice paradigm of DFE. In agreement with the literature, the Allais Paradox remains in the descriptive format, is reduced in the table format, and as predicted by our cognitive model, disappears in the experiential format. Additional analysis provides new detail about the dynamics of underweighting rare events, a robust finding in DFE experiments. Consistent with model predictions, participants only overweigh rare outcomes when they are experienced in later trials and overweigh rare outcomes when they are experienced early.

Learning optimal decision threshold: a computational model (Withdrawn)

Arash Khodadadi (Indiana University)
Pegah Fakhari (Indiana University)
Jerome Busemeyer (Indiana University)

Abstract

In many real life situations the animals face the problem of how much time they should spend on a decision. By deliberating more on each decision, the accuracy increases. However, if the total time for making a number of decisions is limited, by spending more time on one decision less remains for other decisions. If more accurate responding leads to higher values of reward (which is usually the case) then a rational animal should balance between its speed and accuracy in a way that the total amount of reward obtained in a limited time is maximized. In the framework of sequential sampling models, the balance between the speed and accuracy is controlled by the value of the decision threshold. Thus, in this framework to achieve the maximum reward, the animal should set the optimal value of this parameter. In this paper, we propose a theoretical framework and a computational model to investigate the problem of learning the optimal value of the decision threshold. To this end, we consider an experimental design in which each session consists of a number of blocks with fixed duration (for example one minute). The number of trials in a block depends on the time that the subject spends on average on each trial. Crucially, each trial can come from one of the several possible "conditions'. A condition specifies the difficulty of the trial, the reward, the penalty and so on. A cue associated with each condition is presented at the beginning of each trial. We show that to maximize the expected reward during a block, the subject should set a separate value of decision threshold for each condition. We propose a model of learning the optimal value of decision thresholds based on the theory of semi-Markov decision processes (SMDP). In our model, the experimental environment is modeled as an SMDP with each "condition' being a "state' and the value of decision thresholds being the "actions' taken in those states. The problem of finding the optimal decision thresholds then is casted as the stochastic optimal control problem of taking actions in each state in the corresponding SMDP such that the average reward rate is maximized. Our model utilizes a biologically plausible learning algorithm to solve this problem. The simulation results show that at the beginning of learning the model chooses high values of decision threshold which lead to sub-optimal performance. With experience, however, the model learns to lower the value

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Efficiency, fairness, and stability in a real-time, asynchronous game

Robert Hawkins (Indiana University)
Robert Goldstone (Indiana University)

Abstract

Although behavioral game theory has traditionally focused on games unfolding across one or more discrete stages, many real-world situations feature continuous-time, asynchronous decision-making. For example, agents in an economic market may buy or sell shares at any point in time, and the environment in which they are operating is immediately updated after an action has been taken. To begin investigating the introduction of real-time, asynchronous decision-making in repeated games, we implemented an asymmetric anti-coordination game in an online virtual environment. Players controlled avatars that could maneuver to one of two targets representing payoffs, one of which was worth more than the other. If players chose different targets, they received the corresponding values, but if they chose the same payoff, neither received anything. In the 'dynamic' condition, players were free to change their trajectories at any point in continuous time, but in the 'ballistic' condition, mimicking the traditional staged design, players chose their destinations at the beginning of the round and then relinquished control. We randomly paired up Amazon Mechanical Turk workers to form 30 pairs of participants for each condition, and each pair played 50 games together. We characterize the difference between 'dynamic' and 'ballistic' conditions via 3 separate measures: efficiency (quantified as the sum of both players' average payoffs), fairness (quantified as the ratio between payoffs), and stability (quantified as the trapping time of the cross-recurrence plot).

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The time course of preference formation in risky decision making

Shuli Yu (Michigan State University)
Timothy Pleskac (Michigan State University)
Taosheng Liu (Michigan State University)
Christopher Hopwood (Michigan State University)
Kyle Bort (Michigan State University)

Abstract

Impaired judgment and decision making is a common explanation for drug abuse. While research on the source of these impairments has focused largely on the pre-choice evaluation of options and the post-choice reaction to decision outcomes, much less is known about the deliberation process when beliefs and desires are integrated over time to form a preference leading to a choice. To study deliberation, we developed the Flash Gambling Task, where participants choose between two options: a fixed reward, represented by a fixed sample of dots moving onscreen, and a risky gamble, represented by rapidly changing samples of dots from an underlying reward distribution. Results highlight that participants are sensitive to the difference in expected reward between the two options when we vary the mean number of dots between the fixed reward option and risky gamble. Computational modeling work using the observed samples of payoff rates as inputs to a sequential sampling framework show that participants choice process is well described as an evidence accumulation process which compares and integrates potential payoffs over time to form a preference. This is advantageous as the process of deliberation may now be distilled into several cognitive measures, including payoff sensitivity, response caution, and bias to take risks. We find that participants initial bias to choose the gamble predicts participants drug use over and beyond other self-report personality scales that measure risky decision making, impulsivity, sensation-seeking and alcohol consumption. Hence, the FGT is a novel cognitive instrument that may be used to access risky behavior.

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An Application of Dynamic Programming (DP) to Optimal Experimental Design

Woojae Kim (Ohio State University)

Abstract

Experimentation is at the core of research in psychology, yet observations can be expensive and time-consuming to acquire. A major interest of researchers is designing experiments that lead to maximal accumulation of information about the phenomenon under study with the fewest possible number of observations. In addressing this challenge, statisticians have developed design optimization methods. This paper introduces a hierarchical Bayes extension of adaptive design optimization that provides a judicious way to exploit two complementary schemes of inference (with past and future data) to achieve even greater accuracy and efficiency in information gain. We demonstrate the method in a simulation experiment in the field of visual perception.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Adaptive Design Optimization for Comparing Models of Spacing Effect

Yun Tang (Ohio State University)
Tiffany Jastrzembski (Air Force Research Laboratory)
Michael Krusmark (L3 Technologies)
Kevin Gluck (Air Force Research Laboratory)
Mark Pitt (The Ohio State University)

Abstract

In this study we explore an optimal experimental design approach to discriminate spacing effect models. The spacing effect refers to a pervasive phenomenon that increased temporal lag between study episodes can enhance performance on a later test. By integrating cognitive processes of learning and retrieval, Jastrzembski et al. (2008, 2009) have developed a mathematical model, dubbed the Predictive Performance Equation (PPE), that captures the spacing effect in a wide spectrum of learning contexts. In the present study, we investigate two theoretically-distinct variants of PPE models in the context of surgical training and associative memory tasks. The two model variants are compared using generalizability measures such as AIC, BIC, cross validation, and accumulative prediction error. Results from model analyses show that extant experimental designs may not be equally informative for every individual to estimate and compare spacing effect models. A previously developed adaptive design optimization (ADO) procedure is introduced to find informative and efficient experimental designs to better discriminate models and assist with parameter estimation at the individual level of analysis. We will demonstrate the ADO procedure in simulation, as well as discuss the potential implications of using ADO in longitudinal experiments.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Using large datasets to examine the performance space of ACT-R's base-level learning mechanism

Clayton Stanley (Rice University)
Michael Byrne (Rice University)

Abstract

This research explores and further validates ACT-Rs base-level learning mechanism on two large-scale real-world datasets. We framed the process of choosing tags and hashtags on StackOverflow posts and Twitter tweets as a declarative memory retrieval problem. 265,000 posts and 2.4 million tweets from 3900 total authors were collected. ACT-Rs base-level learning equation and the simplified version (assumes equally-spaced retrievals for each chunk) were used to predict each authors chosen hashtags, given their previous hashtag use. The model performance space was explored across 22 levels of the decay rate parameter and 48 dataset subsets. The results show that for these datasets, the optimal decay rate parameter value for the simplified equation is 0.4, close to the standard 0.5 value. When using the standard equation, the optimal decay rate increases to 0.7 and model accuracy improves from 29% to 34%. Further, the standard equation can be implemented in a computationally efficient manner (20 ms per retrieval). Taken together, this research suggests that when modeling retrievals on a broader range of tasks or at least similar tasks consisting of a large amount of retrievals over an extended period of time - it may be worthwhile to test if model accuracy improves after using the standard base-level learning equation and slightly increasing the decay rate. The results also highlight the importance of customizing model retrieval predictions based on each users prior history, as tag retrieval accuracy over the extensive tag space in these datasets is 34% when using only base-level learning and no contextual information.

Canonical Duality and Triality: Unified Understanding Complex Systems and NP-hard Problems in Cognitive Science

David Gao (Federation University Australi)

Abstract

Duality is a beautiful, inspiring, and fundamental concept that underlies all natural phenomena. Canonical duality-triality theory is a newly developed, methodological and potentially powerful theory, which can be used not only to model complex systems within a unified framework, but also for solving a large class of challenging problems in multidisciplinary fields of mathematical physics, global optimization, computational sciences, information technology, cognitive and decision science, industrial and systems engineering, and much more. Beginning from dualities in eastern philosophy and the Garden of Eden, the speaker will first present a unified structure and splendid beauty in art, science, linguistic, mathematics, and general multi-scale systems. By using a very simple, but fundamentally difficult nonconvex minimization problem, the speaker will show how the canonical duality-triality theory can be used to solve challenging problems in nonconvex/nonsmooth/discrete systems, and why this theory is potentially powerful for modeling complex systems. The inter-relations between chaotic dynamics, NP-hard problems in computer science, small world theory in network systems, and the paradox of Buridans donkey in decision sciences will be revealed. Applications will be illustrated by challenging problems in clustering, support-vector machine, and neural network optimization. This talk should bring some new insights into complex systems theory and cognitive science. References: [1] Gao, D.Y. (2000). Duality Principles in Nonconvex Systems: Theory, Methods and Applications. Kluwer Academic Publishers, Boston/Dordrecht/London, 2000, xviii+454pp. [2] D.Y. Gao (2009) Canonical duality theory: Unified understanding and generalized solution for global optimization problems, Computers & Chemical Engineering, 33:1964-1972. doi:10.1016/j.compchemeng.2009.06.009

The Improved Prediction Models for Cognitive Performance using MRI data

Gengxin Li (Wright State University)

Abstract

Magnetic resonance spectroscopy is widely applied to measure neurochemicals, and completely understanding the pathological mechanisms of patients neurological and psychiatric disorders is the main interest in most previous studies. With the rapid development of bio-technology, more and more research groups focus on the case-control cognitive deficits studies to explore the connection between brain metabolites and peoples cognition. But, establishing the complete neurochemical map of normal peoples cognition is still challenging, in particular, when the study only uses few subjects to do the feature selection procedure which might lead to the conservative outcome (selection bias problem). To solve this problem, we propose some prediction models using various Lasso penalties to improve the estimates of each feature. The effectiveness of the proposed method is evaluated by the real data study which measures main metabolites in thirteen brain regions strongly involving in the cognitive tasks.

Physiological Measures as Indicators of Cognitive Workload

Dakota Evans (Wright State University)

Abstract

The future for human-computer interaction encompasses smarter technology that can better understand the user beyond just keyboard and mouse inputs. This will involve hardware such as eye-tracking systems that will be integrated into many everyday products. The hardware will track human physiology and the software will make inferences about user state such as cognitive workload, situation awareness, and fatigue. This study has a focus on understanding physiological measures as indicators of cognitive workload during varying task difficulty levels. Currently, subjective measure acquisition techniques such as post-test questionnaires are commonly used to measure cognitive workload. If physiological measures could be used as an objective indicator of user cognitive workload, user cognition could be evaluated real-time and the software could provide a level of automation that better suits the user. Physiological measures were collected during four task difficulty levels using a first-person 3-d puzzle game called Q.U.B.E (Quick Understanding of Block Extrusion). The physiological responses that were collected for the study include pupil diameter, blink rate, fixation duration, fixation count, galvanic skin response, heart rate, respiratory rate, and electromyography electric potential. The experiment was conducted with two hypothesize. The primary hypothesis was that each of the physiological measures would be different for each of the four levels of the study. This would give insight into physiological measures as indicators of cognitive workload. The secondary hypothesis was that the post-test questionnaire (NASA-TLX) that was used for measuring cognitive workload will indicate the same trend as the physiological measurement responses.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Harmony from Chaos? Investigations in Aperiodic Visual-Motor and Interpersonal Coordination

Auriel Washburn (University of Cincinnati)
Michael Richardson (University of Cincinnati)

Abstract

One only has to consider loading the dishwasher or setting the dinner table with family members to be reminded that people are capable of coordinating in an effortless manner, even when faced with highly variable, often unpredictable behavioral events. While a substantial amount of research on joint-action has focused on the coordination that occurs between simple stereotyped or periodic movements, a larger proportion of everyday social and interpersonal interaction requires that individuals coordinate complex, aperiodic actions. In fact, many of the actions performed by individuals in an interactive context likely exhibit characteristics synonymous with chaos (i.e., are unpredictable yet deterministic). Although counterintuitive, recent research in physics and human movement science indicates that small temporal feedback delays may actually enhance an individual's ability to synchronize with chaotic environmental events. Together, this research suggests that a similar process may be at work in the interpersonal coordination of aperiodic behaviors. Here we present data from a study that investigated this possibility. The results suggest that individuals are able to coordinate aperiodic (chaotic-type) movements in a bi-directional context, and that small information feedback delays may (in some instances) enhance such joint-action coordination and facilitate social anticipation.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Meaning-based natural language processing in agent-based training systems

Dr. Mallory Selfridge (Precision Training Software)
Dr. James McCarthy (Sonalysts)
Lt. Noah Schill (USAF)

Abstract

Modern systems often require teams of skilled operators, and effective team training is important. Ideally, such training involves team members working together to respond to authentic challenges. However, in practice, a number of constraints limit these opportunities. One alternative is to replace 'missing' teammates with synthetic agents. To be effective, these agents must not only carry out the same actions as the missing team members, but they must also communicate naturally with the human trainees to provide them with a realistic training experience. The agents must successfully understand written and spoken input despite missing or extra words or incorrect or unusual syntax. The agents should also have the ability to ask for missing information and carry out mixed-initiative interactions. In addition, since they are operating in a training context, the agents must accommodate errors made by human teammates - either correcting the error if their human counterpart would be able to do so or proceeding forward within the context established by the error as a human would. We are currently exploring agent-augmented training in the context of preparing personnel responsible for operating remotely piloted aircraft. In this paper, we focus on the natural language capabilities of the agents. This capability is based on a cognitive model of human language processing, using a semantic model of the training domain linked to a lexicon of domain-specific word meaning and accessed by a semantics-based preference analyzer that computes the most likely meaning of input based on word meaning, conversation context, and training context. This paper suggests that a 'cognitive' natural language processing enables synthetic agents to carry out realistic natural language interactions with human trainees within the training context, and thus contributes to effective and efficient training.

Characterizing Temporal Patterns in Team Communication in a Large-Scale Air-Combat Simulation Training Exercise

Adam Strang (Air Force Research Laboratory)
Christopher Best (Australia DSTO)
Gregory Funke (United State Air Force Research Laboratory)
Sheldon Russell (United State Air Force Research Laboratory)

Abstract

Verbal communication is a primary means through which military teams interact, and researchers commonly use communication analysis to draw inferences about team coordination and cognition. At present, team communication studies have mostly employed only descriptive measures of communication (e.g., frequency counts). This approach ignores temporal patterns in team communication, which have recently been shown to exhibit association with shifts in team state (e.g., task load, cross training). Sample entropy (SEn) is a nonlinear measure that can be used to characterize the degree of temporal pattern complexity (high versus low) in team communication. The goal of this experiment was to use SEn in order to, a) confirm the existence of deterministic temporal patterning in the communication of teams of enlisted airmen performing a high-fidelity air-combat training simulation, b) identify the minimum number of communications that are necessary to detect this patterning, and c) assess whether increases in task load effect the degree of temporal pattern complexity in team communication. Results confirmed the existence of deterministic temporal patterning within local team communication, as well as across a multi-team communication platform. For all team types, relatively few communications (x 50) were necessary to detect deterministic temporal patterning. Finally, increases in task load were associated with a decrease in communication temporal pattern complexity, a result that is consistent with our previous laboratory findings. Collectively, these results substantiate the use of SEn for characterizing temporal pattern complexity in team communication with high resolution, and indicate that it is a useful and unobtrusive tool for determining team task load shifts in high-fidelity air battle management operations.

Using Network Theory to Introduce Stable Cross-Cluster Ties in Academic Contexts

Samantha Cohen (Indiana University)
Peter Todd (Indiana Univesity)

Abstract

Social organization of networks is often characterized by homophily, where similar individuals cluster together. Network theory indicates that clustering leads to lower diffusion of influence between nodes in the network. Within academic collaboration networks, clustering can take the form of departmental affiliations, which can prevent researchers from collaborating with similar individuals in other departments and inhibit interdisciplinary and innovative research. Is it possible to reorganize pre-existing social networks to increase information flow, and if so, how stable are these newly-created ties within the network? We developed a paradigm to study how to best introduce long-lasting cross-cluster connections into pre-existing academic collaboration networks by combining two mechanisms for partner choice commonly used in romantic contexts: speed-dating and algorithmic matching. This 'speed-networking' event used a novel matching mechanism to assign conversation partners to participants. Members of the Indiana University research community attending this event met with pre-determined partners with varying degrees of overlap in research interests. Participants were divided into two groups, where one group encountered more similar ties while the other encountered more dissimilar ties on average. Different network manipulations of tie strength impacted the flow of information and the discovery of potential collaborations through and outside of the network.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Coordination in conversation: Investigating social interaction from the behavioral dynamics perspective

MaryLauren Malone (University of Cincinnati)
Michael Richardson (University of Cincinnati)

Abstract

Human behavior is deeply rooted in the interpersonal activity that permeates daily life. Successful navigation of this social environment requires interpersonal behavior that is contingent upon a mutual awareness of how actions are identified and understood. Recent research conducted from the dynamical systems perspective suggests that coordination with others directly influences feelings of social connection, and reliably reflects measurements of cooperative task performance. Many of these studies, however, have typically involved incidental, non-goal directed tasks (e.g., rhythmic limb movement), or limit subjects to virtual contact. As such, socially contextual interactions of real communicators are uncommon. Here, we present data from several structured conversation tasks that investigated meaningful changes in the coordinative movement of interacting individuals and their role in successful communication. Employing various linear and nonlinear measures, we examined the structure of the interpersonal movement dynamics and assessed the degree of interpersonal coordination between pairs. The results are discussed in terms of the low-level dynamical processes involved in social interaction that function to stabilize behavioral performance and shared understanding, with a particular emphasis on the differences in interpersonal movement coordination during collaborative action.

Developmental Dynamics of Team Physio-behavioral Coupling during the Early Learning Phase of a Cooperative Supervisory Control Task

Gregory Funke (United State Air Force Research Laboratory)
Adam Strang (Air Force Research Laboratory)
Sheldon Russell (United State Air Force Research Laboratory)

Abstract

Teammates often exhibit similarities in physiological and behavioral responses when performing cooperatively - a phenomenon termed physio-behavioral coupling (PBC). Research indicates that PBC is influenced by team processes (e.g., coordination) and attributes (e.g., cohesion), and that it can predict team performance. However, the developmental trajectory of PBC during the early learning phase of team skill acquisition is unknown. The current experiment explored this issue by examining PBC in the cardiac activity (electrocardiogram inter-beat intervals; IBIs), brain activity (electroencephalography; EEG), and eye-gaze (EG) of ad-hoc team dyads performing cooperatively. The cooperative task employed was the Research Environment for Supervisory Control of Heterogeneous Unmanned Vehicles (RESCHU) - a medium-fidelity air-combat simulation. During the experiment, teams (N = 11) performed 24 trials (each lasting 10min) of RESCHU over two sessions (12 trials per session) that were separated by (at minimum) a two day retention period. As expected, team performance (RESCHU score) improved with practice and exhibited characteristics of learned retention between sessions. EEG coupling decreased with practice, whereas EG coupling increased with practice. Both EEG and EG coupling exhibited characteristics of learned retention, though retention amounts differed. IBI coupling exhibited no change with practice or sign of retention. This indicates that the developmental trajectories of PBC were dissimilar (in shape or direction) among the physio-behavioral responses we examined, which may hint that different physio-behavioral responses characterize different team process. Finally, EG coupling exhibited the closest association with team performance improvements, potentially indicating that EG coupling could serve as a proxy for team performance measures in future cooperative supervisory control applications.

Web-Based Implementation of the Modified Multi-Attribute Task Battery

James Cline (Miami University)
Dustin Arendt (NRC)
Eric Geiselman (United State Air Force Research Laboratory)
Leslie Blaha (United States Air Force Research Laboratory)

Abstract

The goal of this project is to create a portable and reconfigurable implementation of the modified Multi-Attribute Task Battery (m-MAT-B) task. The MAT-B experiment was designed to evaluate pilot performance and workload and is composed of multiple tasks that are analogous to activities an aircraft operator would perform during flight. Each task has input parameters for the frequency of events and speed of objects, which can be manipulated in order to change workload. The original MAT-B was modified to study multitasking workload capacity in more nave participants (i.e., non-pilots), and it has been utilized to study the role of various visual cues for improving performance under conditions of constant workload. The current software implementation of the m-MAT-B is difficult to port and customize, and does not have the capability to adapt the difficulty level to the user during the task. We have implemented the m-MAT-B using a combination of web standards (e.g., HTML, SVG, CSS, and JavaScript) so that the experiment can run in any modern web browser. These web standards are effectively integrated using the Open Source JavaScript library, D3. The difficulty of each task (i.e., tracking, monitoring, communication, and resource management) can be easily controlled by changing the object speed, number of sub-components, or event frequency. Our implementation of the m-MAT-B experiment can be hosted on a web server allowing for large scale participation in workload studies. Furthermore we plan to make the source code available so other researchers can reproduce or build from this work.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Metadata and Memory Cues in a Collaborative Tagging Environment

Jared Lorince (Indiana University)
Peter Todd (Indiana Univesity)

Abstract

How can we identify and study the memory aids that people create for themselves? In Web-based collaborative tagging systems, users annotate resources with free-form textual metadata ('tags'). Though individuals' tagging motivations vary, the most common proposed reason for this behavior is that users tag resources to facilitate re-finding them at a later time. Empirical work quantifying and testing this claim does not yet exist, however, and is the goal of our current research. If users do in fact tag items to facilitate later retrieval, we would expect measurably different re-encounter rates for tagged versus untagged items in tagging systems, in a manner consistent with existing human memory research. To explore this, we use a large-scale dataset (tens of thousands of users) from the social music site Last.fm to examine how music listening patterns covary with tagging behavior. In particular, we present our progress on answering three concrete questions: First, how can we measure and identify particular classes of re-listening patterns (e.g. regular, sporadic, or isolated listening) among the thousands of users and millions of songs in our data? Second, how are tags temporally distributed for items in these different classes? That is, when over the time course of listening to a song or artist is a user most likely to tag it? Finally, when and how does the information content (i.e. specificity) of the tags assigned to an item predict future listening? This research improves our understanding of what drives tagging decisions, but more broadly serves as a case study of human memory and decision-making 'in the wild,' letting us test methods for analyzing when and how people structure their environments with cues for successful resource retrieval.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Post-decisional response dynamics of confidence judgments in a recognition memory task

Patrycja Zdziarska (Michigan State University)
Shuli Yu (Michigan State University)
Timothy Pleskac (Michigan State University)

Abstract

Time heals all wounds; does it mend confidence bias? We used mouse cursor process-tracing to investigate the time course of confidence judgments in a recognition memory task. Participants learned a set of faces and then took a memory test. For each test face, they made an old-new recognition decision and then expressed how confident they were in that decision by moving their mouse cursor from a central starting position to their desired confidence rating on a semi-circular confidence scale. We manipulated the time participants took to make their confidence judgment (inter-judgment time). Results show that participants make a curved path toward their confidence rating, and that the extent of the curvature increases with additional inter-judgment time. Specifically, the mouse paths for confidence judgments made after incorrect old decisions (false alarms) are initially directed towards higher confidence ratings but then curve towards lower confidence ratings. The reverse is true for mouse paths made after correct new decisions (correct rejections). These findings reveal an initial bias to give high confidence ratings after making old responses and provide evidence for post-decisional processing. Together, response dynamics of the mouse paths show that confidence is not always formed immediately at choice; instead, participants may continue to deliberate their decision even after selecting an initial decision. Furthermore, we found that this additional deliberation is useful for correcting the initial bias to give higher confidence ratings after old recognition decisions, leading to better confidence resolution.

Attractor Dynamics in Word recognition

Olivia Pavlov Garcia (University of Cincinnati)
John Holden (University of Cincinnati)

Abstract

How do the components of cognitive systems coordinate their activity to behave as a whole? Reading in particular results from the coordination of a large number of perceptual, muscular and cognitive variables. Word recognition tasks, have long been known to yield 1/f noise (Van Orden, Holden, Turvey, 2009). Furthermore, model self-organizing systems predict 1/f noise to be their output and observing this same phenomenon in human performance allows the inference to be made that coordinative synergies support cognition. In this study, oscillatory patterns were introduced to cognitive variables that affect reading performance. An oscillation in expected average response time was embedded into the trials of a Word Naming task, by presenting items in a fixed sequence. A control condition completed the same trials, in random order. This, in turn, allowed the introduction of relative coordination manipulations. The outcome of our study suggests that cognitive performance entails coupling across a range of temporal scales. In addition, we demonstrate that the nature of the coupling activity expressed in a given cognitive activity is emergent, in that its expression complies with task demands.

Perceived Exhaustion Predicts Mind Wandering

Charles Van Stockum (University of Louisville)
Marci DeCaro (University of Louisville)

Abstract

Executive resource models of mind wandering propose that task-unrelated thoughts (TUTs) depend on the availability of executive resources, which is related to both the attentional demands of the task and individual differences in working memory capacity (WMC). Specifically, previous studies have shown that the frequency of TUTs is inversely related to task difficulty, but this relationship is moderated by attentional control abilities. We tested whether the frequency of TUTs is also influenced by subjective perceptions of exhaustion, while controlling for the availability of executive resources. Attentional demands were manipulated between-subjects: one group performed the Sustained Attention to Response Task, which requires responses to all stimuli except infrequent and unpredictable targets (Go/No-Go group); others performed the same task, but no targets were identified in the instructions (Go group). Ratings of task load were significantly lower, and reports of TUTs significantly higher, in the Go group. Exhaustion ratings did not differ significantly between groups, and were not related to WMC; however, exhaustion was positively related to the frequency of TUTs in both groups. These findings suggest that, irrespective of the availability of executive resources, mind wandering may be most likely to occur when people perceive their cognitive resources as being taxed. This is in line with previous studies showing that perceptions of mental fatigue moderate subsequent exertions of attentional control. Resource models of mind wandering should consider the influence of subjective perceptions of the task, in addition to task-related determinants and attentional control abilities.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Perceptual Evidence Accumulation in a Moving Window Paradigm in Face Categorization

Maxim Bushmakin (IU)

Abstract

The ability to identify and categorize objects is essential for successful interactions with ones environment. Different features of an object contribute differently to the visual identification and categorization of that object. The current project addresses the dynamics of visual object recognition by investigating the differential contribution of visual features across time. Changes in visual information were caused by viewing stimuli through a moving window, where subjects were allowed to see only a limited amount of information per unit of time. We used a set of face stimuli in two orientations. Many researchers have found an advantage for upright compared to inverted faces (Rossion, 2008; Yin, 1969). A common explanation for these effects is that upright faces are processed by a holistic system while other objects - including inverted faces – go through a featural system (Maurer, Grand, & Mondloch, 2002; McKone, 2009). The current work examined these ideas with sequential sampling models (Ratcliff, 1978; Brown & Heathcote, 2008), analyzing subject performance on a categorization task for the upright and inverted faces viewed through a moving window. We used information theoretic approach to estimate amount of information available at each moment and how it related to perceptual evidence accumulation. The results suggest that the size of the face inversion effect is due in part to where subjects choose to look and in part due to the general inefficiencies in processing upside down objects.

Bilateral saccade execution can impair working memory.

James Edlin (University of Louisville)
Charles Van Stockum (University of Louisville)
Marci DeCaro (University of Louisville)
Keith Lyle (University of Louisville)

Abstract

Performing 30 s of bilateral saccades has been shown to enhance subsequent episodic memory retrieval and attentional control. One explanation for these benefits is that saccade execution temporarily increases attentional control by repeatedly activating frontoparietal regions associated with top-down attention. This increase in attentional control also enhances attention-demanding episodic retrieval tasks. One possibility that follows from this hypothesis is that saccades may enhance performance on other tasks that rely on attentional control. We tested whether saccades enhance performance on a measure of working memory capacity that required participants to maintain attention on a primary storage task while minimizing interference from a secondary processing task. First, participants completed the automated operation span task to determine baseline working memory capacity. Then participants performed either saccades or a fixation control activity immediately before completing the automated reading span task. We also measured degree of handedness lateralization, because strongly lateralized individuals have consistently benefited from saccades in previous studies, whereas weakly lateralized individuals have not. Contrary to our predictions, reading span scores were significantly lower following saccade execution versus fixation. No differences related to handedness lateralization were observed. These findings provide novel evidence that performing saccades prior to an attention-demanding task may decrease performance in some cases, regardless of handedness lateralization. A possible explanation for this finding is that repeatedly activating frontoparietal regions prior to a working memory task may impair performance when executive resources have already been depleted by prior exertions of attentional control.

Learning in dynamic decision making (Withdrawn)

Pegah Fakhari (Indiana University)
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Jerome Busemeyer (Indiana University)

Abstract

Reinforcement Learning (RL) theory has been used in many studies to characterize human decisions mechanisms. The goal of RL is to maximize the future discounted rewards; thus it estimate value of each action based on the current reward and what could be expected in future. Traditionally, model-free TD is popular in interpreting behavioral data. In this approach, the value of each alternative is computed directly by using reward (or penalty); however estimating these values could be adjusted by the agents knowledge about the environment as well (model-based RL). Although many robotic studies have revealed the efficiency of the reinforcement learning algorithm in different dynamic applications (mountain climbing, soccer games and firefighting), however, RL has not been applied to more complicated tasks (e.g. navigating in a maze) in which decision maker faces with the consequence of his own actions on later trials and little is known about the human performance in dynamic decision making. In our task subjects learn how to correctly navigate a maze (with some hidden obstacles) in as few moves as possible while maximizing their reward. We fitted model-based and model free RL to subjects choice data and compare their predictions in calculating rewards and actions probability.

The Rapid Assessment of Cognitive Readiness (RACeR) Tool

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Abstract

Cognitive Readiness is a measure of the mental preparation (e.g., skills, knowledge, abilities, motivations) needed to establish and sustain competent performance in complex and unpredictable environments like modern military operations. Cognitive readiness has been hypothesized to be related to multiple underlying psychological components such as situational awareness, memory, and problem solving. Supervisory individuals (e.g., unit commanders) could optimize the performance of their teams if they could task warfighters according to their cognitive readiness to perform various jobs. Commanders could benefit from tools that assess cognitive readiness, and provide guidance for tasking based on results. We have developed the Rapid Assessment of Cognitive Readiness (RACeR) tool to provide rapid and accurate assessment of cognitive readiness and enable supervisors to make informed tasking decisions based on results. RACeR selects the best combination of cognitive tests (from an armory of individual tests) to assess the required skills for a task, and evaluates an individuals cognitive readiness for a particular task based on test performance. RACeR is a client-server-based system consisting of a browser-based Commander app, a mobile Warfighter app, and the RACeR server. The Commander app is used to create assessments for upcoming tasks, assign cognitive tests based on warfighter task qualifications, and view test results to guide task assignment according to readiness levels. The mobile Warfighter app is where cognitive tests are administered. The RACeR server manages current and past test results, including calculations of cognitive readiness scores. We are developing visualization and analytical techniques to understand, correlate and predict cognitive readiness.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Survivor Interaction Contrast Wiggle Predictions of Parallel and Serial Models for an Arbitrary Number of Processes

Haiyuan Yang (Indiana University)
Mario Fific (Grand Valley State University)
James Townsend (Indiana University)

Abstract

The Survivor Interaction Contrast (SIC) is a distribution-free measure for assessing the fundamental properties of human information processing such as architecture (i.e., serial or parallel) and stopping rule (i.e., minimum time or maximum time). Despite its demonstrated utility, there are some vital gaps in our knowledge: First, the shape of the serial maximum time SIC is theoretically unclear, although the one 0-crossing negative-to-positive signature has been found repeatedly in the simulations. Second, the theories of SIC have been restricted to two-process cases, which restrict the applications to a limited class of models and data sets. In this paper, we first prove that in the two-process case, a mild condition known as strictly log-concavity is sufficient as a guarantor of a single 0-crossing of the serial maximum time SIC. We then extend the definition of SIC to an arbitrary number of processes, and develop implicated methodology of SIC in its generalized form, again in a distribution-free manner, for both parallel and serial models in conjunction with both the minimum time and maximum time stopping rules. We conclude the paper by demonstrating application of the theorems to data from a short-term memory search task.

Analysis of Fused and Unfused Imagery using SFT

Elizabeth Fox (Wright State University)
Joseph Houpt (Wright State University)
Fairul Mohd-Zaid (Air Force Institute of Technology)
Jennifer Bittner (Ball Aerospace)

Abstract

Several types of sensors are used to capture imagery to provide information to human observers. Images from each sensor can be presented to an observer individually, or the images from multiple sensors can be algorithmically combined into a single image. The various algorithms for fusing images have been studied from an information theoretic viewpoint, but the advantages (or disadvantages) of fusion for human perceptual and cognitive processing have received relatively little attention. Systems Factorial Technology (SFT; Townsend & Nozawa, 1995) is general framework for assessing of how human observers process multiple sources of information. We applied SFT to measure how observers perform with images from different sensors separately (side-by-side). This performance was used as a baseline to compare performance with fused imagery. Because there are two separate images in the side-by-side presentation, there may be some statistical facilitation of the processing times, while fused presentations eliminate the need to attend to both sides. These two potential gains seem to trade off we found roughly equivalent workload capacity levels, limited for all participants, in both conditions. The survivor interaction contrast (SIC), another measure of SFT, indicated most individuals processed the side-by-side images sources of information simultaneously (in parallel) while responding with the first completed source. Despite the roughly equal capacity, the fused images result in slightly faster response times than the redundant side by side images at the group level, with all sensor types being equally fast with no significant interaction. While the fused imagery is processed slightly faster, performance with the side-by-side presentation is quite good because participants were able to process the images in parallel. Given that there is necessarily some loss of information in the fused images, it may be use side-by-side images even in time critical applications.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Comparing Two Models of Adaptation in Non-Stationary Environments

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Thomas Mielke (The Boeing Company)
Vladislav Veksler (United State Air Force Research Laboratory)
Jack Harris (United State Air Force Research Laboratory)
Kevin Gluck (United State Air Force Research Laboratory)

Abstract

We live in a world where the information we rely on to make decisions can change gradually or immediately. Take research budgets for examplethey ebb and flow with the economy, achievement, and perceived potential for common (or specific) good. To continually acquire funding, one must adapt to the non-stationarity within the budgetary environment. Two classes of theories have been proposed to explain human adaptation within a changing environment. Instance-based learning theory (Gonzalez, Lerch, Lebiere, 2003) proposes that humans store contextual information with a taken action and the outcome of the taken action together in declarative memory as a single experience, or instance. Stored instances can be retrieved and used to guide behavior in similar situations based on the retrieved memories of prior outcomes in the same or similar situations. An alternative, yet similar approach, is grounded in subjective expected utility theory (Savage, 1954). Based on this approach, an action is taken, given a particular context, based on its utilitywhether that action is useful in making a decision given the context. Utilities can be estimated using machine learning techniques such as reinforcement learning (Sutton & Barto, 1998). We provide a comparison between these similar models in their ability to adapt within the context of a diagnosis task where the statistical structure of the task environments changes without the decision-makers awareness. The goal of the comparison is (1) to quantify similarities and differences in their adaptation capacities, and (2) provide predictions for human empirical research.

Modeling trust dynamics in games of strategic interaction

Michael Collins (WrightState)
Ion Juvina (Wright State University)
Gary Douglas (Wright State University)
Kevin Gluck (Air Force Research Laboratory)

Abstract

For many practical purposes it is important to know why and how people become trusting and trustworthy. There is a significant need for studying trust as it develops, erodes, or re-emerges in strategic interaction. Prior research suggests that learning and performance in games of strategic interaction are mediated by development of reciprocal trust. Here we use a computational cognitive model to make predictions about human behavior in an upcoming human study. The model learns to predict the opponent's move and select its own move to maximize its reward. Concurrently, the model learns how much to trust the opponent, which determines its risk-taking behavior. The model's level of trust determines what reward function is used in strategy learning. When the trust level is high, the model tries to maximize joint payoff - a high-risk strategy. When the trust level is low, the model tries to maximize its own payoff and minimize the opponent's payoff - a low-risk strategy. Occasionally, the model tries the maximally risky strategy - maximize the opponents payoff - in order to initiate the development of reciprocal trust. This model explains learning and transfer of learning effects in games of strategic interaction. Upcoming human subjects empirical research will focus on evaluating the validity of this model in a variety of experimental conditions. The model plays Prisoners Dilemma and Chicken Game against simulated players. We manipulated the strategy of the simulated players and their level of trustworthiness. The model predicts that the human participants in the upcoming study will be able to detect differences in their opponents trustworthiness and adjust their strategy accordingly. For example, the model predicts that human participants will detect a 10% difference in their opponents trustworthiness causing them to settle into a cooperative or a competitive strategy in less than 50 trials. These are real predictions, not post hoc model fitting to existing experiment results.

Following the Beat: How 1/f Scaling Transfers Across Systems

Samuel Breheim (University of Cincinnati - PMD)
Charles Coey (University of Cincinnati)
Michael Richardson (University of Cincinnati)

Abstract

Several studies have shown the dynamics of many different behavioral and biological systems tend to contain 1/f scaling relationships. In such fractal dynamics, behaviors are not truly random (white noise), but instead show a complex, scale-invariant pattern of variation over time (pink noise). More recent research also suggests that two interacting systems tend to adopt the same fractal structure. It is yet unclear how this complexity matching happens, and the current study was designed to further investigate this phenomenon. Participants tapped their fingers on a keyboard in time with a metronome. The inter-onset intervals of the metronomes were not perfect, but contained some type of noise pattern. Specifically, metronomes either shifted from white noise to pink noise and back to white (WPW) or from pink to white to pink (PWP). Preliminary results suggest that the inter-tap intervals of the participants behavior indeed followed the same noise patterns as embedded in the metronomes. Furthermore, we also investigated whether this global pattern of coordination was driven by local coordination between the participant and metronome at the immediate timescale, or instead reflected some other process. These results provide valuable insight as to the significance of 1/f scaling in human behavior as well as the dynamics of coordination between natural (i.e., imperfect) systems.

Social Motor Coordination of Children with Autism Spectrum Disorder

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Michael Richardson (University of Cincinnati)

Abstract

Children with Autism Spectrum Disorder (ASD) exhibit numerous impairments in social interaction and communication that typically persist throughout their life and impact functioning at home and in the community. Although interacting competently with others relies on cognitive abilities such as making inferences about anothers mental state (Baron-Cohen & Swettenham, 1997), an equally important, yet less obvious and overlooked component of social competence is social motor coordination. For the current study, 47 children with ASD and 51 typically developing children, between the ages of 6 and 10 (M = 7.92, SD = 1.45 years) completed motor coordination tasks. They were asked to either imitate or synchronize with the movements of an experimenter in five different tasks, to drum while using one or two hands and to play pat-a-cake. The wrist movement of the child and experimenter were tracked using a wireless Polhemus motion tracking system and time series of their movements were compared to each other. Dynamical measures showed that children with ASD performed the tasks significantly different from their typically developing counterparts. Furthermore, children with ASD produce less stable movement patterns and differences by age were also found. Even though the specific processes underlying social competence impairments are not well understood, a growing number of researchers in recent years have proposed that the degree of motor synchrony or motor cooperation in social situations plays an integral role in the effectiveness of social interaction (Marsh, Richardson, & Schmidt, 2009) and therefore, might become a viable diagnostic and treatment tool for children with ASD.

Behavioral Dynamics of Joint-Action and Social Movement Coordination

Joubert Lucas (University of Cincinnati)
Ashley Walton (University of Cincinnati)
Michael Riley (University of Cincinnati)
Michael Richardson (University of Cincinnati)

Abstract

Performing everyday goal-directed tasks such as clearing a table or loading a dishwasher with a family member requires movement coordination that gives rise to and is affected by environmental constraints and designated action roles. Behavioral dynamics provides a way to understand how this coordinated activity between agents emerges and dissolves throughout joint-action tasks. To describe the self-organizing dynamics of physical interactions among socially coordinated human agents, a more experimentally controllable version of everyday tasks was created. In a multi-agent object-moving task two participants moved around a virtual environment depicted on a tabletop from one location to another using wireless motion tracking sensors attached to the fingers. Start, goal positions, and obstacle locations were chosen from a previous experiment to provide sufficient data for characterizing a dynamical model to capture the behavior. Sets were chosen so that conditions that either readily conform to the model or would be difficult to model based on previous research would be present for all participants. Results indicated that what, when, where and how to move or act during a social interaction can be implicit in the dynamics of the task, and that patterns of coordinated social movement can emerge spontaneously from these dynamics with little a priori planning.

How Social Constraints Impair Individual Processes: The Effect of Stereotype Threat on Womens Math Task-Based Performance

Laura McLaughlin (University of Cincinnati)
Brian Eiler (University of Cincinnati)

Abstract

Stereotype threat (ST) posits the risk of confirming negative group stereotypes about ability leads to systematic underperformance by members of stigmatized groups (Steele, 1997). Performance on tests of math ability validate this effectthe stereotype women are worse at math than men leads women to underperform (Steele, Spencer, & Aronson, 2002). According to complex systems theory, these effects demonstrate how slower dynamics of social context enslave faster dynamics of cognitive processes (Eiler, Kallen, Harrison, & Richardson, 2013). The current study investigated whether performance under ST reveals differences in the 1/f scaling behavior characteristic of interaction-dominant dynamical systems. The structure of reaction time (RT) performance was compared between sexes on a two-choice mathematics task. Participants repeatedly sorted numbers (prime/nonprime) via key press. Using detrended fluctuation analyses, 512 trials were used to estimate the fractal dimension (Hurst exponent) for each participants RT time series and randomly shuffled surrogate series. For each condition and sex, the mean Hurst calculated from surrogate data (M = .53) was lower than real data (M = .68), indicating RT performance for participants in all conditions was fractal, t(86) = -89.770, p < .001. An analysis of the Hurst for real RT series revealed a marginal effect of sex, t(40) = -1.862, p = .07, such that women under threat yielded lower Hurst values (M = .66, SD = .08) than men under threat (M = .73, SD = .17). Overall, findings provide evidence for performance under stereotype threat as an emergent property of an interaction-dominant dynamical system.

Adaptive fractal analysis of postural sway variability in adolescents with athletically induced mild traumatic brain injuries

Zachary Taylor (University of Cincinnati)
Colin Martin ()
Steven Larson ()
Scott Bonnette ()
Michael Riley (University of Cincinnati)
Catherine Quatman-Yates ()

Abstract

The decision to permit an adolescent athletes return to sports after a mild traumatic brain injury (mTBI), or concussion, can be daunting. Allowing an injured athlete to participate too soon increases the chance of additional injuries and may lead to secondary health complications, including chronic traumatic encephalopathy, persistent cognitive and motor control deficits, and even death. Often, the choice to clear an athlete for participation in sports is made based on observer-rated assessments or self-reports of concussion-related symptoms. Recently, efforts to identify more objective return-to-sport criteria have taken advantage of the fact that mTBIs alter the normal functioning of sensorimotor processes responsible for postural control. Recent studies that applied nonlinear analysis methods to time series of postural center-of-pressure (COP) trajectories from concussion patients have yielded promising results in discriminating concussed from healthy individuals. In the present study, a relatively new type of analysis, adaptive fractal analysis (AFA), was applied to the COP time series of forty age and gender matched adolescent athletes (20 injured, 20 healthy). A force platform was used to acquire participants COP data at a sampling rate of 50 Hz. Participants were instructed to stand naturally on the platform for two 120 sec trials (one eyes-open and one eyes-closed trial). Differences between fractal scaling exponents (H) and scaling regions (i.e., time span of fractal scaling) for injured and healthy participants are discussed.

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Leaving the uncanny valley: the influence of configural-processing on perceptions of non-human entities

Kurt Schuepfer (Miami University)

Abstract

Mind perception underlies many fundamental processes in cognitive science. Compared to person perception, much less is known about how people perceive nonhuman entities, such as robots. Even less is known regarding mechanisms that may underlie these processes. The current work examines one such mechanism, namely, configural face processing. Our study will investigate how particular cognitive signals that occur during face-processing might influence our perceptions of nonhuman entities, particularly of how creepy they seem. Gray & Wegner (2012) find that the more one believes a robot has the capacity to experience human-like feelings, the creepier it will seem. Importantly, Hugenberg and colleagues (2014) found that the configural face-processing signal is one cue that a perceptual target is human-like. Combining these ideas, we predict that if configural face processing sends the perceiver a signal that an entity is human, then disrupting such processing (via a face-inversion task) will reduce perceptions of robot-human similarity, and in turn, decrease how creepy the robot seems. We will also assess the extent to which such perceptions are mediated by reduced ascriptions of experiential mind. Moreover, we will investigate individual differences in anthropomorphism as a moderator of this effect. If people high in anthropomorphism are especially likely to see humanness in entities such as robots, perhaps they will be especially sensitive to changes in the configural processing signal. * Importantly, at the time of this submission, we are still in the data collection phase, but we will have fully analyzed the results by the day of conference.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

How Anxiety Influence Task choices: Laboratory Experiments on Anxiety and Procrastination

Ping Xu (Ohio University)
Claudia Gonzalez-Vallejo (Ohio University)

Abstract

Research on the relationship between anxiety and procrastination is scarce and findings are inconsistent. This study series employed laboratory experiments to investigate the impact of anxiety on procrastination. Participants were induced into variant levels of state anxiety and then given a period of 12 minutes to either practice for the upcoming test or entertain themselves (e.g., watch videos). The results showed that participants in a relative higher anxiety state spent more time practicing for the upcoming test than participants in a lower anxiety state. The former also began practicing earlier than the latter. However, gender difference was detected with females spending more time practicing than males in higher anxiety states. Self-reported measurements of trait procrastination and trait anxiety were also obtained. No significant correlation was found between trait procrastination and dilatory behavior, or trait anxiety and dilatory behavior. Impulsivity was found to be positively correlated with trait procrastination, and trait anxiety, but not with dilatory behavior. These experiments indicated that a relative higher anxiety state might prompt females to take proactive measures for the most important task, thus reducing procrastination activity; however males might employ a different strategy to copy with anxiety. Implications on emotion related theories were also discussed.

Visualization Support for Cognitive Sciences

Matthew Marangoni ()
Thomas Wischgoll (Wright State University)
YUe Zhou ()
Leslie Blaha (United States Air Force Research Laboratory)
Ross Smith ()
Rhonda Vickery ()

Abstract

The science of computer graphics and visualization is intertwined in many ways with Cognitive Sciences. On the one hand, computer graphics can lead to virtual environments in which a person is exposed to a virtual scenario. Typically, 3D-capable display technology combined with tracking systems, which are capable of identifying where the person is located at, are deployed to achieve maximal immersion in that the persons point of view is recreated in the virtual scenario. As a result, an impressive experience is created such that that person is navigating the virtual scenario as if it was real. On the other hand, visualization techniques can be utilized to present the results from a cognitive science experiment to the user such that it provides easier access to the data. This could range from simple plots to more sophisiticated approaches, such as parallel coordinates. In addition, results from cognitive sciences can feed back into the visualization to make the visualization more user-friendly. For example, more intuitive input devices, such as cyber gloves which track the position of a users fingers, could be used to intuitively make selections or view modifications. The Appenzeller Visualization Laboratory is in a perfect position to enable research in all of these areas mentioned above. Sophisticated display systems are available which provide full immersion, ranging from single screens and head-mounted displays to full-size CAVE-type displays. This presentation will illustrate some examples for visualizations of data from the cognitive science realm and showcase display systems and some of their use cases.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Cognitive and Social Psychological Biases in the Negotiation of Transboundary Resources

Kuyer Fazekas Jr. (Wright State University)

Abstract

Water security has become one of the most controversial and complex issues in the field of international security and resource scarcity issues today. This paper examines what cognitive variables affect the negotiation of an equitable allocation of transboundary drainage basins and associated freshwater resources among riparian states (those located on the bank of a natural watercourse) in the Middle East. I engage in a comparative case study of resource diplomacy in the Jordan and Tigris-Euphrates drainage basins to explain the reasons for variation in cooperation in the two cases. I test the role of cognitive and social psychological biases in the decision-making process and international relations of each state involved in the transboundary negotiations.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

VEILS (Versatile Ecological Interface for Lockdown network Security)

Kevin Bennett (Wright State University)

Abstract

A prototype interface for computer network defense (CND) has been developed using the cognitive systems engineering (CSE) / ecological interface design (EID) framework. This ecological interface, referred to as VEILS, will be demonstrated. VEILS supports CND by collecting and integrating network defense information from a variety of sources including intruder detection / protection systems, firewalls, and network system logs. VEILS was designed to be consistent with three principles of EID. The innovative displays represent the affordances of the work domain in a manner that is compatible with human visual processes (i.e., direct perception). The capability to specify both information content (different types) and information extent (scope) is supported entirely through intuitive and natural control input including point, click, and drag (i.e., direct manipulation). Finally, interface resources are used to highlight functional relationships across displays and to support effective navigation (i.e., visual momentum).

Trust mitigates uncertainty in team-based learning

Gary Douglas (Wright State University)
Ion Juvina (Wright State University)

Abstract

Team-based learning (TBL) has been shown to improve academic performance in certain conditions, yet the mechanisms responsible for this effect are poorly understood. Much of the empirical evidence for TBL is anecdotal, correlational, or quasi-experimental. We are designing an experimental study to investigate some of the factors that differentiate TBL from other teaching methods. The task environment simulates some key aspects of the college learning experience throughout a semester by using a paired-associate learning task that spans through multiple sessions. The participants will be randomly assigned to three between-subject conditions: lecture, interactive lecture, and TBL. Each participant will go through 10 cycles of simulated home time and school time. During home time, participants can choose to study or play. During school time, participants can only study and take tests. Studying during school time is structured differently in the three conditions. In the lecture condition, participants can only view the paired associates (word-digit pairs) as they are presented on screen. In the interactive lecture condition, participants are given the opportunity to issue a response (i.e., digit) before the correct response is displayed. In the TBL condition, participants will work in teams of four. After a stimulus (i.e., word) is displayed, participants issue a response, and they are given the opportunity to see the responses of their teammates. Subsequently, participants can issue a second response. The most frequent second response is automatically chosen as the group response, and feedback (i.e., correct response) is displayed. A group accuracy score is evenly divided between the four participants and an individual final test is also administered. We hypothesize that performance will initially be worse in the TBL condition as compared to the interactive lecture condition because of the compounded uncertainty of the teammates. After a number of cycles, we expect that participants will learn who to trust among their teammates and use their responses to improve their own learning. We also hypothesize that participants in the TBL condition will attempt to increase their own trustworthiness by increasing the share of home time they allocate to study. These hypothesizes will be numerically specified with the aid of computational cognitive model simulations.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Self-Organization and Semiosis in Jazz Improvisation

Ashley Walton (University of Cincinnati)
Michael Richardson (University of Cincinnati)
Anthony Chemero (University of Cincinnati)

Abstract

Self-organization provides new ways to understand the dynamics behind the emergent, spontaneous exchanges of musical performance. In biological self-organization, energy is expended to maintain order in a system in the form of work that constrains the possible behaviors of the components of the system. When two self-organized systems become closely coupled they compose a teleodynamic system where each does work to maintain one anothers constraints. The semiotic exchange between two improvising jazz musicians forms a teleodynamic system where musicians expend energy that constrains each others sign behavior, and each allows their sign behavior to be constrained by the work of the other. This self-organization framework allows for new insight into developing theories of musical semiotics to address spontaneous, emergent musical performances, and non-linear time series analyses can provide the tools necessary for explicating the processes of these complex social exchanges.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Remembered object affordances are independent of remembered geometric properties

Brandon Thomas (University of Cincinnati)
Michael Riley (University of Cincinnati)

Abstract

Affordances are opportunities for an organism to behave in its environment. Individuals are capable of perceiving affordances for remembered objects (Wagman et al., 2013). In three experiments, remembered affordance estimates for absent objects were not dependent on memory for relevant geometrical object properties. The results highlight the potential insights provided by adopting a functional approach to the study of memory phenomena.

Proc. of the 4th Midwestern Cognitive Science Conference,, Dayton, Ohio, May 30–31

Gestalt-enhanced illustrations and learning from scientific text: The role of cognitive load

David Bellinger (University of Louisville)
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Abstract

People learn more when pictures accompany text than from text alone (Fletcher & Tobias, 2005), and science textbooks often leverage this principle by allocating more than half of printed space to illustrations (Mayer, 1993). However, scientific illustrations may not all equally benefit learning, and little is known about which visual features of illustrations underlie their beneficial impact. Specifically, illustrations that emphasize Gestalt principles of perceptual organization (i.e., similarity, proximity) might enhance the quality of schema construction by aiding knowledge organization and decreasing cognitive load (e.g., Carlson, Chandler, & Sweller, 2003). To empirically test this idea, we compared learning from scientific text alone to learning from text accompanied by either a traditional or Gestalt-enhanced illustration. The traditional and Gestalt-enhanced illustrations both significantly improved learning outcomes compared to text alone. However, learning outcomes were comparable between the two illustration conditions. Moreover, ratings of cognitive load did not differ among the three learning conditions. These results suggest that illustrations can facilitate schema construction without directly altering cognitive load. We are currently testing whether Gestalt principles may enhance learning outcomes when situational cognitive load is increased.

Detection of Audiovisual Asynchrony in Degraded Listening Conditions

Hannah Shatzer (The Ohio State University)
Mark Pitt (The Ohio State University)
Antoine Shahin (The Ohio State University)

Abstract

Listeners effortlessly and rapidly combine visual speech and auditory speech into a single percept when communicating, demonstrating the multi-modal quality of speech perception. We examined the strength of the binding across modalities by measuring listeners tolerance to temporal asynchrony in the onsets of the two signals. Participants watched a video of a woman saying a word while simultaneously hearing an audio clip of that word, which was degraded (by noise vocoding) to varying degrees. Using an adaptive procedure, the video followed the audio by increasingly longer delays until participants switched their responses from indicating the stimuli were in sync to out of sync. We hypothesized that the measured onset asynchrony would be a function of the spectrotemporal and lexical fidelity of the auditory speech, with greater tolerance for longer asynchronies as the spoken words became more intelligible (i.e., it became clear that the spoken word matched the presented lip movements). Indeed, results showed that the asynchrony threshold increased as the speech became more intelligible. Findings also demonstrate that spectral cues are necessary for perceiving audiovisual information as a single source.

Index of Authors