The International Society for Ecological Psychology

Volume 4 Number 3 NEWSLETTER December 1990

ANNUAL MEETING 1990

October 20
Trinity College, Hartford, Ct.

Election

Seven people were elected to the Board at the Trinity meeting. As a result, current Board members are:

'89–'91	'90–'92
Rainer Guski	Reinoud Bootsma
Margaret Hagen	Alan Costall
Claes von Hofsten	Eleanor J. Gibson
Bill Mace	James J. Jenkins
Len Mark	Anne D. Pick
Claire Michaels	Sverker Runeson
Robert Shaw	Esther Thelen
William H. Warren, Jr.	

Because Gene Goldfield was unable to attend, Philippe Rochat ("Control of posture and reaching in infancy") and Rhonda Roland Shearer ("The dynamics of plant growth: New exploration in contemporary sculpture") split the morning program. While we missed having two closely related talks on the development of posture and reaching in babies and toddlers, the audience clearly enjoyed having a more relaxed, extended time, for discussion. The afternoon proceeded on schedule with Reinoud Bootsma ("Temporal information as a holonomic constraint on the coordination of components in natural prehension"), Steve Flynn and Tom Stoffregen ("Kinematic specification of support surface dynamics"), and Greg Burton ("Visual vs. nonvisual crossing of path gaps during locomotion").

There was a consensus in the business meeting on the following points: (1) We will pursue the idea of moving the business meetings away from the fall meeting to the Event Conferences. We would then have business biennially instead of annually. Official action requires a change in the bylaws and would be voted on by all members. There will be further discussion of this proposal at Amsterdam (cf. also the report on the Marseille meeting later in this newsletter). (2) The best date for ICEPA7 in Vancouver was narrowed down to the second week of August, 1993. That has subsequently been confirmed by an electronic mail poll and we have put down a deposit (cf. the note from John Pittenger later in this newsletter). (3) Raising the dues substantially to cover projected increases in mailing costs and to fund other projects was endorsed. Voting by mail, the Board strongly endorsed the dues rate you have received in the mail. The main target of any money we accumulate over and above regular expenses is to subsidize registration fees for graduate students at Event Conferences. It is understood that this might be only a small fraction of the cost of attending the conference for many people, but that it could nevertheless be significant enough to demonstrate the commitment to students that we want to show. What we actually can do depends on how the dues collection goes. Thusfar it is going very well, but we owe $ 7,150 to the publisher for member journal subscriptions before we have money for anything else.

Libraries. Finally, we discussed the need for members to work hard to get their libraries to subscribe to the journal. Institutional subscriptions are the key to life for the journal. A list of all currently subscribing libraries and all apparently nonsubscribing libraries at institutions where we have members was made available at the meeting. Later this spring, Bob Shaw will be writing letters to members whose libraries do not subscribe to strongly encourage them to do what they can to begin institutional subscriptions. Some institutions are so short of money that no amount of encouragement will allow them to subscribe. Michael Turvey announced that because Connecticut is one such school, he and Bob Shaw had decided to raise the money themselves and donate the journal to the UConn library. When the idea was mentioned to our publisher during the week after the meeting, LEA said they would back efforts like this with a discount price — higher than what individuals would pay, but less than the full institutional price. If you are in a position to influence your institution to subscribe, please do not wait for a letter. Try to get the process started.

Don't be shy. Please contact Bill Mace or Bob

Shaw if you have other ideas for maximizing the number of institutional subscriptions.

Annual Meetings and next year. Until we change (if we change), members are reminded that our Annual Meetings are always the third Saturday of October and that next fall's meeting will mark our Tenth Anniversary as a Society.

SIXTH INTERNATIONAL CONFERENCE ON EVENT PERCEPTION AND ACTION (ICEPA-6)

Amsterdam
August 25 - 30, 1991

If you do not have information about the Amsterdam meeting directly from Amsterdam, be sure to write for materials to: ICEPA-6, Free University, Faculty of Human Movement Sciences, Van der Boechorststraat 9, 1081 BT Amsterdam, The Netherlands. By e-mail, ICEPA6@SARA.NL.

MARCH 1 is the deadline for posters and abstracts.

ICEPA-7 UPDATE

ISEP has formed an Organizing Committee composed of Carol Fowler, E. J. Gibson, L. Mark, M. Turvey, R. Bootsma, and myself (Chairperson), with W. Mace and B. Shaw as ex-officio members. The following is an update on our plans for the conference.

ICEPA-7 will be held at the Conference Centre of the University of British Columbia in Vancouver, Canada from Monday, August 9 through Friday, August 13. Registration will start Sunday the 8th and we hope to have the now traditional group social event on Saturday the 14th. Facilities are said (by a colleague at UBC) to be excellent and the surroundings, restaurants,cultural amenities etc. are known to be spectacular.

For the first time ISEP is formally sponsoring the conference. The Psychology Department at UBC has graciously agreed to serve as a sponsor as well, thereby greatly reducing charges for the meeting rooms.

Costs are not yet firm but apear to be very reasonable. The registration fee, including a banquet and the program book, is likely to be around US $150.The 1991 room prices range from US $ 26 per night for a single dorm room to US $ 71 for a family apartment with 2 twin beds, living room, wash room, and kitchen.

This Spring we will start forming other committees, including a program committee. Feel free to send nominations, including self nominations, for the latter to me. We are also likely to develop a flyer to be distributed at ICEPA-6 this August in Amsterdam. Since the Dutch have designed a snazzy logo for the 1991 conference, I, not wishing to outdone, solicit sketches from artistically inclined ISEP members for use in printed materials for the 1993 conference.

Send comments, nominations, sketches, etc. to me via your favorite channel;

1) Department of Psychology, UALR, 2801 South University Avenue, Little Rock AR 72204 USA

2) JBPITTEN@UALR.BITNET

3) FAX to 501-569-8323 (address FAX's to Pittenger / Psychology)

Thanks for your help, John Pittenger

Report on the First European Workshop on Ecological Psychology Marseille, 7-8 June 1990

by
Reinoud Bootsma
Free University
Amsterdam, The Netherlands
&
Daniel Mestre
CNRS & University
Aix-Marseille,France

On June 7-8 1990, the First European Workshop on Ecological Psychology was convened by Daniel Mestre in the beautiful city of Marseille, France. Under the watchful eye of the Notre Dame de La Garde, some 60 participants from all over western Europe (including, of course, the odd American (Claire Michaels, John Flach, Margaret Hagen) with apparent identity crises) enjoyed the pleasures of a beer at the delightful "Vieux Port" and a walk through the astonishing seashore hills of the 'Calanques'. From 9 to 5, however, enjoyment of such a mundane nature was out of the question, as Daniel had arranged a tightly packed workshop program at the Faculty of Sciences of the University of Aix-Marseille II. For those non - natives who, in the back of their minds, still believed in something like a cognitive map, the difficulties encountered in simply finding any University of Aix-Marseille settled the issue once and for all. The new theoretical concept emerging from these preliminary studies was termed "shuttle bus" by Daniel and might well prove to be a citation classic. The abstention imposed was, however,fully compensated by the quality of the presentations.

With the first symposium of this first European workshop being called Problems in Direct Perception (organized by Onno G. Meijer and Cees J. Overbeeke), it was not surprising that, in the target presentation, Claire Michaels called for a closing of the

ranks, as she considers the "unity of commitment" to constitute one of the major present day problems. In her overview of the current status of the ecological approach four theoretical tenets were stressed, viz. (i) realism, (ii) animal-environment mutuality,(iii), perception-action interweaving and (iv) specificity of information. The last point has received quite some attention in recent issues of this newsletter and seems to center around the question of the nature of natural ecological kinds. Among other things, Claire argued that considering, for instance, fire and age as such natural kinds might reflect a simplistic ontology of the environment. Her closing motto "avoid polemics and get on with the work!" could however, as was to be expected perhaps, not persuade all subsequent speakers.

From an historical point of view, Fons Blankendaal presented some stimulating thoughts on why for instance Berkeley (pronounced as "Barkly", thank you Fons) insisted on a meaningless world and suggested that the social status of the scientist was at stake. In an attempt to demonstrate the fallacy of the intrinsic meaning concept, Onno Meijer took up the informational specificity point and argued that the realism of the "professional middle class" rested and still rests on the wrong notion of specificity, which precludes evolution, development and learning. Biological relationships, so he argued, are neither arbitrary as Pattee has it, nor intrinsic as Michaels had maintained, but contingent, with meaning only being recognized post-hoc. Cees Overbeeke and Gerda Smets' demonstration of the fascinating possibility playing off spatial resolution against temporal resolution and its subsequent implementation in a reading device for the poor - sighted was a fine example of the vistas opened rather than the problems posed by direct perception theory.

Hereafter almost all participants directly perceived the intrinsic meaning of a formidable French lunch with rather amazing intersubject agreement, although some report to have seen Onno in considerable distress for quite some time.

The (quite long!) following afternoon comprised two symposia. The first one was "Vision, Motion and Action", convened by Michelangelo Flückiger and Daniel Mestre. The aim was to emphasize, once again, the mutuality between (visual) perception and action, where motion (both of the visual world and of the observer) acts as a cornerstone.

First, Rainer Guski elegantly demonstrated that there is no such thing as a purely optical illusion and that the overestimation of the vertical (vs horizontal) is dependent on the observer's interactions with the object. Mario Zanforlin impressed us with bizarre hardware in which motion drastically changes the rigidity and configuration of objects. This brings into question the "rigidity assumption", suggesting openings for a more general theory on the perception of physical and biological motion. This bright show continued with the work of Sten Bergström, who demonstrated that spatial modulations of illumination lead to the perception of 3D form (which comes back to Gibson's original definition of the optic array).

Talking about the visual bases for the control of self - motion, Klaus Landwehr synthesized and criticized different approaches and their contribution to the understanding of how and what optical information enables spatial behaviors. Next, Michelangelo Flückiger reported on experiments about the effect of manipulations of the optical flow projected on the ground during walking, suggesting that a sudden change in optical speed has a strong effect on locomotion only when it corresponds to the direction of flows encountered during natural forward locomotion on the ground. The sensitivity of the observer to changes in the optical flow could well be, as suggested by Mestre, a fundamental adaptive perceptive skill used to obtain action-scaled information.

Finally, Lawrence Warwick - Evans noted that very basic ecological concepts, such as perceptual systems, higher - order invariants and affordance could help solve "old" problems like motion sickness. This way of reasoning also inspired Theophile Ohlmann, who finally suggested that affordances might well be hierarchically organized in individuals (what he terms vicariousness). A short discussion followed asking in particular the interesting question of what exactly is a perceptual error, considering that we have to deal with adaptive behaviors.

After a coffee/sun break, we moved on to a fascinating symposium entitled "The Ecological Interface" by Jens Rasmussen, John Flach and John Paulin Hansen. The major issue here was to demonstrate that ecological concepts, such as information pick-up by active perceptual systems, can be decisive in the building of more efficient human - machine interfaces. John Flach introduced the general idea of using abstraction hierarchy, going from "natural" displays, which intuitively preserve natural invariants, to metaphorical and geometrical displays. These latter have the fundamental advantage of presenting information which is not usually available (e.g. highway in the sky). Their relation to natural intelligence should be considered and might help understand what information and affordances are essential in a given con-

text.

John Paulin Hansen suggested that this methodology has both analytical and empirical aspects, and should lead to a "cook-book" for the design of ecological interfaces. Gerda Smets added that design engineering (design of the artificial) not only has to take into account the properties of perceptual systems but also must introduce meaning into its procedures. She argued that such a process should improve our knowledge of perceptual systems. Gunnar Jansson exemplified this, by showing that the design of tactile displays for visually impaired computer users forces us to consider cross-modal experience of the world.

All this led to an open discussion on natural vs artificial information. One suggestion was that we deal with the artificial on the basis of natural constraints and higher order variables. Consequently, the design of human- machine interfaces is a domain which serves the purpose of understanding the fundamental bases of the control of behavior.

We then discovered that the afternoon had, without letting us know, turned into evening, so we could move downtown for a late conference dinner at Les Arcenaulx, a ship - repair place in the days of yesteryear now transformed into a restaurant / bookstore / tea - room. Note that most participants only used the restaurant facility.

The number of Burgundy bottles emptied on the conference dinner ensured, following the "practice makes perfect" law of motor learning, that on the morning after, the auditorium was filled only with experts for the symposium "Control in Reaching and Grasping" (organized by Reinoud Bootsma and Geert Savelsbergh).

Following an introduction to the symposium by Geert Savelsbergh, Claude Prablanc presented some of the exciting and ongoing work with the double step paradigm in manual pointing tasks. Displacing a target, to which you are supposed to point, during an eye - movement, fixating the target just prior to hand movement onset results in a perfectly smooth trajectory of the hand landing on the displaced target location. Clearly, the very fast on - line regulation of the reaching movement argues against any ballistic conception of movement production. With respect to the transport component of a grasping action (i.e., the movement of the hand/arm system towards the object), Sylvie Athenes examined the tenability of Fitts' law in this type of task. The preliminary conclusion reached was that, whereas movement time does appear to be influenced by the size of the object to be picked up, the modifications to the trajectory only show up in the deceleration phase of the movement and seem to differ from the traditional view.

Patrick Haggard provided some justification for his curious habit of perturbing the ongoing arm movement of the people around him, as they try to apprehend some object, by demonstrating evidence to support his model of coordination in state - space (created by plotting the spatial characteristics of the grasping component [hand aperture] against those of the transport component).

Moving on to a developmental perspective, Audrey van der Meer presented a strong case for her position that the apparently incoherent arm movements of neonates serve to set up a frame of reference for subsequent goal - directed acts. In order to do so, her poor subjects had to pull their arms into view, as she had a pulley - weight system constantly trying to remove the arms from the field of view. The fact that the arm that could enter the field of view was operated much more frequently and vehemently than the other arm was nicely demonstrated by some video clips.

Louise Ronnqvist turned out to be one of the very few people that could perform the finger movements she and Claes von Hofsten were studying in neonates. They showed that grasping in neonates is a gross movement of the whole hand. However, the observation of spontaneous fractionated finger movements suggests that they present some functionality and that they will play important roles in later appearing manual skills. The symposium was concluded, following an attempt by Reinoud Bootsma to formulate a model that could incorporate these diverse findings, by a vivid general discussion.

Lunch time was busy in the poster - session room, which rapidly became a poster - discussion - lunch room. We eventually saw Margaret Hagen presenting a "mass-media" poster on a MacIntosh borrowed from Lawrence Warwick - Evans, who was at the time on sabbatical in the lab (here's for cross-cultural experiences). The last afternoon was devoted to a (not completely) new topic in the field of ecological psychology: Ecological Acoustics. We capitalized on the presence in Marseilles of a famous researcher and musician: Jean Claude Risset who is an expert in music synthesis (building the artificial) and who came to understand over time the benefit of adopting an ecological point of view: replacing purely physical parameters by information and considering the ear as a perceptual system. His talk was built around a fascinating sound track and contributed to one major outcome of the workshop: The idea that the study of perception benefits from a multimodal approach.

Yves Guiard followed that track by elaborating

on the parallel between the information in radiant / ambient sounds and radiant/ambient light, a holistic conception of perception seeming to require the comprehension of both sonic and luminous events.

Rainer Guski took to the stage once again, talking about ecological noise research. He proposed that noise has to be considered as a legitimate part of a perception / action cycle and not only as an unwanted distracting event.

Finally, Claude Cadoz presented a high quality video,in which he showed how computer technology, using both sound and vision, contributes to building new realities and to the understanding of how we perceive realities. He also presented experiments in which new instruments are created, where the subject's actions and sensorial feedback are essential to the definition and testing of the instruments themselves.

This first European Workshop on Ecological Psychology was concluded with a business meeting, where the participants agreed that we had taken a significant step in the direction of regular ecological workshops (thanks to all of them for being present). Important points such as the problem of a legal position of a European group, the editing of proceedings, and the location of the next workshop were raised. With Jimmy Thomson's offer to organize a SEWEP in 1992 in Glasgow, the continuity has at least been guaranteed and the remaining issues will be addressed then. There will also be a European group rendez - vous at the international conference "Amsterdam 91"). For now, we decided to set up an executive committee (Reinoud Bootsma, Yves Guiard, Daniel Mestre, Jimmy Thomson). Please feel free to contact any of us to make any suggestion susceptible to contributing to the growth of this new affordance.

Dartmouth Reprise

The following is a description of a talk at the 1989 Annual Meeting at Dartmouth College (October 21). Like Paul Vincent - Davis' presentation described in the last Newsletter, this is a description based on a tape recording of the talk. Only phrases marked in double quotation marks are verbatim.

Comparing painting styles by "polystyle" composition

Daniel Davidson
U. of California, San Diego

What does a style in painting say about reality? Different styles abstract different features of reality and, agreeing with Margaret Hagen in *Varieties of Realism*, Davidson questioned the wisdom of regarding one style as being *more* realistic than another. To discover what various styles do abstract from reality, and to find out what each does best, is not easy. Davidson developed a technique that he calls "polystyle" painting as one way to investigate the effect of styles on one another through practice. He feels that one can learn most about what a style does by putting it into a common space with other styles. His deeper concern was that there are no standards of evaluation in art today. There are many styles, but they are just different. They can't be evaluated against one another. Some art history is written as if succeeding styles constitute a progression, but "everyone knows this is not true." Davidson's own investigations are most ambitiously embodied in a series of 64 "Mountain Hexagram" paintings (regarded as one work) based on the I Ching. Because some of these are multi - panel, there are more than 64 canvases in the set. Stretched end to end they extend 280 feet.

Davidson's talk described the development of his polystyle, beginning with a 10 year "re - education" in art based on careful study of Chinese painting, primarily at the Palace Museum in Taiwan, as well as particular western masterpieces (e.g. the large Philadelphia "Bathers" by Cezanne). He showed some of the work he first did upon returning from China, using Chinese brush techniques, but with a western eye ("black and white impressionism . . . only without the color theory.")

One example slide leading up to his more mature polystyle showed cubism and surrealism in one painting. He called it "surrealism using cubist transformations" and noted that cubist while units are usually flat, this is not a necessity of the style. One can "set styles to whatever illusionist depth you want but these styles don't necessarily imply a certain kind of picture space." His next slide, "Bear by the tail," showed a painting that moved from impressionism to a traditional pattern, to Matisse to illusionist depth to a cubist landscape. In a "copy" of Cezanne's "Bathers," he did each figure in a different style: cubism, abstraction, surrealism, biomorphic, constructivism. Another showed several subtle variations of cubism all together, leading him to note that cubism was not one thing. One of the variants, he described as, "cubism without the angles." His painting, "Decrease," started with impressionism and moved to something looking like minimalist sculpture. Its counterpart, "Influence," moved from a crystalline, cubist view to soft biomorphism, showing "the good side to degeneration." By learning to make transitions from style to style within one painting, Davidson came to focus on the relations among styles, how to get from one

to another, rather than rigid classifications (all with different names) that separate artists and styles from one another.

ILLINOIS — Reprise
Spring Meeting
May 21 - 22, 1990

Here are some abstracts from the spring meeting, May 1990 at the University of Illinois.

Understanding Ancient Greek Motifs in Contemporary Physical Culture

Cynthia S. Slowikowski
Dept. of Kinesiology, U. of Illinois

Motifs (images, representations, ideologies, beliefs) that we have linked to the ancient Greeks are noticed as they have been reappropiated by popular culture of the contemporary developed world, particularly within the physical culture realm. Physical culture is defined in this work as play games, physical contest, agonistic festivals and the social and artistic representations of these phenomena. These motifs are identifies as serving our culture as a kind of past that is otherwise inaccessible to us. For example, goods such as T-shirts embellished with symbols of ancient Greece; rituals such as our Olympic flame ceremony; designs which assimilate the black - vase figure; and the prominent placing of the discobolus statue within physical culture settings; recall a set of attitudes concerning what we believe to be our bond to the ancient Greeks, allowing us to participate in a past that was never real, but that has been created in the modernity. This study tries to understand why the need for such "ancient" images has come to be felt. Highlighted by slides, text and postmodern interpretation, an attempt is made to "anthropologize" selected practices and representations. At the same time, the literary and archaeological scholarship focusing on ancient Greek athletics is also investigated, for the search for cultural "contexts" has also to do with how present-day scholarship classifies, preserves and revives its past.

Perceptual Differentiation in Movement Learning

Larry Goldfarb

The Feldenkrais Method is a cybernetic approach to motor learning currently being applied in rehabilitation, athletic training, and education. A key notion in the practice and theory of this approach is that motor learning arises from a process of *differentiation*, primarily, of differentiation in kinesthetic experience. During a movement lesson, the guided exploration of simple sequences of gentle movement and the attention to the kinesthetic *consequences* of such movement generates observable effects on muscle tone, range of motion, smoothness of action and coordination. Not only are these effects apparent to the subject but they are measurable by an observer.

Feldenkrais is a relatively new approach and has yet to undergo much experimental scrutiny. After a brief lecture on relavent history and theory, there will be an experiential lesson, wherein participants will have the opportunity to participate in a lesson themselves. A discussion will follow after the lesson, considering how to evaluate this approach and its results. What can be done in the lab to substantiate experiential findings? What kind of research would be relavent? What does this methodology have to offer to ecological psychology? and vise versa?

Dynamical Approach to Skill Acquisition

Beatrix Vereijken
Dept. of Human Movenment Sciences, Amsterdam
and
Dept. of Kinesiology, Urbana-Champaign

Research on motor learning traditionally has tended to focus on single limb or single df movements that more often that not only required rescaling of an *already existing* movement pattern instead of truly requiring a *new* pattern. One of the possible reasons for this might be the lack of a general framework and a suitable methodology for tackling the problem of the *early acquisition phase* of new movement patterns involving the whole body.

It is argued here that a dynamical approach can offer new perspectives for research on motor learning. The following steps are proposed when studying the learning of while body movements. Start by taking into account the several constraints involved with the task. Since these constraints eliminate certain body configurations, the learner only needs to deal with the 'residue' of movement possibilities. Subsequently, we asked expert performers to change movement modes intentionally (like moving faster or with larger amplitude) and looked for invariants across these performances. These invariants can serve as global, low level descriptions of the total effort of the subjects. This global description can subsequently serve a dual role pursuing the answers to two kinds of questions. Firstly, since it captures the essence of the expert performance, the relevant question for motor learning becomes: how do novices converge to that description? the global descriptor can also be used to study how the several body segments are coordinated and covaried to preserve a given solution at the global level, a

question dealing directly with the problem of coordination itself.

The fruitfulness of this approach will be illustrated on the basis of some preliminary data.

Describing the Environment for Complex Skills: Dynamic Affordance Distributions

Alex Kirlik
Center for Human-Machine Systems Reasearch
School of Industrial and Systems Engineering
Georgia Institute of Technology

The problem of context - specificity has plagued the Cognitive and Decision Sciences in the attempt to develop models of complex human behaviors such as planning, decision-making and problem solving. In case after case, humans have been found to exhibit sensitivity to aspects of the task environment that are either equivalently classed, or even abstracted away entirely in the model's environmental description (e.g., decision trees, problem state spaces). While context-specificity in behavior is often viewed as an undesirable departure from normative models. A critical issue, then, is to identify how humans might make productive use of context - specific environmental features in the skilled selection of action. In addition, a language for describing complex task environments is needed that preserves the psychologically relevant environmental properties.

We present a process model of skilled human planning and decision - making behavior based on a description of the environment as a set of dynamic affordance distributions defined over the set of available actions. The model was able to mimic human behavior in a task requiring subjects to control a fleet of five craft to search for and process valued objects in a partially forested "world" shown on graphical displays. Affordances were determined by quantifying the degree of match between human's capacity for action and the opportunities for action in the current world and changed continuously over time due to changes in action capacities and opportunities. After describing the environment in this format, the process model was constructed by identifying the information capable of specifying the relevant affordances, constructing mechanisms sensitive to this information, and creating a mechanism to resolve conflicts caused by the existance of competing and redundant affordances. Problems associated with trying to use such a model in a predictive role will be discussed.

Orientation Aid Impementing The Global Positioning System

D.A. Brusnighan
M.G. Strauss
J.M. Floyd
B.C. Wheeler
University of Illinois

A portable device that enables a visually impaired traveler to quickly and accurately determine distance and direction of travel to a desired destination point is being developed. Coordinates of the traveler's current position are determined through the use of the NAVSTAR Global Positioning System (GPS), developed by the Department of Defense. A microcontroller will use these coordinates, obtained from a GPS receiver, as a point of reference from which to calculate the distance and direction to a desired destination whose coordinates were previously stored in memory. The microcomputer will perform all the necessary mathematical operations to output sufficient information so that the traveler can reach the final destination.

Effects of Spatial Constraints and Movement Symmetry on Two-Handed Coordination in Children

Daniela Corbetta
University of Geneva (Switzerland)

The purpose of this study is to better understand the conditions in which children from 5 to 9 years old are able to coordinate as a single unit symmetrical or asymmetrical two-handed movements. Few studies have addressed this question and those have report discrepancies among their findings. Southard (1985) found that from the age of 5 years children were able to tightly couple size and location. In contrast, Fagard & Barbin (1987), in a spatial constraining task, observed that the ability to couple bimanual movements increases progressively between 5 and 9 years and that only symmetrical movements can be precisely and rapidly performed by 5 to 7 year olds (Fagard, 1987).

Utilizing a task close to Fagard's we attempted to show that the ability to couple two-handed movements in children (as Southard observed) can change dramatically when spatial constraints are imposed on the movement trajectory (as Fagard & Barbin did in their study).

60 right handed male children, aged 5 to 9, participated in the study. The task asked subjects to move and combine the displacement of two handles in order to move a marker diagonally on a PC monitor and to reach a target located in the upper right corner of the screen. In one condition, no spatial constraints were imposed on the movement trajectory. In a decond condition, spatially constrained, the displacement of the markder had to be maintained between two guide lines placed on the screen. These

two tasks were performed wither with symmetrical or asymmetrical two-handed movements.

A crosscorrelation was performed on the left - and right - hand velocity profiles. This analysis clearly revealed that in the less constraining condition, movements were hightly correlated by the age of 5. On the contrary, in the spatially constrained condition, it appeared that at all ages the movement correlation was very low. Such a result indicates that the ability to couple two-handed movement is disrupted when the movement must be coordinated to accommodate external spatial constraints. Concerning the movement symmetry, results didn't involve major differences in physical performances, except in the temporal lag between hand velocities. This result suggests that symmetrical movements were performed more synchronously that asymmetrical ones.

Kinematic specification of surface dynamics: You be the judge

Steven B. Flynn, Cheryl A. Baldwin, Amy L. Shadoin and Thomas A. Stoffregen
The University of Alabama

Stoffregen & Riccio (1988) argued that the control of orientation should be influenced by the dynamics of the surface on which orientation takes place. They argued that ecologically relevant properties of surfaces, such as their rigidity, friction, flatness, and inclination with respect to the direction of balance, were specified in the kinematics of the interaction between an animal and a surface. That is, the dynamics of the surface should influence the motions of animals standing (or otherwise behaving) onit. They argued that these patterns of motion are detected by "behaving" animals. A corollary of this claim is the possibility that these same patterns of bodily motion may be mapped into the optic array, and may be available to observing animals. If this is true the dynamics of a surface could be perceived simply by watching another animal interacting with it, in the manner of Runeson's Kinematic Specification of Dynamics (Runeson & Frykholm, 1983).

The present poster presented kinematic (point-light) videotapes of humans walking and hopping on two kinds of surfaces: rigid (floor) and deformable (mattress). Conference participants viewed the displays. In general, they were readily able to state the nature of each surface in a free report condition. Viewers were less able to detect a narrow surface (a beam) when the actor walked on it. This may have been due to the the side view of the camera: lateral instabilities engendered by the beam were along the line of sight rather than being perpendicular to it as on the mattress. These informal data are encouraging: ecologists (at least) can detect surface dynamics from body kinematics. Formal studies are planned.

Noticing of unexpected events by mildly retarded and non-retarded adults

Cheryl A. Baldwin & Thomas A. Stoffregen
The University of Alabama

Becklen & Cervone (1983) found that statiscally "obvious" aspects of a scene can go wholly undetected when an observer attends to dynamically structured event sequences. Participants watch a videotape of a basketball game, and pushed a response button when the ball was passed. At one point a woman carrying an open umbrella walked through the game (via electronic superimposition). Only 35noticed the "umbrella woman" (UW). Noticing was not related to task performance.

The present study replicated Becklen & Cervone (1983) in mildly retarded adults (IQ: 50-75). It is commonly believed that one manifestation of mental retardation is reduced attentional capacity. This suggests that there should be a stronger relationship between task performance and UW noticing in retarded than in non-retarded persons.

The stimulus was a one-minute videotape of a basketball game played between two teams of three players each. About 30 s into the game a woman carrying an open umbrella on her shoulder walked through the court from basket to basket. Unlike previous studies this was a "live" recording rather than a blended tape. The woman was on the screen for about 20 s. Twenty mildly retarded (MR) adults and 20 non-retarded (NMR) college students viewed the tape with instructions to press a response key each time the ball was passed in the game. Twelve MR participants noticed, campared to only 3 NMR. On average task performance was at the 84% level for NMR and at 38% for MR. For the MR participants there was a significant positive coorelation between IQ and task performance, but not task performance and noticing.

The lack of relationship between noticing and task performance in MR participants is inconsistent with the hypothesis of reduced attentional capacity in mentally retarded persons. This is especially salient given the strong correlation between task performance and IQ. The reduced task performance of MR suggests that mildly retarded persons may be less sensitive to forms of spatio-temporal structure that were present in the stimulus episode. Many events in the real world are characterized by continuity over time, and by partially determinate spatio-temporal structure. Neisser (1979) has argued that these forms of structure may be exploited by observers, allowing

them to "follow" natural events as they unfold. A true assessment of the attentional abilities of MR persons may depend on studies of their ability to exploit these kinds of structure.

General competence and individual differences in children's and adult's perception of social affordances

S. Valenti, R. Kritzer,
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Several programs of research are extending the ecological concept of affordances (opportunities for action) to the domain of social events. A social affordance has been defined as an interactional opportunity for interpersonal exploration, cooperation, and communication. In light of recent work on the social scaffolding of cognitive development, the perception of these opportunities for social interaction appears to be prerequisite for the development of adult levels of academic and social - cognitive competence. Ecological social psychologists seek not only to assess human capacity for perceiving social affordances, but also to uncover both (a) the determinants of human attunement to social affordances, and (b) the firm informational support for social perception in structured arrays of light and sound.

In their sketch of an ecological approach to social perception, MacArthur and Baron (1983) reasoned that attunement to social affordances is based both on the general action capabilities of the animal, and the specific, moment - by - moment adoption of particular goals (intentions to act or interact). Two of the three experiments in this report illustrated children's and adult's capacity to perceive naturally occurring social affordances from brief observations of videotaped interactions. In these two studies, the goals of the perceived person were varied by editing of the videotapes, or the goals of the perceiver were manipulated by training prior to observing the videotapes. A third study of interviews by clinical psychology graduate students examined the relation between several measures of social perceptual skill and interactional synchrony – a possible informational support for the perception of social intent and mutual affective regard (rapport). The data revealed a relationship between a proxy measure of social perceptual skill (faculty ratings of student nonverbal ability), interactional synchrony, and self - reported rapport following the interview. Collectively, these investigations suggest possible sources of information for social perception (facial gesture, whole body movement frequency and amplitude, and interpersonal movement synchrony), and methods which may assist in discovering the fine structure of these informational supports.

A case of reconstructive remembering in the scientific literature

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This paper presents a study of remembering which is unique in that it takes as its subjects matter the professional activity of scientists. The case deals with the literature of the memory recall paradigm, a body of psychological research which has been very influential and widely cited among cognitive psychologists. There has been a large number of citation errors in this literature regarding the details of the first memory recall study conducted by Adriaan de Groot in 1946. An analysis of these errors suggests that scientists exhibit the characteristics of reconstructive remembering. While the findings indicate that remembering in science may not be all that different from remembering in daily life, the implications of reconstructive remembering are more severe for the former.

Posters at Illinois

Carello, C., Fitzpatrick, P., Turvey, M.T. & Treffner, P. (University of Connecticut). *Intentional constraints on Haptic exploration.*

Effken, J.A., Kadar, E.E., & Shaw, R.E. (University of Connecticut). *Validating an invariant for cranio-facial growth.*

Kadar, E.E., Kim N.G., & Shaw, R.E. (University of Connecticut). *Direction-to-contact: a complement to time and distance-to-contact.*

Kim, N.G., Flascher, O.M., & Shaw, R.E. (University of Connecticut) *Display mechanism for directionality.*

Flascher, O.M., Effken, J.A., & Shaw, R.E. (University of Connecticut) *Coordination of detection and control for systems with mutual intentions.*

Flascher, O.M. & Carello, C. (University of Connecticut) *Visual and haptic perception of passability for different styoes of locomotion.*

Jensen, J. & Thelen, E. (Indiana University). *Regulation of muscle stiffness in leg movements of prewalking infants.*

Corbetta, D. (University of Geneva). *Effects of spatial constraints and symmetry of movements on two-handed coordination in children.*

Bingham, G.P. & Muchesky, M (Indiana University). *Center of mass perception.*

Bingham, G.P. & Gutjahr, E.C. (Indiana University). *Perceiving the size of trees.*

Ko, Y. (University of Ilinois). *Self-organizing behavior in the postural control system.*

Martin, E., Riccio, G., & Korach, M. (University of Illinois). *Moving toward the separatrix in postural space.*

Shih, J. (University of Illinois). *Effects of perceived and imagined pendular motion on postural sway.*

Loczi, J. (University of Illinois). *Effects of door dimensions on entering and exiting an automobile.*

Liu, Y.-T. & Lintern, G. (University of Illinois). *The role of the explicit versus the implicit horizon in the control of aircraft landings.*

NEWSLETTER ESSAYS

Paolo Bozzi's studies of event perception: a historical note

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In 1958 and 1959 Paolo Bozzi of the University of Trieste published papers on the perception of natural motion of pendulums and of objects sliding down inclined planes. The studies are of historical interest because they anticipated some of the theoretical questions currently important in the fields of naive physics and event perception. Moreover, some of his results and conclusions have been rediscovered in the last decade or so.

While Bozzi's work is important, it was published in Italian and is not accessible to all those who might be interested in reading it. Since the studies are being cited now (Runeson, 1974; Roncato & Rumiati, 1986; Viviani & Stucchi, 1989; Pittenger, 1990) it seems timely to make them more available to readers of English. Complete translations of both papers have been made. (Directions for requesting copies are given in the last paragraph of this note.) Below we briefly summarize Bozzi's studies and comment on their place in the history of research in naive physics and event perception.

In his 1958 paper Bozzi presented observers with pendulums of several lengths and amplitudes of swing. He varied the frequency of motion until the observer reported that the motion appeared to be natural. The central issue was the consistency of perceived natural motion with physically correct nat- ural motion: A pendulum's period is proportional to the square root of its length and is nearly independent of amplitude. Bozzi's apparatus allowed pendulums, thin rectangles without bobs, to be driven at periods independent of their lengths. His experimental technique, presenting displays that simulate events violating the laws of physics and asking for reports of the perceived naturalness of the events, anticipated subsequent event perception research (Runeson, 1974; Kaiser, Proffitt, .& Anderson, 1985; Pittenger, 1990).

In Study 1 a 40 cm pendulum was swung through either 10 or 60 degrees at a frequency that was obviously too high (or obviously too low) for natural motion. The frequency was lowered (or raised) in small steps until the observer reported that the motion appeared natural. The key result was that the wider swing was seen as natural at consistently lower frequencies than was the narrower swing. The magnitude of this perceptual effect is much greater than the effect of increased width of swing on real pendulums. Also, observers varied widely in the frequencies seen as natural. Finally, though this is not discussed by Bozzi, there is an effect of initial frequency. If a pendulum was initially moving at a very high frequency, then the frequency seen as natural is higher than that for the same pendulum initially shown at a very low frequency.

In Study 2 pendulums of 10, 20, and 40 cm were shown at deviant frequencies. Longer pendulums were judged as natural at lower frequencies. This result is consistent with the motion of real pendulums. However, the frequencies perceived as natural were consistently lower than the actual natural frequencies for these lengths. Again, there were wide individual differences among observers. Also, the perceived natural frequency was biased in the direction of the frequency presented at the start of the trial. The results of this study were later replicated, using different apparatus and procedures, by one of us (Pittenger, 1985 and 1990).

Bozzi also reports some interesting comments made by his observers. They tended to have forgotten the facts learned about pendulum motion in physics courses and provided incorrect principles, cast in the terminology used in physics, to explain their judgments. The finding that formal course work does not reduce errors in naive physics or event perception has been found frequently in later studies (Clement, 1982; Peters, 1982; Kaiser, Jonides, & Alexander, 1986).

In his discussion, and in a subsequent theoretical paper published in 1961, Bozzi points to the parallels between the effect of amplitude on perception he found and the arguments given against Galileo's analysis of harmonic motion. Suggestions that perceptual errors were the basis for incorrect theories of physics have been made by others in recent years (Shannon, 1976; McClosky, 1983).

Bozzi's 1959 paper assessed perceived natural

motion of objects sliding down a frictionless inclined plane as functions of the size of the object and the slope of the incline. His apparatus, adapted from Michotte, consisted of a disk with a spiral drawn on it and a screen placed in front of the disk. A picture of an inclined plane was drawn on the screen. A slot cut along the incline allowed a square segment of the spiral to be seen. As the disk rotated a block, simulated by the square, appeared to move down the plane. Spirals of different shapes produced simulations of motion showing various patterns of acceleration and deceleration. Different screens were used to show different slopes of the incline and sizes of the square.

Study 1 assessed which of five patterns of motion appeared to be most natural for an object sliding, without friction, down the plane; constant velocity, constant acceleration (i.e. the actual natural motion), two different patterns in which the block accelerated throughout the slide but at decreasing rates, and one in which the block accelerated down the first one - fourth of the plane and then moved at a constant velocity down the rest of the plane. Observers viewed each display, commenting on changes needed to make the motion appear natural. Nine of the 10 observers chose the fifth display as natural while only one picked the second, i.e. the physically correct, display. Bozzi notes that acceleration to a constant velocity was a common pre - Galilean belief about the nature of freefall.

In Study 2 a large and a small simulated block were shown, at three different slopes (22, 45 & 68 degrees). All were shown moving with an initial acceleration followed by constant velocity. Duration of the events were varied by adjustment of the disk's rate of rotation. Each display was shown both at an initial duration which was obviously too short for a natural slide and at one which was obviously too long. Duration was adjusted until the motion appeared natural. Bozzi's observers chose, as is physically correct, shorter durations for slides down steeper slopes. However, in contradiction to natural science physics, they selected shorter durations for the large block. Bozzi points out that in pre - Galilean physics, size and weight were often confused and that larger / heavier objects were held to fall more rapidly than smaller / lighter ones. As in the pendulum studies inter - observer differences were substantial and the value of the variable which lead to perceived natural motion was biased toward the value used at the start of a trial. In a third study, Bozzi confirmed these effects of size and slope with a new procedure.

Viewed as research in naive physics, Bozzi's studies appear to be among the first to empirically test the possibility that the phenomenal structure of simple events matches the false beliefs found in pre - Galilean theories of mechanics. Bozzi (1958) does mention the studies by Inhelder (cited in Piaget, 1955) in which children varied the weights, amplitudes, etc. ofpendulums in a task requiring them to isolate the relevant variable in the frequency of pendulum motion (i.e., length). Some children reported seeing changes in frequency as irrelevant variables were manipulated. Bozzi's studies, however, involve much more direct assessments of perception and allowed measurement of magnitudes of the effects.

From the perspective of event perception research, Michotte must stand as the one who pioneered the study of perception of dynamic properties. Furthermore, Johansson's pioneering studies of event perception (e.g. Johansson, 1950) were primarily geared to perception of kinematic properties, not obviously involving dynamic constraints. However, Bozzi may have been the first to bring forth cases in which dynamic aspects have a determinate role in the perceiving of kinematic properties: perceived speed or naturalness of pendulums and sliding objects was found to be contingent on pendulum lengths and incline slopes.

Recent studies (Runeson, 1974, 1975; Bingham & Runeson, 1983) have extended the latter findings. When asked to choose the most nearly constant velocity, or "push", the type of motion preferred by observers is the same as that which provided the most natural - looking sliding down an incline in Bozzi's study: an initial constant acceleration that levels off to a constant velocity. The same holds for both horizontal and vertical directions. This is precisely the type of motion that unfolds when friction is present and something moves off by constant force or power. Thus there is in fact a highly affordance - relevant property that remains at a characteristic constant level throughout any such event. It is therefore right, and makes adaptive sense, that constancy and naturalness are perceived in them.

Perception, along with some pre - Galilean notions, may be wrong when considered as scientific statements. However, contrary to the typical naive - physics outlook, some of Bozzi's results, and some later ones, may be taken to indicate a better attunement of perception to actual terrestrial dynamical conditions than that of the more celestially geared Newtonian mechanics. Thus, further ecologically geared work may come to dissolve many"perceptual error" interpretations – and provide a bit of an amplification to Bozzi's theoretical point that pre - Galilean mechanics wasn't just plain wrong.

English translations of the 1958 and 1959 papers, prepared by Paola Bressan and Paolo Gaudiano, are available without charge from John Pittenger. Requests for copies may be sent to him at:

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Sverker Runeson has a translation, into Swedish, of the 1961 paper. Requests for copies may be sent to him at: Psykologiska Institution Box 1854, S-75148 Uppsala, Sweden or via e-mail to: PSYSR@SEUDAC21.BITNET

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Specificity and Information Some Conceptual Issues for Ecological Psychologists

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Preliminaries

What is at issue in the debate concerning "multiple sources of information?" I believe the conceptual issue underlying this debate is the problem of how to understand the radically new concept of specificity proposed by Gibson in his later writings. Pittenger thinks that environmental events are "multiply specified" and Stoffregen says that they are not. Stoffregen begins his contribution with a useful compilation of questions: 1. Are the supposed several sources of information for a single event equivalent? 2. Can one source of information substitute for another? 3. Are the sources of information for a single event independent? 4. Are the sources redundant?

Each and every one of these questions – as well as the larger question at issue – can be answered only when we have a firm grip on the concept of ecological specificity. I would add that a number of puzzling

empirical phenomena should also be clarified merely through better understanding of the concept of specificity. I have in mind here such a phenomena as so called "inter - modal conflict," certain kinds of illusions and the apparent "triggering"of perceptual or action responses by supposedly insufficient information.

Specificity and Information

One of the basic claims of ecological psychology is that some aspects of an ambient information array specify their sources in the environment. This claim has been taken to mean, at the very least, that some feature of the array F is nomically dependent on an environmental event E (Turvey, et al, 1981). Under evolutionarily typical circumstances, in fact, F is uniquely dependent on E, as well as nomically related to it. (It should become apparent from what follows that a more perspicuous formalization of specificity would be in terms of two "complex particulars," one in the array (A) and one in the environment (E). Each of these particulars possesses a set of properties (p x A) and (p x E) such that at least one member of the former set is nomically dependent on at least one member of the latter set, and that there is a more or less unique relationship between the two particulars A and E.)

We know that there exist a vast number of these "pieces" of information, and that what these pieces of information seem to specify varies from case to case. But the best examples we have of information specify features of what might be called the inhabited environment. The optical horizon specifies not only the separation of ground from sky, but also the eyeheight of the observer; optical "tau" specifies the time to contact of an observer with an environmental surface; optical accretion and deletion of texture specifies the covering/uncovering of one surface by another as seen from a point of view. Stoffregen is reluctant to label such "pieces" of information as information. His argument is that these pieces do not, in fact, completely specify either the observer or the environment. This is correct: for example, on its own, optical "tau" does not specify much of anything about how the closing velocity is being accomplished (e.g. walking versus running). However, while Stoffregen's point is correct, I do not see that it makes his argument: for something to be information it must specify an aspect of the environment, but it need not specify every aspect of the environment, or even every aspect of the event in question.

From the outset of his theorizing about ecological information, Gibson wisely emphasized the richness of ecological information – there is frequently more information than can be used in any instance. As careful research on acoustic and haptic specificities, as well as optical ones, begins to add up, we now realize how prescient Gibson was. Evolving perceivers face the problem of adapting perceptual systems to an embarrassment of riches. I suspect this adaptation therefore involved the evolution of selective systems, in order to deal with this plethora of information, and enable the flexible, coordinated pickup of a great many "pieces" of information (Intra- and inter - modally).

Two Levels of Specificity

The present position implies the need to distinguish two levels of specificity: one concerned with the complete specification of an organism as situated in its environment. For the sake of terminological specificity, I will refer to the first level as the level of **structural specificity** and I will refer to the second level as the level of **functional specificity**. Both are forms of ecological specificity.

Gibson's experimental work – and those of his followers, as Pittenger rightly points out – tended to involve the testing of hypotheses concerning structural specificities. Often this involved the isolation of very particular informational structures (e.g., isolating accretion/deletion from parallax) for the sake of experimental rigor. In spite of this, Gibson's theoretical work was always developed with an eye towards functional specificity, so that the experimental discoveries could be understood in a broadly ecological context, for reasons related to both practical application and Gibson's general conceptual approach.

From a biological point of view, the distinction between two levels of specificity makes a great deal of sense. If there exist structural specificities, based on nomic relations between informative arrays and the environment, different organisms in different habitats will obtain experience of these regularities in very different ways. The evolutionary problem thus set for a perceptual system is how to select, out of all presently available specificities, those that are of greatest current relevance to one's overall situation in the environment.

Is this cue theory? I think not, for several reasons. First, the emphasis on nomic relations is unlike the bias for statistical analyses found in most cue theories. Second, cue theory treats cues as modifying one another (becoming integrated, or conflicting, or reinforcing one another); the present account assumes, to the contrary, that the functional situation does no more than select what information is most relevant – neither the situation nor the various pieces of information modify the structural specificities (they can-

not, by definition). Third, because it is assumed here that perceptual systems are selective, there will be far more variability than in cue - based models. A given functional situation may be apprehended through detection of a great variety of structural specificities. Hence, the same situation might be apprehended first by one, then by another, different set of information.

Interim Conclusion

The answers to Stoffregen's questions are thus as follows:

1. It is unlikely that two pieces of information are ever identical, if by identical one means that they share uniquely identical structural specificities; however, two pieces of information may be non-identical in this sense, and nevertheless contributes to the same functional specificity.

2. Hence, two pieces of information can be interchangeable, to the extent that they contribute to a given functional specificity.

3. The specificities of different pieces of information can be either independent or interdependent.

4. Pieces of information can be redundant for functional specificity, without being redundant (or identical) for structural specificity.

It will be useful to test this way of thinking against certain standard problems in the literature on multiple specificity. For instance, from the present point of view, Stoffregen's concerns about the lack of complete information in, e.g, Warren's studies, should be reinterpreted as a caution against extrapolating from data about how isolated structurally specific information is used to a complete analysis of a functionally specific situation – a caution I am certain all parties in this debate will endorse. Intermodal conflict, on this view, becomes a theory - laden concept which is unnecessary. For intermodal conflict to occur, one must assume that there exist cues (or structurally specific pieces of information) which **necessarily** cause the perception of a unique organism - environment situation (functionally specific). The present account denies this assumption. Like Stoffregen, I would interpret alleged intermodal conflict situations as "in the mind of the beholder" who assumes that one perceptual system "has to" register a different functional fact.

The present account also helps to underscore Pittenger's account of the successes of experimentation in ecological psychology. It is possible to give law - based accounts of structural specificity and its pickup, at least by clever use of laboratory displays and control of subjects' intentions and tasks. It is not possible, even in principle, to simulate an organism - environment situation "In vivo" as versus "in vitro." Studies of perception and action pose many challenges.

Appendix

On The Analogy Between Immune and Perceptual Function

The argument made in the above concerning two levels of specificity may sound strange to ecological psychologists. Yet it has strong roots in the biology of selectionist systems. In particular, there is a direct analogy between the role played by biochemical specificity in immunological function and the role played by ecological specificity in perceptual functioning.

The immune system "recognizes" antigens in a way referred to as "selectionist" in contrast with "instructionist". It does not, in any sense, build up a template or representation of antigens either on the basis of individual of phylogenetic experience. Instead, what has evolved is a special genetic "shuffling" apparatus that means that each individual's immune system is equipped with the capacity to recognize an enormous number of invaders, including non - biological invaders which are totally novel, and to which no ancestor was exposed. Hence, it is evident that neither the environment or the genes "instruct" the system in how to accomplish its function.

Each antigen of interest (e.g., a virus) is itself composed of a number of biochemically distinct regions, which are called **antigenic determinants** if they stimulate any immune response. the presence of antigen in the body selects a whole host of different antibody cells by virtue of these determinants. The specificity of the antibody cells is not to the antigen as a whole, but rather to particular determinants. In recent theoretical immunology the chemical structure of the antigenic determinant is called the **epitope** and this is said to be matched by a **paratope** on the antibody cells which is specific to that chemical structure. Each item of antigen thus has a unique constellation of epitopes (this is especially true of biotic invaders) so that each exposure to an antigen of that kind stimulates some of the same specific matches of paratope to epitope, but also some different matches. After the initial reaction to an antigen however, the vertebrate immune system is so organized that those cells whose paratopes were stimulated undergo a process of relatively rapid clonal reproduction, so that when another instance of that antigen is detected it is more likely to meet cells with those paratopes than it was before.

This whole process was dubbed "clonal selection" by Macfarlane Burnet in the late 1950's. The idea is two fold: first at the level of antigenic determinants and of corresponding antibody paratopes, there

are chemical affinities which produce highly specific matches; second at the level of immune response (i.e., of antigen - antibody interaction) there are ensembles of those lower level specificities which allow functional recognition and response to occur, despite the significant local variations from time to time and context to context.

The chemical relationship at the level of epitope and paratope is a lawful one, based on rates of reactions. It is called *affinity* and is measured in terms of kinematics as follows:

(Where Ag= Antigen; Ab = uncomplexed antibody; Ag-Ab = Bound complex; k1,k2 = rate of forward and reverse reaction) Where $k < 10{,}000$ liters / mole one usually considers this relation non - specific. Thus, these structural specifications of paratope to epitope can and should be measured in isolation, as separate lawful relationships between a bodily structure and an invader. (I am ignoring idiotypic networks for the sake of simplicity here)

However, specificity at the level of antibody - antigen relationships — what I am tempted to dub functional specificity — is not predictable from affinities. For one thing, the rates of reaction of any two items will be affected by third and fourth items, so that binding as measured in isolation cannot predict in vivo performance. For another thing, the history of an individual's immune system will bias it in favor of recognizing previously detected antigens and determinants. Thus whereas paratope-epitope specificity is measured in terms of affinity, antigen - antibody specificity is measured in terms of *avidity*, the half saturation of antibody.

Note how the history of a particular immune system will yield changes in avidities without changing affinities at all. Thus, if you have been exposed to antigen A#1 which happens to share a high proportion of antigenic determinants with A#2, it is quite possible that on your first exposure to the latter, your immune system will "cross-react" and respond as if to A#1. This sort of process is actually exploited these days in the preparation of vaccines. Often a virulent strain is bred out so that it becomes attenuated (it loses those determinants related to the actual production of disease). These attenuated viruses can still be used in (some) vaccines, because sufficient exposure to them will produce immune response to their virulent cousins. With genetic engineering technology one can directly delete some of the viral components that are disease-producing, thus producing a kind of artificially attenuated vaccine. (I hope the analogous implication for certain sorts of illusions is not lost on readers)

It is thus because the pieces of the immune system are uniquely specific to pieces of antigens that the system can function as a while to recognize and respond to antigens. The piece-meal specifications are nomic, whereas the functional specificities are historically developed coalitions of these nomic processes, and can and do differ from time to time, context to context, individual to individual, without undermining the lawful relations upon which the system is built.

One should not stretch this immune - perception analogy too far. The immune system is immensely complicated, with an enormous diversity of cells, and a cluster of relatively non - specific functional components, none of which was referred to herein. The key point I wish to press is simply this analogy between two levels of specificity, structural and functional, with a selectionist system accounting for the linking of the two levels. If I had more space I would try to spell out some of the plausible neural substrates of structural and functional specificity. What Edelman calls a **global mapping** would seem to be the smallest candidate for a perceptual system paratope. Such a mapping integrates the motor components of information pickup with the diverse central mappings of peripheral receptor sheets; hence, in principle at least, some such mappings could be capable of detecting significant environmental invariances. A given event, however, would clearly implicate a cluster of such global mappings and these would need to be coordinated via the process of **reentrance** as Edelman suggests in order for a functionally specific perceptual act to emerge. From this point of view, some of the models developed by Finkel and Edelman (of *The Remembered Present*) in which several different "submodalities" of vision (e.g., motion, occlusion, brightness) are reentrantly linked and then shown to be capable of at least a limited kind of object recognition take on considerable interest.

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