

Neuroscience and Learning Determinism or Choice ?

Preliminary Submission

Computer and Biology - Project

NEUROSCIENCE

Scope - assumptions and definitions
background
context
epistemology

The computer aspect of the project offers the possibility
not only of arithmetic, logical and structural relationships,
but of even kinds of overstructured or transcendental relationships.

This is made possible by means of the computer language APL.

Primary functions are able to be compounded by means of operators
e.g. reduction, scan, the axis operator, inner product, outer product.

Overstructures and Transcendentals

Overstructuring and transcendental relationships
will be progressively described, defined, exemplified,
and illustrated through the text.

Multidisciplinary / Interdisciplinary

The biological aspect of the project takes into account
the large number of disciplines which are entailed in life science
and the necessity of interdisciplinary science.

Biology involves a spectrum of scales of view
from physics, chemistry, organic chemistry and biochemistry
at the lower end of the spectrum through anatomy, morphology
and physiology in mid-spectrum
to psychology, sociology and anthropology
at the far end of large scale science.

One theme which scans the scales
of biological consideration and benefits not only by computational practices,
but especially by APL language structure is NEUROSCIENCE.

Neuroscience and Learning Determinism or Choice ?

The Gifford Lecture of 1975 - 1977

by J. Z. Young "Programs of the Brain"

introduced issues which can be schematically related in modules.

I reviewed these Lectures given at the University of Aberdeen, Scotland
for Scottish International, see Appendix A. {not found in original text}

There are 50,000 million cells in the brain.

How many pathways of relationship, of how many kinds, is an open issue.

A glimpse which exaggerates the degree of simplification

can take the bacteria which chooses certain responsive reactions

by selecting what enzymes to make.

Monod says, "the exclusive choice of a substrate [is] determined

by its steric structure" (1972).

Young makes the point that describing the chemistry of DNA

and its relations does not completely describe the process.

The bacteria can produce b (beta)-galactosidase

in response to lactose in one case,

because it is endowed by its past history not only with DNA,

but with a very particular composition and organization.

Young, in the context of discussing "determinism", says,

"It is the presence of this elaborate individual, with a history,

acting as a chooser, with an 'air', that makes the process

so unlike all known chemical reactions except those of other living things."

Compounded and Perpendicular Data Vectors

In terms of a Computers and Biology project using APL,

one data vector is a population of individual bacteria $B_1, B_2, B_3 - B_N$,

in a culture with positions in a matrix

with the profile of a cross-section through the culture,

matrix points $M_{1A}, M_{2A}, M_{3A} - M_{NA}$;

$M_{1B}, M_{2B}, M_{3B}, - M_{NB}$, etc.,

with a temporal vector $T_1, T_2, T_3 - T_N$.

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Supplied by a select nutrient in a gel of 97% liquid 3% protein matrix
with diffusion rates of member nutrients and metabolites
to the culture system boundaries
or an open culture system continuous fermentation system.

Stages of Generalization

This system is generalized in stages from a population
of procaryotic bacterial cells in a continuous fermentation system
to a symbiotic population in the digestive tract of a ruminant animal.
A further generalization can occur with the transition to eucaryotic cells
with closely patterned structure and physiology
which form the tissues of a digestive system.

The overstructure or transcendental is the steps
or stages of generalization and the underlying system vector of choice
versus degree of organization, scale of organization.

(Professor's response / comments to this introduction:

"This proposal is too nebulous for its prospects to be assessed. It is difficult to discern in it either start or end points, much less even a hint of criteria by which successful completion would be recognized."

E. H. A. 83 10 28)

Project:

Fall 1983

for Professor E. H. Anthony, Ph.D.

Wednesday, November 9th, 1983

Re: Project character

Nature of APL

Your Critique

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In your note of October 28th - you state the proposal to be nebulous.
You point out the difficulty in discerning the start or end points.
There is no criteria by which successful completion could be judged.

I submit:

- 1) Part of the project source is Programs of the Brain by J. Z. Young
- 2) Part of the project source is Brain, Mind & Computers by Stanley L. Jaki, the Lacompte du Nouy Prize for 1970
- 3) Part of the project source is Superlearning by Ostrander and Schroeder.

-
1. The phrase from the Project Proposal -
" . . issues which can be schematically related in modules"
refers to the Gifford Lectures by J. Z. Young.
It also points to the book based upon those lectures Programs of the Brain.

The example issue with which I commenced
was the issue of determinism versus choice,
choice derived from learning.

Monod pleads determinism! - "the exclusive choice of a substrate [is]
determined by its steric structure" - exclusive means only.

That would mean:

- 1) - the steric structure is at least partly the product of learning -
either ancestral learning encoded in its genetics
or of personal history
- 2) - there are no choices! or
- 3) There are other choices.

There is an unnecessary overcommitment to the local effect (without context).

The bacteria in question produces beta-galactosidase

in response to lactose.

How does it sense the presence of the lactose?

Can it tell how much lactose is in range?

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Does it matter how much, because of its own limited response or demand?

How much enzyme does it produce? Exactly when does it produce it?

Does it have motility?

What if, instead, it moves closer into range

and produces more, sooner, or moves out of range and produces none?

Is there a meaning containing or meaning conveying function

in the posture of the DNA loop?

What about the proximity of the DNA loop

with respect to the cytoplasm and cell membrane -

does that have a meaning containing and meaning conveying context,

an intelligence?

Does a shift in the DNA loop's posture or position coincide with learning?

Is there a field shape supported by the susceptibility

of certain substances and forms in certain postures and positions?

2. With respect to time and choice or determinism:

"Biological Effects of Electric and Magnetic Fields

of Extremely Low Frequency" is a review of the literature

by Asher R. Sheppard and Merrill Eisenbud.

The low frequency is 0 - 300 hertz.

Under the heading: Neurophysiological and Behavioral Effects

the point is made - "Both electric and magnetic fields

of relatively low strength appear to affect higher functions of the brain

involving cognition or perception of the passage of time".

It is possible to generate such electrical and magnetic fields

by the concentration and / or motion of even Na or K ions

by a cell or tissue.

An organ can provide even more intricately related

electric and magnetic fields which vary in strength and time.

These electric and magnetic fields can be moderated

by the susceptibility of water.

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That constitutes a moderating context,
a mechanism of information containing and conveying,
a personal history affecting choice, learning!

Actual Project Submission

Contents

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	Identification, Hypothesis and Feedback	5)
	Modeling and Representation	6)
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Text

Bibliography

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Introduction

This project relates to **Neuroscience**.

- 1) Part of the project source is ¹ Programs of the Brain by J. Z. Young
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Present learning processes are "half witted and disembodied".³
We tend to be left brain oriented and very much in our heads.

Georgi Lozanov has demonstrated the alternative method of learning which harmonizes and supports left brain learning with the right brain and body.

Learning is a biological function.

APL is something we have attempted to learn.

APL is something we want to use to help us in our biological research.

This project is intended to illustrate provisional findings
about the learning process by applying it to the learning of APL.

This project is also intended to use APL to structure
and express some of the principles of learning as a biological function.

The methods demonstrated are reported to increase ability
to learn and remember by 5 to 50 times.

Temporal and spatial rhythms are major themes in the methods.

Rhythms are matrices.

Rhythms overstructure both data and biological assimilation
and response to data input.

Rhythms provide phase alignment between the temporal
or spatial data inputs of perception and sensation
and the biological sequences of assimilation and response.

We breathe about 5,000 gallons (35 pounds) of air per day.

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The brain needs about 3 times as much oxygen as the body to function.

Rhythmic breathing could lead to better brain oxidation.

But clearly, if the body can cooperate with brain demand for oxygen
by diminishing its oxygen requirements -
enhanced learning and memory can result.

I can personally report that taking beta blockers to reduce blood pressure -
by relaxing blood vessels - affected memory, attention span
and concentration from early October until early November,
when I abandoned the use of the medication
in spite of the recommendation of two physicians.

Measured blood pressure went down from 160 / 110 in early October
to 122 / 80 in mid October.

Upon abandoning the medications,
blood pressure went back up to 155 / 118.

But memory, attention span and concentration all returned within 24 - 48 hours.

Approximately 208 gallons of air per hour is 18% oxygen.

That means 37 gallons of oxygen per hour is used on average.

About 0.62 gallons of oxygen per minute is required.

Those using the accelerated memory and learning methods
report a breathing rate ideal of about 8 per minute.

That would mean 0.08 gallons of oxygen per breath.

There are 50,000 million cells in the brain.

50×10^9 cells next need to be considered
with respect to oxygen demand per cell.

Then the number of cells involve
kinds and degrees of memory and learning
dependent upon the parts of the brain involved.

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The immediate parts of the brain involved relate to the recognition of speech.

{missing page 4 of 5 in this portion of original text or incorrectly labelled?}

The methods of physiology so far have not even been able
to account for all of the ways in which the brain is involved in speech,
much less speech recognition.

Wilder Penfield did establish that due to electrical stimulus of cells
in a person without general anaesthesia,
complete recollection of childhood perceptions were accessible.

One of the implications is that there is storage memory
which may require low maintenance levels of metabolism.

Paths of stimulation may escalate the activity of the cells
and their oxygen demand.

Open questions are what is the length of the path,
the methods of selecting the path and the member brain parts,
tissues and cells involved in the path.

We possess a meaning containing and a meaning conveying faculty.
We cogitate. We edit, revise, amend, and expand our meaning library.
We think. Can we extend the process? Can we augment thinking?
Can we combine natural intelligence and artificial intelligence?
We must know the properties of natural intelligence.

We suspect we have a large amount of statistical information
about the sequence of units (phonemes) in the cortex, but how is it held there?
How does the cortex contain meaning?

Tuesday, November 8th, 1983

APL allows outlines, overstructures or metaprograms.

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Not only can one view behaviour as a highly detailed intricate set
of motions of a specific set of forms and substances with exact forces,
deployed in temporal arrays with significant ratios
and spatial arrays with dimensional ratios or proportions,
but even the information / energy ratios which underlie behaviour
can be identified with execution transformations.

Learning involves the structuring of perceptions
not only with respect to one another,
but with respect to pre-experienced perceptions
and evolved patterns of meaning.

The conscious self navigates and pilots the behaviour
and identity of the human form.

The conscious self employs an abstract intelligence.

Abstract intelligence can scan an array of perceptions and experiences,
can identify common elements in those perceptions and experiences
and can combine those common elements into a generalized pattern.

The subconscious is a data gathering and storing self.

The subconscious submits perception
sets interactively to the conscious self -
based upon an associative intelligence.

The subconscious has a program routine:

search based upon perceptive association
and submit to the conscious self the associated perceptions
for possible relationship to current perception
for abstract structuring.

The conscious self requisitions other associative intelligence memories
based upon other bounding or defining criteria.

This reassigns the subconscious to another search routine.

Every perception set will be sorted
with varying degrees of analytical configuration.

There are data vectors
of subconscious self associative intelligence parameters or properties.

Neuroscience and Learning

Determinism or Choice

?

Each member of the perception data vector has varying numbers
of converging vectors with varying properties
of the same scalar perception point.

There are vector end points with one or more links
to the end or midpoints of other perceptive data vectors.

The scan can progress along a perceptive data vector
with a bounding or defining parameter or property.

As soon as the vector and its end point path tributaries vary
beyond the bounding or defining parameter or property,
the search breaks and submits the array for conscious interaction.

Exempla gratia (e.g.) perception 1:

A stop sign, an octagon of thin material on the end of a post usually.

Four white letters spell the English word STOP.

The background is red.

Along one converging axis is a second member of the vector sequence:
another thin material with white letters in English
and a background in red: a coca cola sign.

Along another converging axis is a second member of the vector sequence:
a strawberry, a ripe strawberry.

The bounding or defining property of the vector
is the abstract (common element) quality of redness.

Along the vector with the stop sign, and the cola sign is a Royal Crown cola sign.

{Diagram - page 3 of 9 in this section of original
- scan vector (free association) and exact identity entrance point,
bounding or defining for association - incomplete}

Rorschach - silhouette and scale vector selection
with scale adjustment based upon perspective,
distance of view or rotation of angle of view

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Abstract intelligence is related to the rarity of the common bounding
or defining property which creates the data vector.

The concentration of attention is a function of the conscious self.

The field of focus and direction of attention

is another function of the conscious self in general,
but the subconscious can moderate or veer the direction
or vector of attention by means of interrogative requisitions.

"Is it a bird?"

"Is it a plane?"

Conscious resolution of the direction of attention,
the field of focus (scale) and the greatest number
of common abstract elements provide the data point fit:

"No, it's Superman."

A later point on a vector may be a whole array on a vector of arrays.

The vector of arrays could be

Exercise 1, Exercise 2, Exercise 3, Exercise N
on a vector of arrays called Computer and Biology assignments.

A larger vector of arrays could then be Anthony source
which would include all of the assignments
plus class and laboratory lectures or text from his book for 431.

Anthony Source " A vector of arrays, q

q + / text notes in class exercise conversations published, q
q programs in his space

Part of the indexing of the arrays can be a time stamp.

This allows for future editing

and perhaps periodic poling of the programs and variables -
part of the indexing can be an edit source
allowing for subsequent amendment or expansion by others.

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A distribution path for a variable or program
can allow for future amendment or expansion
to be submitted for interactive choice of relevance
to a body of work to which it has been distributed.

Format Meaning Containing and Meaning Conveying "The Medium is the Massage"

Some relationships between data points of a scalar nature
is implied by their membership in any set, any vector, matrix or array.

Each word in these sentences may be considered a scalar data point
or the sentence may be considered to be a vector of arrays.

The sentence which made that statement has 24 words.

The word "be" is the 7th, 17th and 20th word.

That word occurs more frequently than any other in that sentence.

There are 21 other words in the sentence.

The second most frequently appearing words are "a" and "considered".

They occur twice.

A sentence decode priority could first scan for words
appearing more than once and show these words
and the number of times they appear.

Next the word which appears most frequently
could be considered the highest in priority for a lexical search.

The first identity could be the part of speech.

For "be" it would state it to be a verb.

For "a" it would state it to be an adjective.

The other 19 words could helpfully be alphabetized.

Next, they could be grouped according their part of speech class.

Next, the words could be organized
according to the number of letters in each word.

This could contribute to lexigraphic ergonomic efficiency.

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The first letter in each word can be listed:

1	Each	4 letters	E
2	word	4 letters	W
3	in	2 letters	I
4	these	5 letters	T
5	sentences	9 letters	S
6	may	3 letters	M
7	be	2 letters	B
8	considered	10 letters	C
9	a	1 letter	A
10	scalar	6 letters	S
11	data	4 letters	D
12	point	5 letters	P
13	or	2 letters	O
14	the	3 letters	T
15	sentence	8 letters	S
16	may	3 letters	M
17	be	2 letters	B
18	considered	10 letters	C
19	to	2 letters	T
20	be	2 letters	B
21	a	1 letter	A
22	vector	6 letters	V
23	of	2 letters	O
24	arrays	6 letters	A

{See original text for connecting arrows

between bolded words and numbers in above chart - incomplete}

The sentence vector can be rotated 024 1p sentences.

The longest word in the sentence has 10 letters.

The shortest word in the sentence has 1 letter.

A list can be made from 1 - 10 because there is at least one word

which has every number of letters from 1 - 10.

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1	..	2
2	..	6
3	..	3
4	..	3
5	..	2
6	..	3
7	..	1
8	..	1
9	..	1
10	..	2

Number of words .. + / 1 2 3 4 5 6 7 8 9 10

Number of words .. p vector of arrays
p scalar data points

Functions can be written by indexing the number of the word or words
in the sentences as the name of the function

e.g. word - sentence 10, 11, 12,

word - scalar data point

sentence - sentence 22, 23, 24

In order to get the vector of arrays to catenate -

each word can be given 10 spaces

since the longest word is 10 letters long.

The spaces can be assigned at one end or the other

or distributed between the two ends.

The High Level Computer Language

APL and the APL Keyboard

(while looking at the keyboard diagram)

criteria: > 9 words / phrase

> 20 syllables

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One of the two shift keys must be held depressed
in order to access the upper level symbol set.

Depressing the lock key - holds the access
to the upper level symbol set,
until it is depressed again to release it.

APL uses 141 symbols at the present.

94 of these 141 are shown by means of a simple single symbol.

56 of these 141 require a compound symbol.

Compound symbols are created by means of combining two simple symbols.

Of the 94 simple symbols, 26 are the letters of the English alphabet.

Ten of the symbols are the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

Four of the symbols are the arithmetic functions for addition, subtraction,
multiplication and division.

Forty of the 94 simple symbols are accounted for with these three sets,
the alphabet, the numerals and the normal arithmetic functions.

APL has 8 other arithmetic functions.

Five of these 8 arithmetic functions are represented by simple symbols
and three are represented by compound symbols.

APL has 11 Boolean or logical and relational functions.

Nine of these 11 Boolean and relational functions are represented
by simple symbols.

2 of them are represented by compound symbols.

Fifty four of the simple symbols are now accounted for
by adding the five simple arithmetic symbols
and nine single Boolean symbols
to the three sets making up the first 40 simple symbols.

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These 54 simple symbols are composed of the four sets:

alphabetic

numeric

normal arithmetic and APL arithmetic and

Boolean or relational.

This introduces two important concepts involved in APL:

- 1) APL has a large number of primary functions
- 2) APL uses a uniform notational method for mathematics.

The APL extended list of arithmetic functions evidence these two concepts.

APL uses a five pointed star to symbolize the function
of an exponent which raises the power of a number.

This five pointed star introduces the notational method of APL:

Conventional mathematical notation states

$$3 + 2 = 5, \quad 3 - 2 = 1, \quad 3 \times 2 = 6 \quad \text{or} \quad 3 / 2 = 1.5$$

The numerals 3 and 2 are the left and right arguments

of the 4 normal arithmetic functions, +, -, x and {symbol for divide}.

The left and right arguments are generalized to lead a and w.

APL uses one or two variables,

symbolized as a and w as left and right arguments of a function.

{Diagram - chart of symbols for APL system , 3 pages, original text

see original text for correct insertion of symbols in left margin - incomplete}

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<u>Symbol</u>	<u>Name</u>	<u>Function</u>
	dieresis	with operator
	overbar	
	less than	enclose - encode entire argument as a scalar
	less than or equal, not greater	
	not less	
	greater than	disclose
	not equal	
	inverted caret	greatest common divisor
	or caret & hyphen	lowest common denominator
	bar	negative; minus
	divide	reciprocal; divide
	plus	positive; plus; conjugate
	times	signum times
	query or	deal or roll
	question mark	
	omega	right argument
	epsilon	membership
	rho	size or reshape
	tilde	not
	up arrow	take
	down arrow	drop
	iota	index generator or index of
	circle	π or circular functions
	star	exponent or power
	right arrow	branch
	left arrow	name or assign
	right tack	
	left tack	
	alpha	left argument
	upstile	ceiling or maximum

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downstile	floor or minimum
underbar	
del	switches terminal to function definition mode and closes function
delta	
null or jot	
quote	bounds character constant
quad	system variable or system function indicator
left paren	
right paren	
left bracket	left index separator or left axis operator
right bracket	right index separator or right axis operator
left shoe	
right shoe	
cap	
cup	
base	decode monovalent dyadic with respect to radix or number base
top	encode monovalent dyadic - radix or number base
stile	magnitude or residue
semicolon	separates expressions for successive areas
colon	separates label from body of line
comma	ravel or catenote
dot	inner product operator
slope	expansion function - scan operator
slash	compression function - reduction operator
space	separates character sets or numbers
diamond	divides line into segments
nor	not or logical primary function
nand	not and logical primary function

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del stile	grade down
delta stile	grade up
circle stile	Reverse or Rotate with last axis default
circle slope	Transpose
log	natural log or log of right argument with base of left argument
I beam	line counter function
del tilde	
base null	execute vector (as a line of APL) (or scalar) w
top null or thorn	format - character representation left of argument
slope bar	expand with first axis default
slash bar	replicate with first axis default
cap null	lamp indicates balance of line is a comment
quote quad	
quote dot	factorial or binomial coefficient
domino	matrix inverse or matrix divide
dieresis null or paw	on operator
dieresis circle or hoof	upon operator
equal underbarmatch	
cent	

APL is modular. APL has operators.

Neuroscience " Spectrum viewscale

Viewscale " + / neurophysics neurochemistry, q

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q (neurochemistry biochemistry context related), q
organic chemistry, q
q neuroanatomy, neurophysiology, q
q psychology, sociology, anthropology, ecology

There are context operators.

The functions of subroutines moderate the boundaries,
the portholes, the pores, the handles of enclosed arrays.

e.g. dendrite morphology ~ surface area, number of filaments, q
q length of filaments, diameter of filaments

reaction operator due to location
reaction operator due to temporal experiences
reaction operator due to bias of synapses
reaction operator due to neurotransmitter

neurotransmitter synaptic field

del P ~ Neuroact S; Q; C; B; F; R;

- [1] s ~ + / S1,A,C,B (cap null) S is signed, S1 is set 1
- [2] Z ~ X / + / F ++/Rx/(B) (cap null) Q is qualified, B is bias
- [3] C ~ + / B1 (cap null) C is _____
- [4] B ~ + / B1, B2, B3 (cap null) B1, B2, B3 are Bias sets
- [5] F ~ + / F1, F2, F3 (cap null) F is forward bias component
- [6] R ~ + / R1, R2, R3 (cap null) R is reverse bias component

del SU - conduct N; SU; OHM, MHO, POL

[1]

{Incomplete - Due to illness, Z. P. Charnoe was unable to complete projects
related to this course during the rest of the semester}