Concurrent Roles for the Eye
(Passive 'Camera' plus Active Decoder) — Hence Separate Mechanisms?

A semi-open letter reply of 29 March 2012 to Professor István Bókkon
(with copies to some other interested parties),
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Robert R. Traill

email: rrtraill4{at}bigpond·com

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P.S. COMMENT

It seems to me that science needs to rethink the relationship between theory and experiment, and I suspect that the present study could benefit significantly from that. In fact I expect to discuss this in some detail in forthcoming papers, such as the much-postponed www.ondwelle.com/OSM07.pdf which should appear before November.

R. R. Traill,
Melbourne, 31 July 2015.

Dear Professor Bókkon,

c.c.	Amedeo d'Angiulli,	William Bains,
Michal Cifra,	Felix Scholkmann,	Jaipei Dai

Firstly, thanks to you (and to Ad'A, WB, MC, and FS) for sending-or-prompting those various relevant papers: [1–6].

As suggested from these assorted contacts, there is something in common between our two approaches to neuroscience; and I think we agree in principle that it would be useful to collaborate. The trouble is that it is not quite clear how this collaboration could take place, given that we are actually studying (i) somewhat different domains, **and** (ii) envisaging somewhat different types of mechanism; — effectively differing on two different dimensions. Thus:

		Main focus of study	
		Visual system capable of restoring images on recall. *Passive*(?) retention of images	Advanced intelligence, based on RNA(?) codes for *Action*, incl. scan, handle, draw
Mechanisms envisaged	𝕿𝖍𝖊 𝕸𝖔𝖗𝖊 𝕸𝖆𝖈𝖗𝖔: Action-potential system (cell-level), using photons ↔ images retaining their topology	**Bókkon etc.** ↔Kosslyn[7]	**?**
	𝖀𝖑𝖙𝖗𝖆-𝖒𝖎𝖈𝖗𝖔: Molecular phonons ↔ IR photons. (Links to outside via Action-potential signals)	**?** ≈Pylyshyn?? [8]	**Traill** based on Piaget [10]

When confronted with this comparison, my first thoughts were that the connection was probably too tenuous — like the separate worlds of Carpentry and Metalwork, (largely independent, even if there are useful connections to be made *post hoc*!). Since then, I have vacillated on this question, sometimes favouring the "common ground" verdict:—

After all, ●both research domains invoke the *not-yet-fashionable idea* that **photons** play an integral part in bio-activity, and ●both seek to explain an aspect of neurophysiology. But is that enough for them to be of direct *in-depth* help to each other? Or should we just be content that they both offer evidence for the importance of bio-photons? Either way, we should try to be clear about where any connection lies — tenuous or not.

At last I think I can offer some compromise explications arising out of your dilemma between Kosslyn[7] and Pylyshyn[8]!   But first consider this↓ suggested principle: *"Nature is good at providing redundant multiple techniques — but Science tends to stop looking once it has found just one of them."* (E.g. "If we have action-potentials, why consider alternatives such as photon-signalling?" Etc…— but I won't inflict my longish list on you!).

As it happens, it has long been known (though often forgotten) that there *are at least two* types of visual processing; so if we now contemplate *both*, that could account for the dilemma. Here the two systems are: **(i)** The orthodox path via the visual cortex; — plus **(ii)** the "blindsight" route via the retinotectal pathway to the superior colliculus. Also [9].

Hence it seems plausible that the Kosslyn and Pylyshyn scenarios might <u>both</u> be right — but located separately, using different mechanisms, and predominantly serving different purposes. [At this stage I am not necessarily identifying their dualism with the "(i)/(ii)" dualism above. I am just saying that we should be on the lookout for concurrent alternative systems, with some properties similar, and others perhaps different.]

Thus the **Kosslyn** model emphasizes strict retention of <u>topological</u> properties ("near" remains near, etc.) thus enabling a reasonably faithful image to be easily reconstructed *physically* (in some sense) if that ever becomes necessary.

On the other hand, the **Pylyshyn** model presumably lays much more emphasis on the <u>symbolic meaning</u> of each item within the visual field and *"what use I could make of it"* or *"How it would respond if I tried to turn it upside-down"*, etc. (I have not studied either author in any great detail; but the latter seems very close to Piaget's account which I *have* considered at length, e.g. [10,11]; and it also relates well to Darwinian principles.)

In short there is a valid case for both approaches — and we might expect their respective analyses to be cross-referenced to each other whenever the occasion (and the time) permits. Meanwhile the above table can now be tentatively modified, to give:

		Col.3	Col.4	Col.5
		Visual system **I** capable of restoring images on recall. *Passive*(?) retention of images	Visual-**II** **&/or** *Haptic* system. *Activity-codes* used to construct (image+)-*concept*	Advanced intelligence, based on RNA(?) codes for *Action*, incl. scan, introspection, symbolism, control
Mechanisms envisaged	𝔗𝔥𝔢 𝔐𝔬𝔯𝔢 𝔐𝔞𝔠𝔯𝔬: Action-potential system (cell-level), using photons ↔ images retaining their topology	**Bókkon etc.** ↔Kosslyn[7]		**?**
	𝔘𝔩𝔱𝔯𝔞-𝔪𝔦𝔠𝔯𝔬: Molecular phonons ↔ IR photons. (Links to outside via Action-potential		**Piaget &/or Pylyshyn**	**Traill** based on Piaget [10]

This table (col.4) depicts the Pylyshyn-related "Visual-II" column as a mere adjunct to the "intelligence" agenda (col.5). In fact the col.4 heading is "Visual-II &/or <u>Haptic</u>" (=sight &/or <u>touch</u>) — so arguably this "Visual-II picture" need not necessarily involve sight at all, and would be available to the blind — even though no doubt sight would still help greatly!

Consequences so far

This supports my original first thoughts, that our two set of theories did not really have much in common at this early stage. Despite outward appearances. they were considering different phenomena, and were directed to different short-term tasks. (Of course the long-term task must be to seek adequate *integration* of such separate flows of information and analysis. Hence there must be some connection subsequently, and that is one place *where we might eventually find useful collaboration* (♦[1]); but I see that as something for the future — a later development which is currently out of reach.)

Nevertheless, both approaches do apparently depend (in their different ways) on the availability and transmissibility of meaningful photon-flows. Hence the value of any studies (like[5]) which report <u>experimental</u> findings about such matters — or which simply offer relevant <u>theories</u> which might usefully be investigated, e.g. concerning •cytochrome oxidase [2,12], or regarding •coaxial-cable nature of myelinated axons [10].

In fact, it might be seen as a matter of some urgency to properly check these two "•" theories experimentally, if that is feasible. Any suggestions?

Other close scrutiny needed for my own work

My knowledge of biochemistry is somewhat limited, so my comments on such matters should at least be examined critically. E.g. the "phonon circuit" concepts of *fig.2* in [10]. Other theory-based conclusions, for which lab-investigation is now due, are explicitly listed in two appendix-tables [10,13].

So criticisms and suggestions are now welcome-and-encouraged.

Bókkon+Kosslyn, vs Pylyshyn/Piaget — Clues from the Differences!

Maybe our best hope for collective progress lies in *focussing on the differences themselves* (♦) — from which we might get a better picture of the likely "division of labour" and how the whole integrated system might be expected to function.

1. Holograms and other faithful reconstructions

You seem to imply the possible temporary close-reconstruction of original images (2D &/or 3D) within the brain — as holograms — almost like a secret "stage show". That might conceivably be feasible, though I shall explain why I tend to see it (*as it stands*) as an unnecessary "overkill" even for image-recall;
— *i.e.* effective-but-inefficient, so that a less extreme version might work just as well..

Nevertheless you might first be interested in my defence of the **"in principle" feasibility of holograms** — supporting Pribram's basic suggestion (1974) against his very-damning critics! [14, footnote 87, p.46].   Then on p.61 I suggest that while holograms themselves are little more than a complex "party trick", their underlying *phase-coordination* approach is very valuable — the basis for night-navigation during WW2 and now the basis for GPS — something to be taken very seriously.

But also note this analogy: Similar "optical interference templates" can be invoked to explain some enigmas of how the accurate shapes and sizes of ultra-micro *anatomy* are achieved [10] — these shapes being seen as actual <u>*solid structures*</u> of proteins or lipids. That contrasts with your (simultaneously valid?) reconstruction of *optical image displays.*

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[1] I shall use this "♦" symbol to mark suggested possible areas for active collaboration (including repeats!).

So why do I see the "re-staged displays" as "overkill"? Consider this parable-story: *It seems that, in ancient times, the role for written-text was assumed to be "something to be read aloud" — yet a certain scholar (St.Augustine?) astonished his viewers by apparently assimilating a written message silently — without even moving his lips!*

The question is "What is the fundamental goal? — (the *core* activity)?": and so:

"How can the system achieve this activity most efficiently, bypassing any 'obsolete' steps?" Hence: "What is the real purpose of each vision-task?" For Piaget the goal is the *intellectual meaning* in the image (rather than pictorial details as such). — But even for Kosslyn (presumably intent on reconstructing *perceived* shape-and-typology generally), this reconstruction should surely be in a form *most readily utilized* by the brain — and *arguably* that is likely to be in some semi-coded format (unrecognizable to any outside observer). Indeed any fully visible re-staging would then presumably have to be re-coded in some complex retina-like system.

To unravel the essential features here, we might best discuss them with a mathematician specializing in *topology*. Anyhow it would seem that the essential point is to keep track of proximity relationships, and (perhaps) directions, etc. [Note that here *deemed-proximities* could be "virtual" regardless of actual locations (like a fixed network of *maintained mobile-telephone linkages,* held constant despite hectic travel of its members).] Or consider a machine given the task of analysing CCT tape-footage: It would not necessarily need to "screen" the images; — it might do better just exploring what the mag.codes represent by some other algorithmic means, (incomprehensible to us mere lay mortals!).

[Note: Here I am trying to avoid invoking the more abstract Piagetian approach of the right-hand columns]

2. Passive rather than Active — Is there a reason for both?

Whereas the Piagetian systems (associated with "intelligence") are seen as based on active elements, with initiatives of their own, it seems that Kosslyn-pictorial memory must be largely *passive* — like a photographic plate — recording the (somewhat pre-processed) input in the form that it arrives. In a sense this is Lamarckian-recording, whereas the Piagetian "action first" model is essentially Darwinian.

E.g. "Darwinian" suggests that each available memory site within the cortex will "offer some *arbitrarily-preset* memory-coding which includes its own *implicit address*"! — And if such sites are actually of molecular size rather than synaptic, that implies a *huge population* of candidates to choose from, so that successful pre-made "encoding" will usually work!
Note that the immune system works on similar pre-set principles; — both evolving ≈together?
Note too, that this would explain Lashley's surprise findings that any part of the monkey-cortex seemed to be as good as any other for remembering his tasks; [15,16].
I would guess that you might find *different results* if you selectively ablated sites relevant to Kosslyn's theories! Any thought about that?

If that duplication does really exist here, (Active-and-also-Passive), then:
Is there a good bio-reason to have both? — *Perhaps* it's a matter of statistics?
I will not go deeply into the question here, but ponder this:

If I remember correctly, W.M.Elsasser defined an **"immense" number** as 10^{huge} — and maybe that covers the number of those candidate memory-codes discussed above. But now consider the number of *all conceivable complete-images*, at some reasonable degree of resolution: Could we now say that the number of possibilities is $10^{immense}$ (super-immense), and therefore no longer feasible to match with preset anticipations — rendering the Darwinian approach unworkable. The only alternative then would be some

sort of Lamarckian "photography," even though that would now need a purpose-built "camera+scanner" system.   I.e. the two "vision" tasks would *need* different mechanisms.

That is just a speculation at this stage, but it might be worth looking into???
So maybe there is room for future collaboration♦ on such points.

3. Phosphenes

Your use of the phosphene phenomenon [1] is interesting — but I don't think it can be of any direct help for my intelligence-investigations. By the same token, I currently feel in no position to comment usefully on this matter; but I wish you well for this approach, especially if it tells us more about the flow of photons (for whatever task).

4. Long Term Memory?

For the case of Kosslyn-images, I provisionally go along with your account of how LTM could be organized. However my concept of how Piagetian concepts/images are "fixed" is radically different: The initial STM concepts are supposedly constructed provisionally from more basic "schème" elements (conditionally identified as ncRNA-based) — and we would expect these STM ensembles to be *ephemeral* unless bolstered in some way.

But Piaget also claimed that progress is made by a (virtual?) *link-up* of these component schèmes through a process of "equilibration"[2] — such that they produced a *logically self-consistent concept*. As stated, that is all rather abstract. However *if* the schèmes are embodied as ncRNA, and **if** their "logical self-consistency" were to correspond to something like the development of chemical bonds (which thus conferred a new stability to the ensemble) — then that could simultaneously explain both *this type of* **LTM,** *and* **Piagetian equilibration**.
Of course there is no direct evidence yet to support this idea, but it maybe deserves further investigation as the Piagetian arm of the postulated dualism.

5. Self-Organizing Ability

That last paragraph offers a prime example of a (postulated) self-organizing system — and clearly the more an organism depends on such a strategy, the less it will need to be governed by cumbersome genetic instructions. That is the great strength of Darwinian trial-and-error strategies, especially wherever there are no pre-set instructions to be had.

Another potential example is the postulated *myelin-growth-control* by a template of IR standing waves around an axon, [10]. If that is true at all, then it seems likely that the wavelength underlying the standing wave would be related to some component of any IR signal-traffic attempting to pass along that axon. Thus the would-be signals would tend to dictate their own choice of cable-dimensions — creating them in their own likeness.

.The Lamarckian alternative is to rely on some "outside *designer*". This designer (perhaps bestowed genetically through arduous *previous* Darwinism) then needs to provide a *sophisticated ready-made mechanism* of some sort. That is what most textbooks assume, and to some extent it must be necessary. Note that there is even room for it within Piaget's theory of hierarchical stages: Thus the basic M^0L level of intelligence comes to be partially re-designed by a new higher M^1L intelligence-level — though the latter first has to *learn this re-design role* through its own Darwinian trial-and-error.

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[2] This equilibration-process is arguably the main reason for sleep in its various forms: [17: pp.17,69-70].

(This process is then seen as repeating itself recursively ($\rightarrow M^2L \rightarrow M^3L \dots$) — hence human intelligence). [11, espec. Table S, p.33].

Here the practical value of these thoughts is this: In assessing the credibility of a bio-hypothesis, we should add some marks to its score if it offers an explanation for some self-organizing process — bearing in mind that this would offer logistical economies.

6. Simpler organisms — a means to untangle the complexity?

For some (unspecified) aspects of your problem — perhaps one aspect at a time — it might be useful to consider vision-memory (including IR vision) of simpler animals.

Thus it might be worth considering **insects** [18,19,20], (especially if the photons-of-interest are in the infra-red range) — meanwhile bearing in mind:
(i) their apparent ability to "see" IR (via arrays of "aerials" rather than eyes);
(ii) the likely photon-transmitting nature of the chitin of their exoskeletons:
(iii) their relative dryness, whereas water absorbs IR emissions very readily, as you know.
(iv) circumstantial evidence that they can receive IR *without using action-potentials!*

Or even more extreme: IR-memory of **eukaryotes**! — whose centrioles appear to act as eyes capable of distinguishing direction of incoming IR-light. (Albrecht-Buehler [21]).

Conclusion

On checking my "♦" marks, I find they are all just repeating the same message: that the best area for our mutual collaboration appears to lie in our actual differences themselves! If so, then our task seems to be *"to decide on whether there really is an underlying dualism — of two rather different subsystems operating more-or-less independently on the same input — and if so, to elucidate this contrast"*.

I would welcome your opinion & criticism. Maybe you see things differently?

Kind Regards,

Robert R. Traill   rrtraill4@bigpond.com

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copies originally sent to:
   bokkoni@yahoo.com,
   amedeo@connect.carleton.ca
   william@williambains.co.uk,
   cifra@ufe.cz,
   Felix.Scholkmann@usz.ch
   jdai@mail.scuec.edu.cn