The International Society for Ecological Psychology

Spring Meeting, May 20-21, 1988

Antioch College
Yellow Springs, Ohio

Program and Abstracts

Organized by Gary E. Riccio & Thomas A. Stoffregen

Notes

Our central goal for this meeting (in addition to maximizing the comfort of the participants) was the promotion of interchange between presenters and audience. This applied to both posters and talks. Each speaker was alloted 45 minutes, but was *strongly* encouraged to talk for only 25, with the remaining time reserved for discussion. Both speakers and audience responded very well to this format, with the result that discussions were rich and unhurried. We attempted to increase the utility of poster presentations by scheduling two poster sessions, each containing all posters presented at the meeting, and by having the sessions separated only by a night, rather than by other programmatic material. We hoped that this would give participants time to "digest" posters and return for fuller discussion. Several "posters" contained or simply *were* video presentations; these seemed to be especially effective.

Acknowledgements

We would like to thank Antioch College for allowing us to use their facilities, and Florence Lorenz, Carole Braun, Karyn Sandlin, John Shilson, Mike Halpin, Kay Williams, and the security staff for important support. We are especially indebted to Dr. Jay Sayer and the Center for Adult Learning at Antioch, who allowed us to use the room in which the conference was held. Eric Martin and Kim Reardon, with the assistance of Brian Salzman, took care of many details and made the meeting run smoothly. We thank them sincerely. Finally, we thank KathyRiccio, for patience, and for volunteering to host the reception.

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Talks

(in alphabetical order, by first author)

J.J. Gibson, Psychologist, and Ernie Gehr, Filmmaker: A Case of Conceptual Parallelism Between Science and Art

Robert Becklen
Sarah Lawrence College

J.J. Gibson became this century's pre-eminent functionalist in the psychology of perception. Quite simply, he took biological evolution as his first principle, and built his whole theory on it. His "ecological approach", as he came to call it, challenged long-established intellectual traditions in psychology and related fields. Several thinkers (e.g., Reed & Jones, 1979) have considered its implications profound enough to justify the term "revolution".

The Gibsonian perspective has inspired vigorous commentary and debate from disciplines as varied as artificial intelligence and art criticism. The present paper borrows the thesis "conceptual parallelism" within science and art, as outlined by Vitz & Glimcher (1984), to argue that Gibson's intuitions about visual perception are in basic respects shared by the contemporary avant garde filmmaker Ernie Gehr. I shall argue that Gehr's films embody a Gibsonian conception of what is fundamental in vision and that his works can be seen as artistic "experiments" on Gibsonian ideas.

The Gibson-Gehr parallelism insists on the primacy of perceived motion and intrinsic meaning in vision, and in this sense its foundations are different from the 19th and early 20th century modernist parallelisms discussed by Vitz & Glimcher. In retrospect, it is perhaps natural that we find a cinematic parallel to Gibson's science, given his explicitly acknowledged inspiration by the medium. Examples of Gehr's work will illustrate the theoretical points.

Timing and Phase-locking in Cascade Juggling

Peter Beek
Free University, Amsterdam

A natural physical approach is pursued in uncovering basic timing and phase relations in human rhythmic movement. The approach is based on the theory of non-linear oscillatory motion, entrained by either continuous or discretely distributed forcing. In the context of juggling three balls, a preliminary modelling attempt of the cyclical hand-motion suggested that the underlying dynamics are captured best by a discretely kicked, highly non-linear, self-sustained oscillator. Discretely kicked non-linear oscillators may be characterized by regime diagrams that depict the periodic (phase-locked) and quasi-periodic (not phase-locked) regimes in which the system can operate dependent on the magnitude of the kicks. The paper provides evidence for two-quasi-periodicity and near, but not perfect, phase locking between *tl*/*tf* and *tl*/*tu* (where *tl* is the mean time that the hands move loaded with the ball, *tu* is the mean time that the hands move empty, and *tf* is the mean flight time of the balls). Jugglers perform along the boundaries of Arnold tongues (representing complete phase locking) in a regime diagram without actually settling down on them. With the help of Dentoy's decomposition of phase modulation into a fast and a slow mode, the deviation from the potential minimum defined by complete phase locking can be understood. The frequency ratios within the continuous relative phase between the two juggling hands, however, reveal a Farey-type of phase locking structure, allowing qualitative insights into which regimes jugglers position themselves when asked to speed up or slow down their act. The modified standard map promises to be an adequate tool in analyzing the phase progression in juggling. All in all, the results strongly favor an understanding of rhythmic movement in terms of discretely forced, non-linear dynamics, rather than fully autonomous, self-sustaining oscillators.

Perception-Action Coupling in Table Tennis

Reinoud Bootsma
Free University, Amsterdam

Five top table tennis players were asked to perform attacking forehand drives, landing the balls as accurately and as fast as possible onto a target on the opposite side of the table and net. The number of balls that hit the target was registered, and film recordings of at least seven drives per subject were made. From the literature on skill performance three different strategies of perception/action coupling were derived: (a) utilizing a consistent, non-altered movement, that is, initiated at a constant time-to-contact; (b) utilizing a trial-to-trial adaptive movement; and (c) utilizing a continuously adapted, visually guided movement. Option (a) is discarded as not viable on the basis of finding a better timing accuracy at the moment of ball contact than was apparent at initiation. Correlations between Tau at initiation and mean accleration during the drive suggest functional adaptation at least between trials, while further evidence suggests that even in rapid actions (e.g., in attacking forehand drive) visual information is used during ongoing movement to insure that contact is made in such a way that the ball departs in exactly the correct direction.

Postural Control and the Design of Ergonomic Chairs

Marvin Dainoff
Miami University

As the contemporary workplace becomes increasingly automated a significant fraction of working people will spend the majority of their working hours seated at a visual display terminal in relatively fixed postures. Consequently, understanding such postures is of more than academic interest; recent evidence links prolonged sitting with high levels of musculo-skeletal disorders. It is argued that understanding this problem, as well as generating solutions through ergonomic design, will be enhanced by a systematic application of ecological principles. In particular, research evidence from our laboratory has identified specific postural configurations (regions of high stability) which seem to be associated with specific sets of task and chair constraints. When operators independently controlled three dimensions of chair adjustability (height, seatpan tilt, backrest tilt) and the seat surfaces remained steady after adjustment, they adopted stable forward-leaning configurations for copy-intensive tasks, and backward-leaning configurations for screen-intensive tasks. However, when seat surfaces moved dynamically with the operator, the resulting set of configurations was less stable. Outcomes from this research, as well as from planned follow-up studies, should have broad conceptual relevance to the general problem of delineating constraints on postural dynamics; at the same time, these results have practical implications for design of ergonomic chairs as well as in training operators to use these design features for maximum benefit.

The Ecology of Human-Machine Systems: Problems, Prayers, and Promises

John Flach
University of Illinois at Urbana-Champaign

Taylor (1957) argued that "the involvement of psychologists in the design of man-machine systems is one of the most important events that has occured in psychology". Gibson's "Ecological Approach" to the study of human perception is founded on the premise that the human-environment system must be the unit of analysis. It is interesting to note that Gibson's early experiences with human-machine systems (automobiles - Gibson & Crooks, 1938; and aviation - Gibson, 1947) were critical events in his break from traditional approaches to perception (Lombardo, 1987). In this paper, I will reflect on the potential for symbiotic interaction between the Ecological community and the Human Factors community.

There are two problems that I will address. The first problem concerns a growing disenchantment of the Human Factors community with basic research. This problem creates an opportunity for the Ecological community. The second problem concerns the following question: What does direct perception mean in artificial environments where the medium between the process to be controlled and the ego is artifactual (e.g., nuclear power plant control rooms)? How do you go about constructing a medium (displays) to support direct perception? This problem is posed as a challenge to the Ecological community.

Prayers refers to my beliefs. I believe that there are no distinctions between basic and applied research. I believe the current disenchantment with basic research is an indictment of the fundamental assumptions underlying this research. A second belief is that the control problems posed by process environments are of no greater complexity than the problems posed in locomoting through a cluttered environment. The problem is not the complexity of the control, but rather the poverty of the medium for communication between process and ego. I believe that current technology has provided the opportunity to greatly enrich this medium. What is lacking is theoretical guidance for shaping this space.

I will make two promises. For the Human Factors community I promise an approach to basic research that will have direct relevance to applied problems. To the Ecological community I promise an eager and receptive audience.

Linguistic Rhythm in Language Change

Michael Kelly
University of Pennsylvania

An account is given for the evolution of strong-weak (trochaic) stress on disyllabic English nouns and weak-strong (iambic) stress on disyllabic English verbs. This explanation draws on two claims: 1) Language users adjust the stress patterns on words so that alternations between strong and weak beats are created (the principle of rhythmic alternation), and 2) nouns and verbs tend to appear in different rhythmic contexts, such that verbs are more likely than nouns to be biased toward iambic stress. Analyses of spoken and written samples of English reveal that disyllabic verbs were more likely than disyllabic nouns to receive an inflection that adds a syllable onto the word. Because such syllables are weakly stressed, rhythmic alternation would be created if the disyllabic word received stress on the second syllable (e.g., *suggesting*) rather than the first syllable (e.g., *promising*). Two experiments showed that stress assignments on pseudo-words like "cortand" are in fact varied depending on the syllabic nature of inflections added to the words. In addition, the text analyses and experiments can account for specific sub-patterns within the noun-verb stress asymmetry as well as the general asymmetry itself. Implications of these findings for theories of word stress are discussed, as well as the more general point that patterns of language change can be illuminated through basic psycholinguistic research.

Bimanual Control of a Compensatory Tracking Task as a Function of Control Authority

Robert K. Osgood
University of South Dakota, and
Systems Research Laboratories, Inc., Dayton, OH

The role of the human operator has become increasingly sophisticated due to advances in computer technology. A requirement of the human operator in manual control systems employing overlapping control authority on a single dynamic parameter is the use of bimanual controls. In this experiment, eighteen subjects controlled a single cursor through the use of two matching joysticks. Nine of the subjects were right handed, and nine were left handed. Two difficulty levels of a compensatory tracking task and two levels of control condition were examined. Control condition was manipulated by using alternate levels of gain for each joystick. Performance differed significantly among task difficulty levels. Results suggested that there were differences between the way right handed and left handed operators performed on the tracking task. Control use data indicated that the non-dominant hand contributed a considerable amount of effort to damp out tracking error. A coordinative-structure effect was less pronounced for the left handed operators when the control authority was lower in the right hand. The left handed subjects seemed to rely more on their dominant hand for both control conditions, and across both difficulty levels.

Animal Communication: Is it Mediated by Information?

Donald Owings
University of California at Davis

The prevailing view in the study of animal communication is that signaling behavior achieves its proximate impact on the behavior of others by "sending" information to them. The purpose of this paper is to offer the following challenge to that way of thinking about the proximate coupling between signaler and perceiver behavior. (1) Giving signalers the primary causal role in communication has its roots in the assumption that information aquisition is passive rather than active. (2) Treating information aquisition as active gives perceivers credit for the signaler-perceiver coupling, and gives perceiving equal status with signaling as a process underlying communication. (3) Signaling then can be conceptualized as the proximate instrumental process of exploiting the information-extraction activities of others. (4) The apparent informativeness of signals arises in part from the proximate and ultimate co-evolution of signaling and perceiving roles. (5) Communication is more than the "intentional" exchange of information; it is an inter-individual process founded on the individual processes of signaling (an instrumental activity) and perceiving (an informational activity). Relevant data will be presented on naturally-occuring predator-prey episodes, and on the ontogeny of communicative behavior.

Affordances as Constraints on the Control of Stance

Gary E. Riccio
Armstrong Aerospace Medical Research Laboratory, WPAFB, Ohio
Thomas A. Stoffregen
University of Alabama

In this talk we present an ecological treatment of the control of stance by multi-segment organisms. We treat the organism as a black box, and the organism-environment interaction as a closed-loop system. We argue that different ways of controlling stance can have differing utility (affordances) for perception and action. We further argue that the affordances of a particular control strategy are in part determined by (a) the mechanical properties of the organism, (b) the mechanical properties of the surface on which stance takes place, and (c) the goals of behavior. Our conclusion is that the control of stance is based on, or constrained by, perception of the kinematic consequences, or affordances, of control actions. Finally, we argue that the relationship between affordances and constraints on control actions should be investigated using geometrical methods.

An Ecological Theory of Motion Sickness and the Perception-Action Cycle
I. A Critique of the Sensory Conflict Hypothesis

Thomas A. Stoffregen
University of Alabama
Gary E. Riccio
Armstrong Aerospace Medical Research Laboratory, WPAFB, Ohio

Sensory conflict is the central concept in traditional approaches to motion sickness. However, the predictive value of the conflict hypothesis has proved to be nil. Nevertheless it remains the generally accepted explanation of motion sickness. As a forerunner to the presentation of a theory of motion sickness based on ecological precepts, we here present a critique of the sensory conflict view.

We argue that *any* concept of sensory conflict *necessarily* relies on expectations or assumptions made by the organism. The implication of this is that sensory conflict cannot, in principle, be measured objectively. Since it is the magnitude of conflict that is believed to be central in motion sickness, this is a serious problem for the sensory conflict hypothesis. If sensory conflict causes motion sickness, then the malady should occur whenever such conflict is present. The rarity of motion sickness indicates that sensory conflict should also be rare. We argue that sensory conflict must be an extremely common feature of interaction with the natural environment. The relationship between the stimulation of different perceptual systems will change whenever properties of the environment change (e.g., properties of the surface of support, or the direction of the gravitoinertial force vector). Frequent conflict should also arise from static discrepancies between putative sensory reference frames, from "noise" within sensory systems, etc.

If sensory conflict cannot be measured, and if it is more frequent than motion sickness, it is difficult to see how any approach based on it could either explain or predict the malady. A new approach to motion sickness is needed.

The Social Affordances of Childrens' Intended Actions: Perception of Social Intentions by Children with and without Handicapping Conditions

Richard van Acker
University of Illinois at Chicago
S. Stavros Valenti
Hofstra University

Children with mild mentally handicapping conditions are at high risk for social isolation. It has been proposed that their isolation indicates poor social interaction skills - a consequence, perhaps, of poor social perceptual skills. Past research has provided only equivocal support for this proposition. An ecological approach to social perception would allow researchers to determine if these children (a) have different perceptual attunements, and hence miss opportunities to initiate or reciprocate peer exchanges, or (b) are provided with a different domain of social affordances by other children who do not intend to interact with them. To test these ideas, films were made of 12 episodes of natural interactions between a seated child (normal or handicapped) who was playing alone with a toy, and an approaching child (normal or handicapped) who was sent into the room to get a toy. Twenty-four films (12 of seated children and 12 of approaching children) were shown to 30 children (handicapped and non-handicapped). Results showed that handicapped and non-handicapped children rated both the normal children who were approaching a handicapped child, and the normal children who were being approached by a handicapped child, as *not* intending to engage in social play. These data indicate that both mild mentally handicapped children and non-handicapped children have similar perceptions of another's intention to play or not to play socially. Further research, aimed at identifying the information that specifies these social intentions, is in progress.

Altitude Control over Different Planar Environments

Lawrence Wolpert
Systems Research Laboratories, Inc., Dayton, Ohio

Earlier research (e.g., Wolpert, Warren & Owen, 1983) showed that detection of loss in altitude was more accurate over texture consisting of stripes parallel to the direction of flight than over texture consisting of perpendicular stripes or a combination of both, ie., a square pattern. While that study was passive in nature, the current experiment required the participants to actively control and maintain a constant altitude over similar textures in the presence of an upward or downward wind shear.

Results replicated those of the earlier judgement study, with a change in altitude being detected earlier, and better controlled when flight took place over parallel texture than over perpendicular or square texture. Performance improved with practice. Theoretical and applied implications of these findings are discussed.

Posters

(in alphabetical order, by first author)

Vector field analysis of action-related properties in optical flow

Alex Antoniou & Peter N. Kugler
University of Illinois at Urbana-Champaign

This paper will address the issue of how low-dimensional properties in a vector field can organize complex optical flow. It demonstrates that optical flow is rich in action-related properties. The question being asked is: given a field that can be in n-dimensional space, that has many components, how do biological systems orient themselves in the work space? A vector field analysis is proposed in which critical points emerge. These critical points are structurally stable under perturbations of the field. It was Gibson's hypothesis that these structurally stable properties provide the primary source of information used to guide and direct action. It is quite conceivable to have a multi-dimensional field that has a great amount of detail, and yet is organized around a few critical points. The type of critical point(s) specifies the nature of the flow and, in turn, the nature of the flow specifies and locates the critical point(s) in the field. Thus, the transformation generating the flows lawfully relates the critical point(s) to the transformation. The goal of a self-organizing system is to create and annihilate critical points as it orients itself in the work space. The behavior of the organism both contributes to and is constrained by the structural properties of the optical flow field. The organism contributes by continually fixating on new critical points which in turn constrain them by directing actions. This is what makes the system both "self-reading" and "self-writing".

Time pressure, skill, and move quality in chess

Roberta Calderwood, Gary A. Klein, & Beth Crandall
Klein Associates, Yellow Springs, OH

Evidence for the view that chess skill is dependent on recognitional/percetptual processes has been based primarily on findings from recall tasks and from analysis of verbal protocols. The present study employed a time pressure manipulation as a possible source of converging evidence, based on assumed differences in the temporal requirements of recognitional versus calculational modes of processing. The rated quality of moves for very strong (master) and weaker (class B) players was compared in tournament games played under regulation and blitz time rules. The findings supported the predicted interaction between skill level and game type, wherein the decrement in move quality for blitz games compared with regulation games was greater for the class B players than for the masters. These results were interpreted as supporting the view that the more highly skilled players are able to rely more extensively on rapid recognitional processes than less skilled players.

(This poster was not presented. The abstract has been retained due to interest expressed at the meeting.)

The effects of simulator delay on the control of heading and altitude: an evaluation of performance and control behavior

Jeffrey D. Cress
Systems Research Laboratories, Inc., Dayton, Ohio
Gary E. Riccio
Armstrong Aerospace Medical Research Laboratory, WPAFB, Ohio

The effects of simulator delays on performance, control behavior and transfer of training were investigated with a group of subjects who had no previous experience with flight control tasks. Two types of aircraft were simulated: one with highly responsive dynamics and one with sluggish dynamics. Subjects were assigned to one of four time-delay conditions and one of two aircraft types. In the first phase of the experiment subjects participated in fifty trials (ten trials per day) with a particular time-delay (50, 100, 200, or 400 milliseconds). After this "training" phase, all subjects "transferred" to the minimum time-delay condition (50 milliseconds) for another fifty trials. The experimental task required that the subject maintain constant heading and altitude in the presence of pseudo-random roll-rate and pitch-rate disturbances. There were statistically significant effects of time-delay on root-mean-square heading and altitude errors on both training and transfer phases of the experiment. The effect of delay on transfer of training was greater for the aircraft with the sluggish dynamics.

Body-scale constraints in judgement and performance of catching

Walter E. Davis
Kent State University
Janet E. Clark
University of Maryland

Two experiments were designed to determine differences between nondisabled and mentally disabled subjects in both the actual performance and in the subjects' perceptual judgements of the maximum size spherical object catchable. In Experiment 1, subjects were asked to first judge and then actually grasp in one hand lightweight (100 g) stationary balls of various sizes. Results indicated maximum grasping size to be largely a function of hand size. All subject groups performed nearly the same on the actual grasp, but the nondisabled subjects were more accurate in prediction. Down's syndrome subjects also differed in that finger length rather than hand area or span correlated with maximum grasp size, as would be expected from anatomical differences. The mean Pi-numbers (a ratio of hand size to ball size) of each group were not different from each other but the individual variability was greater than found in previous studies of leg length and stool and stair heights in sitting (Mark & Vogele, 1987) and climbing (Warren, 1984). This suggests that even in grasping a lightweight object factors other than just size are important.

In Experiment 2 velocity was introduced to determine further the point at which size was no longer the major factor. Here, clear differences between subject groups emerged, with the mentally disabled groups significantly over-estimating their ability to catch. The mentally disabled subjects were also less successful in actually catching the moving balls, particularly at the higher velocities and when size was near critical grasp. Preliminary analysis (one subject of each group) showed that the non-disabled subjects timed the opening of their hand to the velocity of the ball preparatory to catching. However, the mentally disabled subjects' hand movements did not vary with variation in ball velocity. This finding, if it holds, is consistent with the perceptual judgement results.

Overall, the results show that mentally handicapped subjects and especially Down's syndrome subjects are effected most by ball velocity in both perceptual judgement and actual performance. They reached a critical catching size and speed sooner, thus indicating a less stable perceptual-motor system.

Taxonomies of event words

Cathy Dent
Miami University
John Pittenger
University of Arkansas
Pamila Orosan
Miami University

This study tests whether theoretically derived taxonomies of events correspond to how people understand the organization of different types of events. Twenty college students were given a set of 21 event words naming different types of events, such as changes of state (boil) and rigid motions (turn). They were asked to group the events that were the same kind of thing, label the groups, and then group the groups, creating a hierarchy. Analyzing the content of the labels showed that *pattern of change* predominated as an important aspect of events. However, *material* and *human action* were sometimes used. Using the number of nodes between pairs of words to determine which kinds of events were seen as similar showed four distinct groups: 1) changes of state, 2) changes of shape, 3) non-rigid transformations, and 4) rigid motion. Groupings of kinds of events were close to those derived from ecological theory. However, wide individual differences in the hierarchies existed.

Cognitive maps understood as mapping theories: A methodology for ecological cognitivism

James K. Hardy
Vanderbilt University

Many investigations of spatial knowledge have been motivated by an information processing framework (IP). Although the value of IP has been questioned, the data provided by spatial knowledge research is still informative when treated as a mapping theory that specifies the reference between information available in the environment to knowledge available to an animal. An example of treating a spatial knowledge experiment as a mapping theory is given, and the methodological and theoretical implications of this approach for cognitive psychology are discussed.

Vection and sickness in flight simulators

Lawrence J. Hettinger, Robert S. Kennedy & Margaret D. Nolan
Essex Corporation, Orlando, Florida

According to the sensory conflict theory of motion sickness a mismatch of neural signals coding movement in space results in the development of the constellation of symptoms known as motion sickness. The two sensory systems most directly involved are the visual and vestibular systems. In a fixed-base flight simulator these two inputs are mismatched to the extent that the visual stimulus creates an illusion of movement which is not corroborated by the vestibular system. Visually-induced illusory self-motion is known as "vection", and a strict interpretation of sensory mismatch theory makes vection a necessary precondition for simulator sickness. The present study is the first direct demonstration of this predicted relationship.

Exploring the perceptual environment of biomechanical work spaces

Peter N. Kugler, Karl Newell, Richard Van Emmerick, & Vernon MacDonald
University of Illinois at Urbana-Champaign

It is commonplace in movement science to model stability and reproducibility of movement patterns in terms of sets of internal memory constructs whose existence precedes the execution of the movement (e.g., set points, schemata, scripts, frames, motor programs). These *a priori* representations are viewed as the referent against which movement details are continuously specified and/or evaluated. In contrast, the model construct advanced by our laboratory approaches the problem of stability and reproducibility in terms of generic unfoldings of equilibrium regions in the biomechanical workspace. These equilibrium regions emerge during the actual execution of movement. The layout and locations of equilibirum regions can vary as a function of thermodynamic, mechanical, and geometric constraints. Movement can initially be organized very crudely, and can become more precise as it becomes more influenced by the attractor. With changes in control parameters, the layout of equilibrium regions can suddenly change, resulting in a corresponding change in the qualitative organization of the macroscopic dynamics. The creation and annihilation of these equilibrium regions is strategically continuous with the physical design principles for self-organizing systems. In this paper, an inventory of building materials of evolving field processes will be presented, as well as different ways of reaching chaotic regimes in dynamical systems (subharmonic cascade or period doubling and quasi-periodicity). In addition, computer-generated models of the equilibrium models will be shown together with an outline to approach the exploratory search strategies employed by subjects in searching the perceptual-motor workspace.

The geometry of vision

Joseph S. Lappin (Department of Psychology) &
John G. Ratcliffe (Department of Mathematics)
Vanderbilt University

General Problem

What is the retinal optical information for perceiving the geometric structure of environmental objects? Structure from motion stereopsis: Does the "interpretation" of retinal motion and stereoscopic parallax require extra-retinal information about viewing distance, as many investgators have concluded? Is viewing fundamentally inferential? Or is it a "direct" detection of retinal optical information?

Theoretical Results

The geometry of vision is simpler than previously believed:

1) The metric structure of an environmental surface is related to its retinal image by merely a linear coordinate transformation.

2) Local measures of retinal images of surface patches are sufficient.

3) The coefficients of this linear coordinate transformation are conjointly determined by two functionally separate sets of parameters:

(a) visual parameters, defined by the partial derivatives of the retinal coordinates relative to the intrinsic surface coordinates, directly specified by any given spatial image, and

(b) perspective parameters which embed the retinal coordinates into Euclidean 3-space, defined by the partial derivatives of the cartesian coordinates of 3-space relative to the retinal coordinates, determined by the congruence of the surface patch under perspective transformations associated with motion or stereopsis.

4) Because the perspective embedding of the retinal image may be determined by its congruence under motion, the 3-D metric structure of the surface may be determined without additional information about viewing distance and is invariant under alterations of natural perspective such as occur with cinema or optical lenses.

Flat world, flat displays, flat perception?

John Larish & John Flach
University of Illinois at Urbana-Champaign

Two experiments were performed examining the judgement of speed of self-motion (egospeed). Previous research found that two optical variables, edge rate and global optical flow rate, are useful in judgements of accelerating and decelerating self-motion. The first experiment investigated edge rate, global optical flow rate, viewing condition, and type of display. Two viewing conditions were used. In one condition, subjects viewed the graphics monitor directly with no restrictions. In the second condition, a viewing tube restricted the field of view to a monocular view of the display. Two display types were used: uniform grids, or randomized dots. Both edge rate and global optical flow rate were useful in the perception of egospeed. Edge rate dominated in the uncontrolled viewing condition. Individual differences were found for the effectiveness of edge rate and global optical flow rate. Differential sensitivity to flatness cues are proposed to account for these differences. No significant display effects were found.

The second experiment added a secondary task to determine if the dominance of edge rate information reported was the result of counting strategies. Flatness cues were also further reduced. Both edge rate and global optical flow rate were found to contribute to the perception of egospeed, with edge rate dominating for most subjects. Flow rate effects were dependent upon both the range of flow rates used and the degree to which flatness information was controlled. The hypothesis that individual differences in usage of edge rate and global optical flow rate information were related to differential sensitivity to flatness cues was supported. Edge rate dominance was not shown to be related to the use of counting strategies.

Proof of the pudding: the original flight transfer experiment

Gavan Lintern & Michael Walker
University of Illinois at Urbana-Champaign

In 1949 Edwin A. Link was building more canoes than flight trainers when Paul E. Dittman, a graduate student attending the Univiversity of Illinois on a Link Aviation fellowship, prepared a sales brochure based upon the results of a transfer of training study conceived and planned by Alexander C. Williams at the University's Institute of Aviation and conducted by Ralph E. Flexman, who was then a graduate student in Psychology. Dittman presented his "proof of the pudding" to the deputy chief of staff for personnel of the United States Air Force.

Proof of the pudding contains a clever combination of cartoons, photographs, words, numbers, and dollar signs, showing how the air force could save money, time and lives by capitalizing on the experimentally demonstrated transfer of synthetic flight training from the first simulator of a specifc training airplane to its flying counterpart, the North American T6/SNJ. Dittman's presentation was pivotal to the future of the Link company, to the establishment in 1950 of the U.S.A.F. basic pilot training research laboratory at Goodfellow AFB in Texas, and to the application of the unpublished results of the first two flight transfer experiments conducted at the University of Illinois to the training of air force pilots.

In this poster we present Dittman's original view-graphs and will be prepared to discuss the implications of the ecological perspective to flight training.

Perceiving the intent to deceive

Leonard Mark, Mark Hatala, Christine Farley, & Susan Davis
Miami University

Sverker Runeson has demonstrated that movements (kinematics) are able to specify the causal (ie., dynamic) factors of events, what Runeson has referred to as the kinemcatic specification of dynamics. Moreover, in recent investigations of the perception of lifted weight, Runeson & Frykholm have shown that movements of people lifting the weight specify the amount of weight being lifted, the lifter's gender, and actors' intention to deceive the observer, that is, that they are lifting a heavier weight than they really are. When looking at such a "fake act," observers were typically able to detect the actual weight being lifted as well as the actors' intention to deceive them. This finding suggests that intentions may well be specified in peoples' movements, a finding that challenges the need for cognitively based attributions.

An often-voiced question regarding Runeson & Frykholm's work concerned the qualifications of the actors employed to deceive people. They had no formal drama training, and they were given only six chances to practice each deception before the investigators filmed their attempt. Would trained actors or mimes be more successful in deceiving observers?

The current study replicated the original investigation using two trained actors and two untrained people. The current work replicated Runeson and Frykholms' procedures in all essential details. College students were asked to judge the weight being lifted, whether the actor intended to deceive them, and the intended weight.

To date, the following results have been obtained: 1) observers' judgement of the actions of the untrained actors were comparable to those in the original study, though our subjects tended to underestimate the absolute magnitude of the weight being lifted. 2) the trained actors were only slightly more successful in deceiving the observers as to the weight being lifted. Curiously, observers were still able to detect the trained actors intention to deceive them; however, judgements of the intended weight were typically higher than either those obtained for our untrained actors or Runeson and Frykholm's actors.

The effects of inverted-pendulum dynamics on the perceived upright

Eric Martin
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Gary E. Riccio
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Thomas A. Stoffregen
University of Alabama

The perceived direction of "upright" is influenced by the direction of balance, a dynamic property that can be manipulated independently of the direction of gravitoinertial force. In this study, subjects estimated their mean tilt with respect to "upright" after controlling their roll orientation for 31 seconds in the presence of a continuous roll-axis disturbance. The influence of the balance point was found to be greater than the influence of gravity. These findings are at odds with classical approaches to the perception and control of spatial orientation, in which the perception of gravity is deemed to play a fundamental role.

Perception of heading from optical flow

D. Mestre
CNRS, Marseille, France
W. H. Warren, & A. W. Blackwell
Brown University

Gibson (1950) initially proposed that a moving observer could perceive the heading direction from optical patterns. However, previous studies reported heading errors of 5-10 degrees in pointing tasks. Moreover, radial outflow patterns only occur during observer translation. There is no focus of expansion when the observer is following a curvilinear path.

Using a discrimination task in which subjects had to judge whether they were heading to the right or to the left of a target, we examined the perception of heading during both translational and curvilinear motion. During translation, observers are quite accurate in perceiving their heading direction, with 75%-correct thresholds on the order of 1.2 degrees. For curvilinear paths with radii of 50 to 200 eyeheights, a mean threshold of 1.3 degrees was found, comparable with translational movement. However, for small radii of 20 to 30 eyeheights, mean thresholds jump to 6 degrees, and it seems that subjects tend to underestimate the sharpness of the curve.

These experiments show that, contrary to previous reports, optical flow patterns provide a sufficient basis for heading judgements during translation and in a large range of curvilinear paths. It remains to be understood if the drop in performance at small radii is simply an artifact of the displays or whether the subjects tend to see themselves as heading to the outside of the actual curve.

International Society for Ecological Psychology - May, 1988 - Posters

The active eye

Michael Mills & William Schiff
New York University

Decades of scattered bits and pieces of passive slide, film, video, and mechanical presentations in perceptual/cognitive science can be replaced by a few good discs. The "active eye" perceptual demonstration package also becomes the interactive eye with several programs for laboratory use. We present some traditional and ecological perceptual demonstrations running on the MacIntosh computer.

Long-range detection of geometric structure in optic flow

J. Farley Norman, Joseph S. Lappin
Vanderbilt University
Thomas D. Wason
Allotech, Inc.

How detectable are geometrical relationships among spatially separated moving points? Several lines of physiological and psychophysical research suggest that detection of correlated motion requires that the moving elements must be spatially adjacent: Neural receptive fields are primarily restricted to spatially localized retinal areas. Psychophysical analyses of visual detection mechanisms have found spatially localized responses. Experiments on the detectability of coherent motion in random-element patterns have found that spatial displacements between successive positions must be within a short-range distance. Geometric analyses of optic flow (e.g., Koenderink & van Doorn, 1975) have found that local measures of four geometric transformations are sufficient to describe 3-D structure and motion.

We report now that these geometric relations associated with rigid motions in 3-D space may be detected among moving points separated by at least 10 deg. Three points located at the vertices of an imaginary triangle were simultaneously displaced in randomly changing directions at 20 msec intervals. Under many conditions observers saw a rigid triangle rotating, translating, and rocking in depth. Thus, even rapidly changing random combinations of the geometric components of optic flow may be detected by the relations among coherent measures of motion at widely separated retinal locations.

An affordance theory analysis of cartoon humor

Dean Owen
The Ohio State University

A cartoon informs a person *about* a situation that is potentially humorous *to* the person. A complete account of cartoon humor must, then, include an account of the content of the cartoon. An adequate explanation of reactions to cartoons must also consider the possibility that the same cartoon may be humorous, offensive, or not understood at all. Variation in degree of affect and level of understanding must be accounted for as well.

An attempt to understand the emotional impact of a cartoon on an individual must consider the behaviors and environments of the depicted cartoon characters. This is the medium within which the cartoonist communicates with the viewer. The cartoon mediates between the situation conceived and visualized by the cartoonist and information aquisition by the viewer. On the one hand, a theorist must ask what principles cartoonists use to structure this medium so that the viewer can comprehend what the creator is attempting to communicate. On the other hand, the theorist must address the knowledge the viewer must bring to the cartoon viewing to guide attention to the structure presented by the cartoonist. What is the nature of this structure?

A cluster of themes frequently exploited by cartoonists matches categories of perception and action addressed by affordance theory. The largest category consists of unusual beneficial or injurious affordances of common objects, including people and animals. Other categories are multiple effectuations of a single affordance, body scaling of affordances, absence of an affordance or an effectivity, affordances misclassified or not perceived at all, and effectiveness or ineffectiveness of an individual's action. A small class depicts creating, extending, constraining, or eliminating an affordance or an effectivity.

Examples will be presented and discussed.

The utility of nested texture and emergent detail in flight simulation

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Gibson stressed the importance of texture in the environment. He saw texture as having a nesting quality where there are forms within forms or smaller units embedded within larger units. For the human, the amount of nesting that can be resolved is dependent on the distance from the surface. As one moves toward a surface more detail becomes visible. This is not true in the computer-generated world of low-cost simulators. Generally, texture is either present or absent in the scene. What effect, if any, does the emergence of texture have on pilot performance? With a landing-judgement task, subjects received three displays; an outline of a runway, a constant x-pattern, and an emergent, or nested x-pattern. The nested x-pattern was identical to the constant x-pattern except that the texture faded onto the dispaly as a function of altitude. The results indicate that texture improves performance, and that nested texture further increases accuracy.

The perception of orientation under water

Brian Salzman
Wright State University
Gary E. Riccio
Armstrong Aerospace Medical Research Laboratory, WPAFB, Ohio

Traditionally it has been thought that organisms orient themselves with respect to gravity, and that gravity is directly perceived. Gravity is assumed to be perceived through the visual and somatosensory systems and particularly through the otolith organs of the vestibular system. At the surface of the earth gravity-based stimulation of the somatosensory system can be minimized by water immersion. This is because somatosensory stimulation under water is nearly uniform over the surface of the body. Water immersion represents the best available method for assessing detection of the gravitoinertial force vector on the basis of information available to the otolith organs. On land there is another source of information available to moving organisms, the direction of balance (Stoffregen & Riccio, 1988). The direction of balance has been shown to be the primary determinant of the perceived upright (Riccio, Martin, & Stoffregen, 1988). This source of information is elminated by restraining the organism. We describe an experiment (in progress) on the perception of orientation by blindfolded subjects that are restrained while under water. It is our hypothesis that the subjects will not be able to perceive what direction is "up". This would provide more evidence against the traditional assumption that the primary function of the otolith organs is the registration of the gravitoinertial force vector.

Helicopter flight using transformed visual images

Leon Segal & Gavan Lintern
University of Illinois at Urbana-Champaign

To fly a helicopter at low level, or to guide an aircraft through an object-filled world, is a complex control task that depends heavily on visual information. Several different systems have been developed to help pilots fly low-level at night, and under low-visibility conditions. These systems sense wavelengths that are beyond the pilot's sensory threshold, transform them to visible light, and display them to the pilot. The information available, the form of the display, and possible augmenting symbology combine to create a challenging scenario for the most highly skilled pilots. They have to perform a control task in which the invariants available in the natural scene may be transformed and represented in different ways, or ignored altogether. In this poster we summarize the problems experienced by pilots in the control of helicopters.

Ecological Connectionism and Animal-Environment Mutuality

Paul Treffner
University of Essex, U.K.

"Animal-environment dualism" arises in perception models due to an accepted logical independence between the proximal input pattern of the percipient, and the distal environmental object. The approaches of the "indirect perception" school (e.g., Fodor & Pylyshyn, 1981) and also present connectionism, apparently subscribe to this dualism. They both assume that external entities, since logically independent from the percipient, may be objectively specified and modelled as a spatial input pattern without reference to the animal's perspective. Rather than assuming that animal-environment dualism is a necessary scientific methodology in the cognitive sciences, I propose that there is a benefit in modelling visual perception using "ecological connectionism". This is an application of neural network dynamics - particularly attractor and chaotic behavior - to characterise perception of environmental events. The approach focuses upon the fundamental mutuality of interaction, and I suggest that the environment should thus be incorporated into models as an important aspect of cognitive theory.

I shall first outline an alternative, ecological formulation of some problems in perception, and how the uncertain world of the organism's medium might become perceptually "digitalised" (Dretske, 1981) into a concrete interpretation as a function of a perceiver's needs. I then indicate a possible characterisation of an ecological approach to animal-environment (A-E) mutuality, as that of using a neural network's "attractor" and limit-cycle states in an A-E state space which includes environmental variables. "Chaotic" behaviour will be indicated as a possible source of generating new, top-down information and features which converge with stable hypotheses formed by a bottom-up attractor process. This corresponds to the move toward naturalised, A-E integrative event-based systems, and a move away from the tendancy to invoke A-E dualistic symbol systems to account for phenomena which the dynamical system might explain in a more natural and evolutionarily realistic way.

Super-Vision: Perceiving other people's affordances

Brian Zaff
The Ohio State University

A number of studies have examined the perception of affordances as they pertain to the perceiver's ability to · late his or her activities to his or her own body dimension. However, the accuracy with which an individual judges the affordances of another person has yet to receive serious consideration.

There are several notable instances when the individual becomes concerned with the affordances of another person. A common instance arises in the context of parental supervision of a young child. "Super-vision" is a particularly apt term for describing what parents must do when caring for a young child, insofar as the term refers to the notion of one person being able to see what the environment affords for another person.

This experiment examines the differences occuring between perceiving one's own affordances and perceiving what the environment affords another person within the context of judging the maximum shelf height that would permit another person to successfully reach an object located overhead. Subjects were required to judge the reaching abilities of four actors ranging in height from three to six feet. The results showed systematic distortions in judging what the environment affords for another individual: the reaching abilities of the three- and four-foot actors were underestimated, while the reaching ability of the six-foot actor was overestimated.

The results raise both theoretical and practical issues. Traditional theories of perception would predict superior performance at the task of juding the reaching abilities of another person standing directly in front of the perspective shelf, insofar as the height of the shelf can be seen in relatino to the height and arm lenght of the other person. The results clearly run counter to this prediction. The results also have practical significance for designers, architects and any other person in the business of judging the affordances of another perons, as the results point to tendencies to make errors of considerable magnitude in such judgements

Program

Friday, May 20

9:00	Coffee	2:00	T. Stoffregen
9:45	Opening Remarks	2:45	M. Kelly
10:00	J. Flach	3:30	R. Becklen
10:45	M. Dainoff	4:15	Break
11:30	G. Riccio	4:30	Poster Session
12:15-2:00	Lunch	7:00	Dinner/Pubs

Saturday, May 21

9:00	Poster Session	2:30	R. Osgood
11:00	P. Beek	3:15	L. Wolpert
11:45	R. Bootsma	4:00	Break
		4:15	R. van Acker
12:30-2:30	Lunch	5:00	D. Owings
		5:45	Closing Remarks
		6:00	Dinner/Pubs