

Systematic Innovation



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The Systematic Innovation e-zine is a monthly, subscription only, publication. Each month will feature articles and features aimed at advancing the state of the art in TRIZ and related problem solving methodologies.

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Case Study: Cleaning School

In theory, keeping school buildings clean is a simple problem. On the other hand, because it involves people – especially those wonderful balls of chaos called ‘pupils’ – it turns out to be complex. As in complex-adaptive-system complex. Which in turn means that the cleanliness of buildings is an emergent property driven largely by the presence or otherwise of feedback loops. If the wrong kind of feedback loops are in play, the task of keeping the buildings clean can easily slip into a depressing downward spiral of more and more cleaner effort producing buildings that get grubbier and grubbier.

When a school finds itself in this kind of downward spiral situation, it’s a good idea to try and work out what’s driving it. The Perception Mapping process is designed to help do this job. We can make it explicitly relevant by formulating the initial question around the downward spiral issue.

Something like, ‘The school is in a cleanliness downward spiral because...’

Here are the responses we received after posing this question to a number of stakeholders:

Identifier	Perception	Leads To?
A	more activities squeezed into the day (e.g. after-school)	C
B	pupils don’t care	G
C	mess-maker doesn’t see/suffer the consequences	M
D	teachers too busy with other things	H
E	insufficient cleaning hours/shifts	P
F	not enough places to deposit waste	I
G	pupils bring in mess (dirt on feet, etc)	I
H	pupils sneak things into class	I
I	pupil pranks/blame someone else	C
J	rooms difficult to clean (chairs/tables clutter floor)	P
K	old infrastructure/not designed to be cleaned	J
L	generational shift of cleaners (lower motivation)	E
M	no incentive to be tidy	B
N	littering is a sign of control	H
O	uncool to be following rules	H
P	broken-window syndrome (one untreated problem triggers more)	M

As per usual Perception Mapping convention, the right hand column of the table contains the results of the ‘leads to’ analysis – the activity that allows problem solvers to manage the complexity of a situation by examining the relationships *between* each of the perception statements.

Figure 1 illustrates the resulting Perception Map. The Perception Mapping process forces the discovery of at least one loop, which, if the initial question is framed as a negative one, will reveal the downward spiral (or spirals) present in a situation. As may be seen from the Figure, in this case, there is one such loop. Examination of the five perception statements within the loop reveals a downward spiral stemming from not caring and no consequences. The single most significant perception within the loop is Perception ‘I’,

pranks and the passing of blame to someone else. In order to solve the overall cleanliness, then, this downward spiral has to be removed somehow.

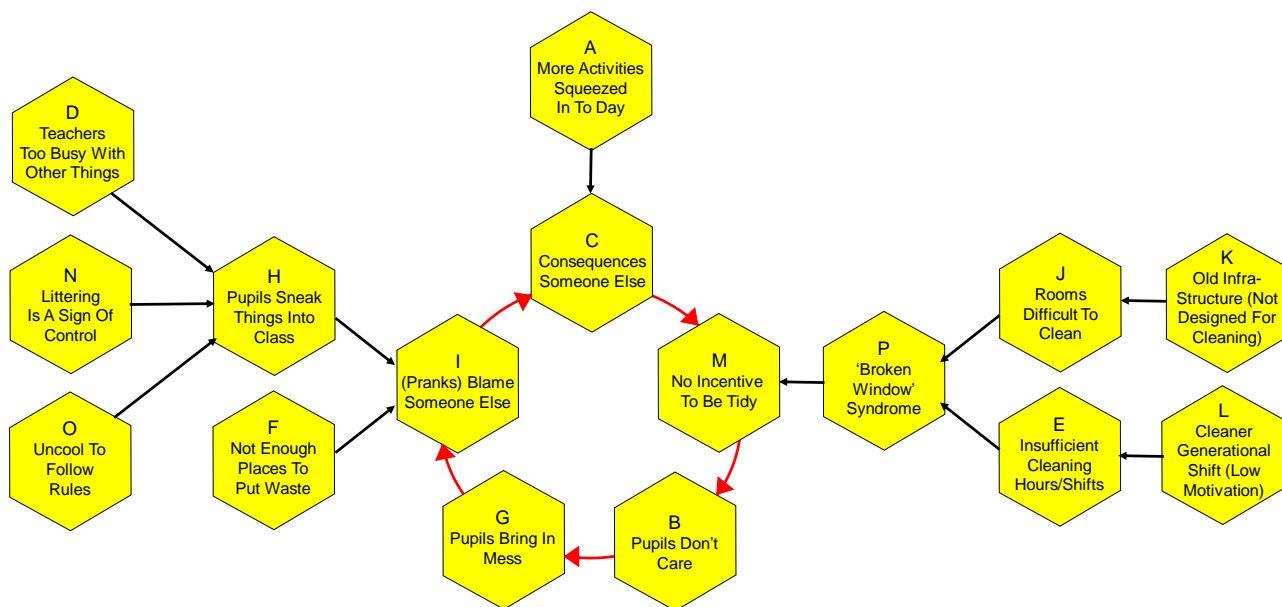


Figure 1: Perception Map Of The School Cleanliness Problem

Looking at each of the perceptions within the downward spiral, the one that appears to be the easiest one to influence seems to be Perception B, 'pupils don't care'. This might then be the perception we chose to couple with the initial problem statement to form a conflict pair we can submit to the Contradiction Matrix.

When we did this job in this case, we decided to use the new Business Matrix, and mapped the conflict as a Support Capability (i.e. cleanliness of the school) versus Engagement (i.e. pupils don't care) problem. Which gave us the following Inventive Principle suggestions:

- 2 – Taking Out
- 13 – The Other Way Around
- 19 – Periodic Action
- 25 – Self-Service

While I'm certain the answer being suggested by these Principles won't work in every school, what happened in the one where this exercise was conducted was that the cleaning staff were taken out and the pupils were tasked with making sure the school was clean. The pupils, in other words, are the ones quite literally that will clean the school at the end of the day.

What is far more generalizable is the idea that the downward spiral needs to be 'turned around' and made into a virtuous one: which is what very quickly happened at the school where the pupils were handed over the task of cleaning. If you're the person who's going to have to clean up your own mess, you very quickly learn that you can make life easier for yourself by not making the mess in the first place.

The generalization may, I think, be extended even further. Inventive Principle 13 is something that ought to be contemplated for any complex system environment in which there is evidence of any kind of downward spiral. No need for a Contradiction Matrix, the problem solvers job is to turn downward spirals into virtuous ones. And that in turn usually means using some kind of 'self-x' solution strategy.

ABC-M, SCARF And Self-Esteem As A System

In any organization, there are people that we manage, and people who manage us. Getting the most out of the people we manage – in a nice way – is the secret of good management. And sometimes, we need a way of managing our managers. And other times, we just need to be able to manage the people on, for example, a committee outside work. One way of thinking about social interactions is to use the SCARF model, which can help to make those interactions more successful.

Unlike many other motivational theories, the SCARF model is quite modern – it was first published in 2008 by David Rock (Reference 1). SCARF is an acronym, where the letters are taken from the first letters of the words:

- Status, which is about relative importance to others.
- Certainty, which concerns being able to predict the future.
- Autonomy, which provides people a sense of control over events.
- Relatedness, which is a sense of safety with others.
- Fairness, which is a perception of fair exchanges between people.

Behind all this, is the idea that our brain will make use behave in ways that try to minimize perceived threats and maximize rewards; and that the brain reacts in the same way to social needs as to our primary needs like food and water. So, if a stimulus is associated with positive emotions or rewards, you will probably approach it. But if it is associated with negative emotions or punishments, you will perceive it as a threat and you will probably avoid it.

In many senses, the SCARF model is similar in purpose to our ABC-M model. Both are trying to look at the core 'intangibles' that drive human behaviour. The fact that the two models appear – on the surface at least – to be different should give rise to an opportunity to build a better model.

Since the Autonomy-Belonging-Competence-Meaning model is probably better known to readers of this ezine (see Reference 2 if not), in order to explore the similarities and differences between the two models, it's probably appropriate to examine the SCARF model in a bit more detail. Here's a closer look at the five domains:

1. Status – this is our sense of worth, it's where we fit into the hierarchy at work both socially and organizationally. Status is a significant driver of workplace behaviour. If your boss has had his status threatened, it may help you to understand his behaviour, when you find that he's taking it out on you, if you know about this model.
2. Certainty – clarity and certainty are important. A person's brain uses fewer resources in familiar situations than unfamiliar ones. And working with a lack of clarity can increase a person's stress levels and impair their ability to make effective balanced decisions.
3. Autonomy – gives a person a sense of control over what they do. A person's brain will process the lack of autonomy as a threat situation (and this will lead to more stress), whereas being promised more autonomy actually activates the reward system in the brain.

4. Relatedness – we're social animals, and we naturally form social groups and build relationships. These groups build mutual trust and form a barrier against the unknown. This leads to the production of oxytocin, which increases the positive feeling of trust and stabilizes these relationships. It helps build the team.
5. Fairness – if a person thinks something is unfair, their brain automatically goes into defence mode. A strong response from a person that removes the unfairness can activate the reward centre of the brain.

All in all, then, there seems to be considerable common ground. Figure 1 represents our attempt to map the commonalities:

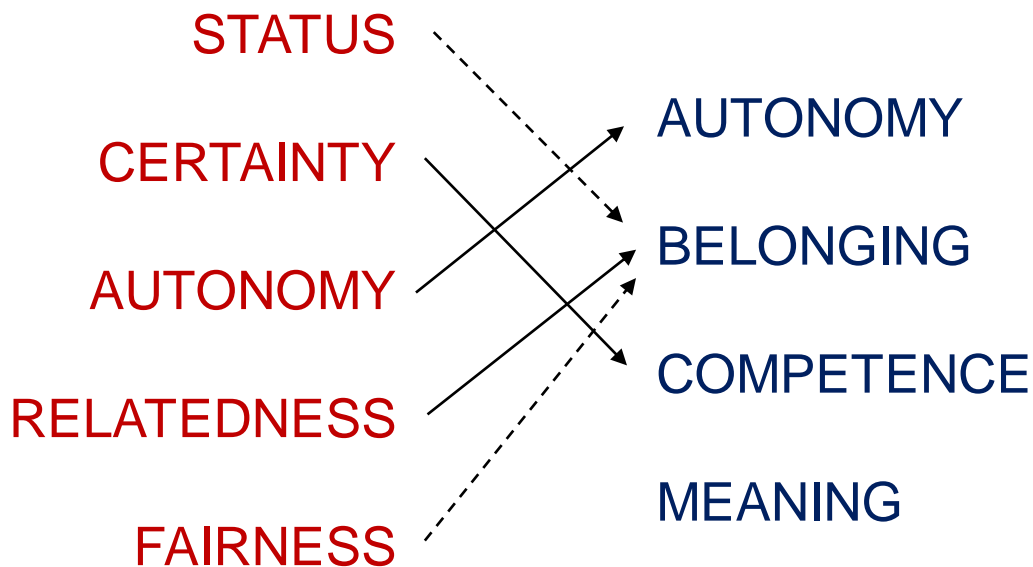


Figure 1: Mapping The ABC-M And SCARF Model Equivalences

Autonomy offers up the most direct match between the two models: our desire to be in control appears to be obvious to all. Relatedness and Belonging also seem fairly directly linked since the two words are often used as synonyms. The gap between 'certainty' and 'competence' appears slightly greater, but it still feels like they are closely allied. For those of us more familiar with the 'competence' label, pairing it with 'certainty' seems to add a new level of richness to what we mean when we talk about our ability (or otherwise) to demonstrate to ourselves and others that we are competent at things.

Therein, the similarity between the two models appears to fall down somewhat. When forced to connect the two models, it feels like 'status' and 'fairness' both feel like subsets of the Belonging need. In that a) we all recognize that the tribes we belong to all contain some kind of hierarchy, and that we usually aspire to find our place towards the top rather than at the bottom of such hierarchies (i.e. we want others to respect us, and in some ways 'envy' us, but not so much that they feel a desire to throw us out of the tribe) and, b) we use 'fairness' as the main measure of who is and who isn't deserving of membership of the tribe, and becomes the measure by which we all try and balance the conflict between our parallel desires for autonomy *and* belonging.

Finally, there seems to be nothing in the SCARF model that taps into our need for Meaning.

Which perhaps begs the question, does Meaning belong in the model? Or perhaps, the bigger question, are both of the models incomplete in some way?

If we wish to answer this kind of question, we usually need to have a think about the Law Of System Completeness. The rationale here is simple: if human beings desire 'self esteem' and expect to be able to achieve it, then will only be possible if a viable system exists to make it possible.

Here's what happens when we take both the SCARF and ABC-M models and attempt to fit them into the six essential elements of the Law Of System Completeness:

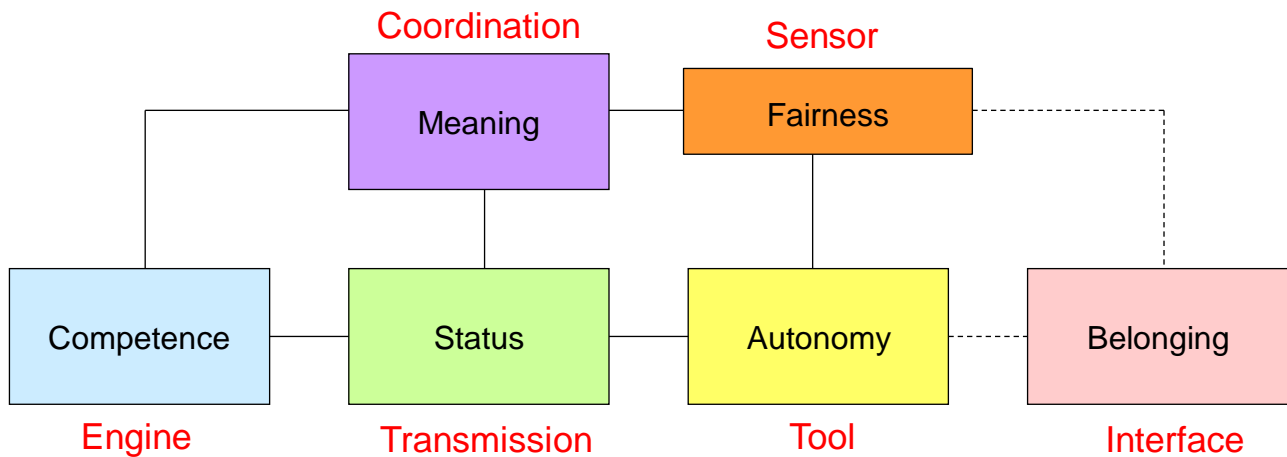


Figure 2: Law Of System Completeness For 'Self-Esteem' System

Although it feels like early days, it's also fair to say that this model appears to carry a whole new level of insight into what makes us who we are. I can sense a new PanSensic tool on the horizon. Expect to hear more about this topic in the future. For the moment, we think it needs a little time to incubate.

Reference

- 1) https://www.med.illinois.edu/depts_programs/academic_affairs/downloads/SCARF-NeuroleadershipArticle.pdf
- 2) Systematic Innovation E-Zine, 'ABC-M Landscapes', Issue 167, February 2016.

Not So Funny – Principle 2 Signs

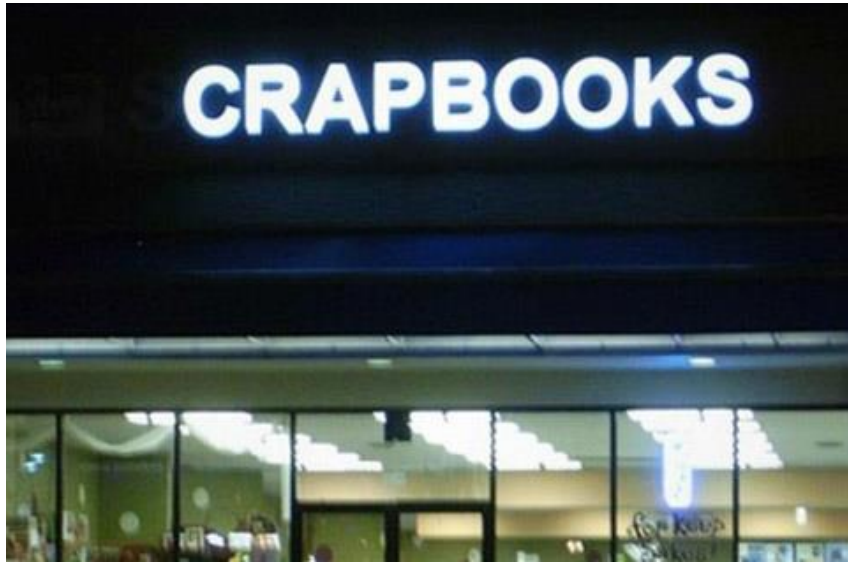
Advertising contradiction solving is easy with Inventive Principle 2:



Sometimes, it helps to Take-out more than you keep:



Take-out the 's' and create a whole new kind of bookshop:



Methinks someone has an 's' fetish:



Which can sometimes create new problems...



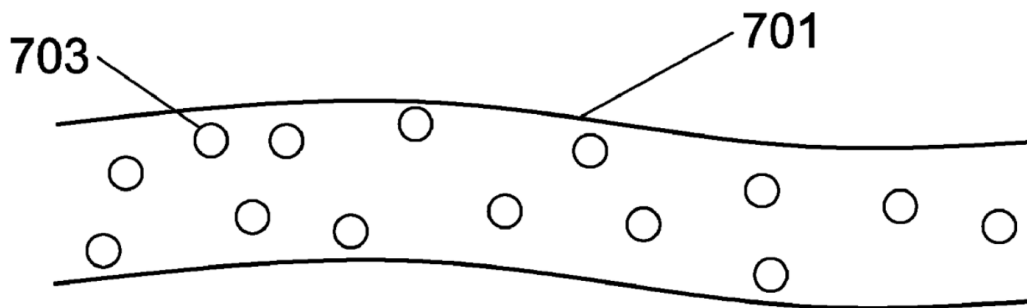
Finally, someone with the gumption to stand up and do something...



Meanwhile, I like to carry this one around with me on my travels...



Patent of the Month – Implantable Devices



Patent of the month this month takes us to a pair of inventors at the University Of Rochester in New York. US9.492,652 was granted to the pair on 15 November. Here's what the background description has to say about the problem needing to be sold:

Implantable medical devices such as stents, vascular grafts, cardiac rhythm management devices, catheters, vena cava filters, and the like, are well known. Over the years, numerous improvements to these devices have occurred. There are still, however, difficulties. For example, in-stent restenosis is a complication where there is a reclosure of a previously stenosed coronary artery. Atherosclerosis, a common disease of the arteries, occurs where fatty material accumulates on the smooth muscle of a vessel wall, resulting in the eventual impediment of blood flow. Cardiac rhythm management devices such as pacemakers and implantable cardioverter defibrillators at times require the removal and replacement of an implanted endocardial lead. This need may arise for a variety of reasons, such as growth (in the case of children), lead failures, infections, and the like. The ease of lead removal and associated risk varies with the time that the implanted endocardial lead has been in place. A t lead that has been in place for three months or less is usually easily removed. However, a lead that has been in place for a year or longer presents removal difficulties due to fibrosis and encapsulation. These difficulties are in turn associated with mortality and significant morbidity. Pacing lead removal using simple traction is straightforward and with few complications. Unfortunately, fibrous adhesions to the Lead body complicate lead extraction and require more complex extraction techniques such as invasive surgical techniques and the use of assistive tools. As contemporary leads in use today are low profile and primarily coaxial bipolar, they do not stand up to simple traction where there is significant fibrosis present and the Lead is chronically implanted as a result. Polymethane insulated pacing leads see less fibrosis than the earlier silastic leads, but chronically implanted leads are still common. What is needed is a device that prevents fibrosis in medical devices such as cardiac pacing device leads. It is therefore an object of the present invention to provide an internal medical device that prevents or reduces fibrosis. It is another object of the present invention to provide an internal medical device that prevents or reduces fibrosis without the need for an external power source. It is another object of the present invention to provide an internal medical device that reduces atherosclerotic disease and ischemic vascular events. It is yet another object of the present invention to provide a stent for transluminal implantation that reduces the occurrence of in-stent restenosis. It is another object of the present invention to provide a vascular graft with improved healing characteristics.

So, in lay-person's terms, the core problem is the need to make implanted devices be able to be easily removed for a longer period once they're implanted, and what prevents this from happening are bio-compatibility issues like fibrosis and restenosis. Here's what the problem looks like when mapped on to the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE
SELECTED:

**Duration of Action of Stationary Object
(13)**

WORSENING PARAMETERS YOU HAVE
SELECTED:

Compatibility/Connectivity (33)

SUGGESTED INVENTIVE PRINCIPLES:

10, 24, 17, 28, 11, 3

Here's what the first Claim of the patent tells us about the solution:

An implantable medical device comprising: a discrete electric field point source with an intrinsic electric charge and adapted for fastening and placement to a vessel of a living organism, the discrete electric field point source comprising an electric field generating material capable of generating a localized electric field in proximity to the discrete electric field point source without connection to a power supply; wherein the discrete electric field point source is substantially smaller than the implantable medical device.

An obvious illustration of Principle 28 methinks.

The next problem, then, is working out how to achieve the necessary field without the use of an external power source:

...the use of a piezoelectric material such as barium titanate, lead titanate, gallium orthophosphate, bismuth ferrite, sodium potassium niobate, sodium niobate, polyvinylidene fluoride, aluminum nitride, or the like. When using a piezoelectric material, layers containing conductive material such as gold, copper, platinum, molybdenum, and the like are further contained about the piezoelectric material. In such a topology, charge is created when the lead deforms such that a force is created on the piezoelectric layer that in turn creates charge. The layers of piezoelectric material and conductive material may be deposited as a film or similar structure using techniques such as chemical vapor deposition, evaporation, or the like. In the case of a piezoelectric material, internal pressure changes such as pressure changes due to blood flow and heart rhythms will cause a charge buildup in the piezoelectric structure and result in an electric field...

...In another embodiment of the present invention, an electret material is used as a layer in the lead... An electret material may be deposited or otherwise formed on or within the lead. An electret is a dielectric material that has an electric charge. An electret generates an electric field and may be used in conjunction with a metal layer or a polymer layer. There are two types of charges that create the electric field in an electret material. The first being polarization charges which are the result of the displacement of positive and negative charges within the material by way of preferential orientation caused by a strong electric field being applied while the material is in a liquid state during manufacture. The second source of charges being coulomb charges caused by an excess or deficiency of electrons over a portion of the material. These Coulomb charges generate longer range forces than polarization charges. It is also possible to generate regions of isolated charges at various locations in the material for therapeutic reasons that may be required with a given treatment regimen. Additives to the material may also improve coulomb charge storage in the material.

And finally, this choice nugget from the detailed description of the solution:

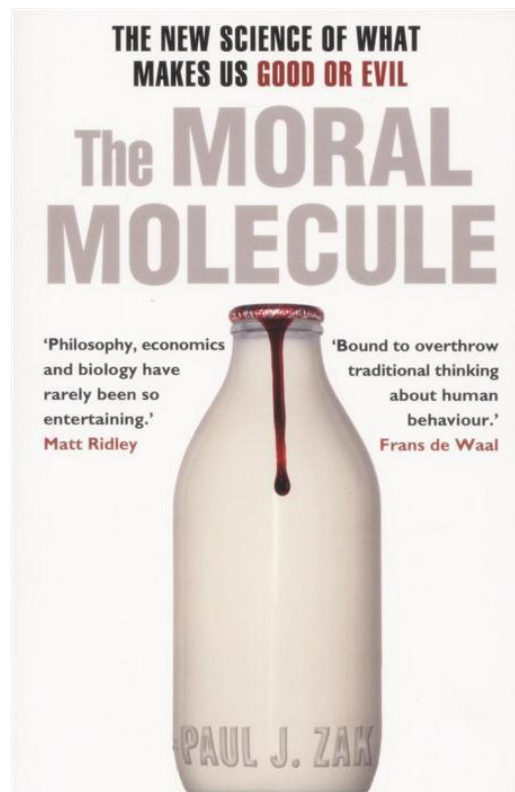
When energized, a low level electric field, preferably negative, emanates from the elongated main body lead to repel platelets and reduce fibrosis and encapsulation. The

structure may, in one embodiment of the present invention, continuously generate a low intensity electric field (up to 200 mV/cm, for example). In other embodiments, the electric field may be pulsed, sinusoidal, sporadic, or otherwise temporally patterned. The electric field may also, in some embodiments of the present invention, change polarity, gradient, strength, polarization, direction, or other parameters.

Yet again, it seems, 'the field' wins. Even more so when we learn to pulse it and localize it and point it in different directions.

It's almost like they used TRIZ.

Best of the Month – The Moral Molecule



Getting back to first principles has been one of our big themes of the year. Ditto complexity and complex adaptive systems. You don't get to successfully change a complex adaptive system unless you do it at the 'first principle' level. The challenge has been – for systems involving humans at least – to work out what 'first principles' actually means. Paul Zak's book, I think, offers up an intriguing opportunity to re-think previous understanding of the whole first principle idea. Start with the oldest and most universally recognized moral principle, codified more than 2,000 years ago by the Jewish sage Hillel the Elder: "Whatsoever thou wouldst that men should not do to thee, do not do that to them. This is the whole Law. The rest is only explanation." The explanation of morality was the subject of intense theological and philosophical disputation well before Hillel, of course, and has been ever since. Lately scientists have begun weighing in with naturalistic views of the matter, and now their cause has been joined by Paul J. Zak with "The Moral Molecule".

Mr. Zak, an economist and pioneer in the new science of neuro-economics, has built his reputation on research that has identified the hormone oxytocin as a biological proxy for trust. As he documents, countries whose citizens trust one another gain economically, enjoying a higher gross domestic product, on average, than countries where lower levels of trust exist. Mr. Zak explains that trust is built through mutually beneficial exchanges that result in higher levels of oxytocin.

How does he know this? By studying blood samples taken from participants in economic-exchange games administered by researchers as well as from people in real-world encounters. "The Moral Molecule" is an engaging popular account of Mr. Zak's decade of intense research into how oxytocin evolved for one purpose—pair bonding and attachment

in social mammals—but had the bonus effect of cementing a sense of trust among strangers.

The problem to be solved here is why strangers would be nice to one another. Evolutionary "selfish gene" theory accounts for why we would be nice to our kin—they share our genes, so being altruistic and moral has an evolutionary payoff in our genes being indirectly propagated into future generations. The theory of kin selection explains how this works, and the theory of reciprocal altruism—I'll scratch your back if you'll scratch mine—goes a long way toward explaining why unrelated people in a social group would be kind to one another: My generosity to you today, when my fortunes are sound, may pay off down the road if life is good to you and my luck has run out. What Mr. Zak has so brilliantly done is to identify the precise biological pathways through which this behavior system evolved and operates today.

"The Moral Molecule" is filled with Mr. Zak's chronicles of how he got his data, starting with a wedding he attended in the English countryside to draw the blood and measure the oxytocin levels of the bride and groom, and their parents, before and after the vows. Oxytocin's half-life is measured in minutes, so Mr. Zak had to draw 24 blood samples in under 10 minutes; the samples then had to be frozen and shipped back to his lab for analysis. The results, he says, "could be mapped out like the solar system, with the bride as the sun."

The bride's oxytocin level shot up by 28% after the vows, "and for each of the other people tested, the increase in oxytocin was in direct proportion to the likely intensity of emotional engagement in the event." Bride's mother: up 24%. Groom's father: up 19%. The groom: up only 13%. Why? It turns out that testosterone interferes with the release of oxytocin—and Mr. Zak measured a 100% spike in the groom's testosterone level immediately after the ceremony.

How far will Mr. Zak go to get his data? In the western highlands of Papua New Guinea he set up a makeshift lab to draw blood from tribal warriors before and after they performed a ritual dance. He found that the "band of brothers" phenomenon has a molecular basis in oxytocin.

But his findings show more than simple cause-and-effect when certain activities—getting married, sharing a tribal dance—produces an increase in the hormone. The presence of oxytocin itself can guide behavior. Aiming to explain "the source of love and prosperity," Mr. Zak identifies a causal chain from oxytocin to empathy to morality to trust to economic flourishing.

Many experiments that Mr. Zak has conducted in his lab, detailed in the book, show that subjects who are cooperative and generous in a trust game begin the activity with higher levels of oxytocin than other participants. And infusing the latter with oxytocin through a nose spray causes their generosity and cooperativeness to increase. Mr. Zak concludes with a thoughtful discussion of how liberal democracies and free markets produce the types of social systems that best enable people to interact in a way that puts them on the oxytocin-empathy-morality-trust-prosperity continuum.

Zak has now made provocative scientific contributions to the millennia-long discussion about the nature of morality. Theologians and philosophers are unlikely to retire from the field based on the evidence of "The Moral Molecule", but thinkers everywhere will be forced—as they are in many arenas—to consider biology in realms that once seemed strictly matters of the heart and soul.

The perennial contradictions in life – the ones between the individual and the collective, between stability and progress, and between conflict and harmony – it suddenly seems, might just come down to the ratio of oxytocin and testosterone in the atmosphere. Which suddenly feels a whole lot more solvable than many of us previously thought.

Check out the book and see what you think. Whether you agree with the conclusion or not, at the very least it's a great read and about as high on the insights-per-page index as you'll ever see from a 'management text'.

Wow In Music – Supper's Ready



The 1972 suite of songs *Supper's Ready*, from the album *Foxtrot* by English rock band Genesis was described by AllMusic as an “undisputed masterpiece”. It follows other long and structured progressive rock music, mixing loud/soft passages, extended instrumental solos bending acoustic, electric and electronic instruments, each playing a role in translating the emotion of the composition by undergoing multiple changes in time signature, key signature, leitmotif, instrumentation and mood.

According to Sarah Hill (reference below), this “allegorical 23-minute epic, abundant with references to the Book of Revelation, provides an intriguing model for the ‘concept song’, and continually confounds the listener’s expectations – lyrically, structurally, temporally and musically. One should need a deep breath in order to be taken through a journey comprised of seven episodes (or ‘tableaux’), each of which recounts a particular series of events either witnessed or experienced by the narrator: (i) *Lover’s Leap*, (ii) *The Guaranteed Eternal Sanctuary Man*, (iii) *Ikhnoton and Itsacon and Their Band of Merry Men*, (iv) *How Dare I Be So Beautiful?* (v) *Willow Farm*, (vi) *Apocalypse*, and (vii) *As Sure as Eggs Is Eggs*. Apparently, these titles do not have any inherent logic but rather delineate movements of the larger suite, an extremely creative succession of carefully crafted moments.

Peter Gabriel used to summarise the story behind *Supper's Ready* as “a personal journey which ends up walking through scenes from Revelation in the Bible”. On a ‘slightly’ longer version of this story, usually told at public performances, he said: “Old Henry went past the pet shop, which was never open, into the park, which was never closed, and the park was full of a very smooth, clean, green grass. So he took off all his clothes and began rubbing his flesh into the wet, clean, green grass. He accompanied himself with a little tune—it went like this ... Beneath the ground, the dirty brown writhing things called ‘worms’ interpreted the pitter-patter from above as rainfall. Rainfall in worm-world means two things: mating and bath time. Both of these experiences were thoroughly enjoyable to the worm colony. Within seconds, the entire surface of the park was a mass of dirty, brown, soggy, writhing forms.

"He was still pleased, old Henry, and he began whistling a tune this time to accompany himself." ... "Jerusalem Boogie' to us, perhaps. But to the birds it meant that supper was ready."

Compositional strategies that lead to centres of attraction, wow, and engagement with the audience are abundant:

Tableau	Action/effect	Josephson's 'Harmonic matrices and symphonic analogies'	Spicer's 'Large-scale strategy and compositional design'
i	Prologue; beginning of vision	A-C-E-F# to B ^b -D-F; contrasting themes represent lyrical male-female dialogue	Tonal ambiguity <i>à la</i> Schumann's <i>Dichterliebe</i> ; short cadential pattern in E major, modulating to B ^b major (#IV) in mm 6-8
ii	Rock context: first entrance of drum kit	A-C-E/A-D-F# to A-C#-E; folkish bridge leading to fanfare-like apotheosis of tableau i feminine theme	Largely A major environment with common Mixolydian progression: VII-IV-(I)
iii	Narration in 1st person plural	C-E-F# to D-F#; thematic reminiscence of tableau i culminating in toccata-style battle scene	D major jam; militaristic snare-drum figure; only stereotypical 'rock-sounding' electric guitar solo in song
iv	Narration in 1st person plural; absence of rhythm section; recitative-like vocal line	C-E-F#-A; static slow movement	Tonal ambiguity, though vague G major environment: IV ⁷ -VII ^{♭4/3} ; I ⁷ -#IV ^{4/3}
v	Babylon; 12/8 metre	A ^b ; scherzo with trio (and repeated scherzo)	Large ternary form; A ^b minor tonality; Phrygian bass figure
vi	3rd verse marks end of vision/return to material from tableau i; dense texture; 9/8 metre	C-E-F#-A to B ^b -D-F; folkish bridge leading to toccata-like climax and recall of tableau i feminine theme	Harmonic, rhythmic structures similar to 'Augurs of Spring' from <i>The Rite of Spring</i> ; E-F#-B pattern underscoring 'Emersonian' organ solo; tonality modulates from E to B ^b major at return of tableau i refrain
vii	Epilogue; lyrical passages taken from Revelation	A-C#-E-F#; recapitulation of tableau ii apotheosis and tableau i harmonies; A major catharsis	'the most explicit intertextual reference of the entire piece: a recasting of William Blake's "Jerusalem";

From tonal ambiguities, several modulations and the use of different modes and tonalities, to the use of militaristic drum figures, a wealth of other resources follow throughout the entire suite. You will also find references to classical music such as Stravinsky's *Rite of Spring* and William Blake's *Jerusalem*.

Throughout the 23 minutes the listener is exposed to a panoply of unexpected moments. Musical expectations that are confounded. Contradictions created and resolved. And then we come to the end:

Apocalyptic literature 'envisages eschatological salvation'. The arc of 'Supper's Ready', which leads the listener through various battles and stages of spiritual uncertainty, is designed to offer the listener hope at the end of the final battle of good and evil. At the moment of final judgment, the lovers are returned to each other's arms, and everything is 'going to work out fine'. That cycle seems to have reached closure: we are back in familiar musical terrain; where there were two voices there now is one, and the angel of Revelation is signalling an end to worldly troubles. Surely this is the end of the epic? Well, yes and no. Yes, because we've been brought to what we hear as a lyrical and harmonic resolution of the 22 preceding minutes; no, because we have also been conditioned to expect a brief lull in the action before the commencement of another phase in the cycle.

Furthermore, the album's liner notes leave us dangling in a rather unusual way. Between the final line of text, 'to take them to the new Jerusalem', and the album credits, we have '(CONTINUED)'. Compounding this lyrical inconclusion, rather than allowing their listeners a properly religious, final plagal cadence, Genesis opt again for a fade-out. This is in one sense satisfying – the implied endlessness of this musical ending is akin to the *et in saecula saeculorum*, amen of so many liturgical works, and the listener therefore envisions the New Jerusalem as the 'world without end'. But maybe '(CONTINUED)' implies something altogether different. The end of 'Supper's Ready' does something towards changing our understanding of the beginning of the song: as one reviewer described, it 'frankly transfigures the events in which they were immanent'. The listener was not aware, as Gabriel 'walked across the sitting-room', that he would ultimately be led to the New Jerusalem. But the lack of closure – the characters are still in motion as the music fades away – is essentially a more realistic way to end an allegorical story, albeit one based on an actual experience. Loose ends may seem tied up, but the listener's interest is piqued by the further implications of '(CONTINUED)', of 'what happened next'. The final contradiction remains unsolved.

If you want to know more about Supper's Ready, here is a YouTube video:

<https://www.youtube.com/watch?v=szJq1lwnkNw>

And the excellent analysis by Sarah Hill:

Hill, S. (2013) 'Ending it all: Genesis and Revelation', *Popular Music*, 32(2), pp. 197–221. DOI: 10.1017/S0261143013000044.

Enjoy!

Investments – Water Seer



A new device that relies on simple condensation to collect clean water from the atmosphere promises to provide up to 11 gallons of safe drinking water without an external power source, greenhouse gas emissions, or adverse environmental impacts. What's more, the innovative Water Seer collection device could potentially run forever, gifting generations of people with access to 'liquid gold' in areas of the world where a harsh climate or lack of infrastructure make access to clean drinking water a major problem. Water Seer is powered by a simple wind turbine, and the device could easily be the first step toward a sustainable, enduring solution to water shortages around the world.

The Water Seer device is planted six or more feet into the ground, and soil is then packed around its metal neck. The top of the Water Seer holds a vertical wind turbine, which spins internal fan blades to draw air into the subterranean chamber. Because the underground chamber portion of the Water Seer is cooled by the surrounding earth, water condenses in the reservoir to create a sort of an artificial well, from which people can draw clean, safe drinking water around the clock.

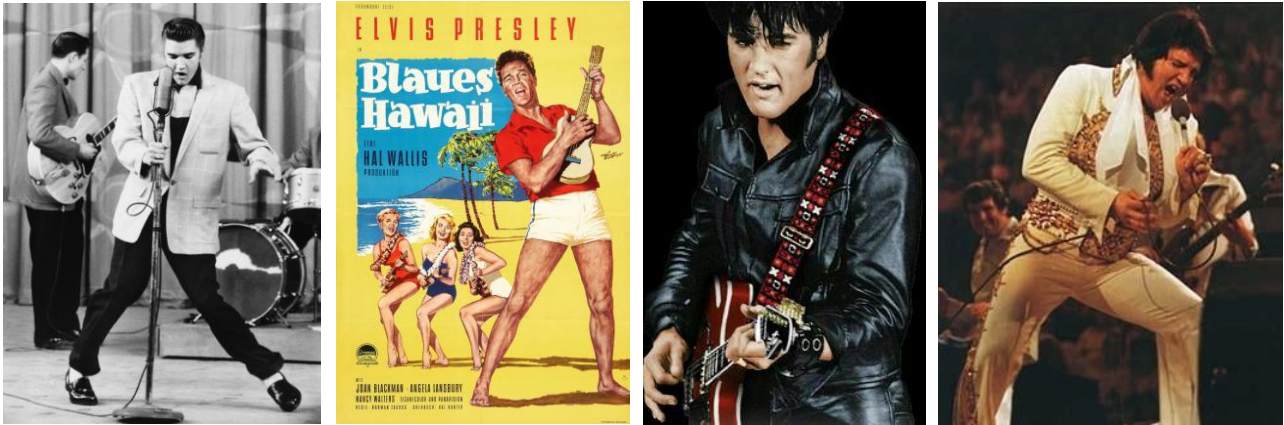
The low-cost device was developed by VICI-Labs, in partnership with UC Berkeley and the National Peace Corps Association, as a possible solution for the 2.3 million people on the planet who lack regular access to safe drinking water. The not-for-profit company will match US purchases of each unit by donating a Water Seer collection device to those in need living in developing countries or in arid climates.

Water Seer launched an Indiegogo campaign to raise \$77,000 to build "orchards" of water collection devices around the world. The device has already been tested as a prototype, and the latest model was finalized in August 2016 and will undergo field tests with the National Peace Corps Association once the crowdfunding campaign closes.

Find out more and see a video here:

<http://inhabitat.com/wind-powered-water-seer-produces-11-gallons-of-clean-drinking-water-from-the-air/>

Generational Cycles – The King



Elvis Aaron Presley (January 8, 1935 – August 16, 1977) was an American singer and actor. Regarded as one of the most significant cultural icons of the 20th century, he is often referred to as "the King of Rock and Roll", or simply, "the King". When trying to explain the reasons for his enduring appeal, it starts to become clear that it has a strong generational effect. Elvis means something different to different people. So much so that it feels like there wasn't one Elvis, there were four.

Elvis I – (1954-8) – pre-Army Elvis was 'Elvis-the-Pelvis', the dangerous entertainer that could only be shown on TV from the waist-up, the heart-throb of the second half of the generation of Suffocated 'Silent Generation' Artists.

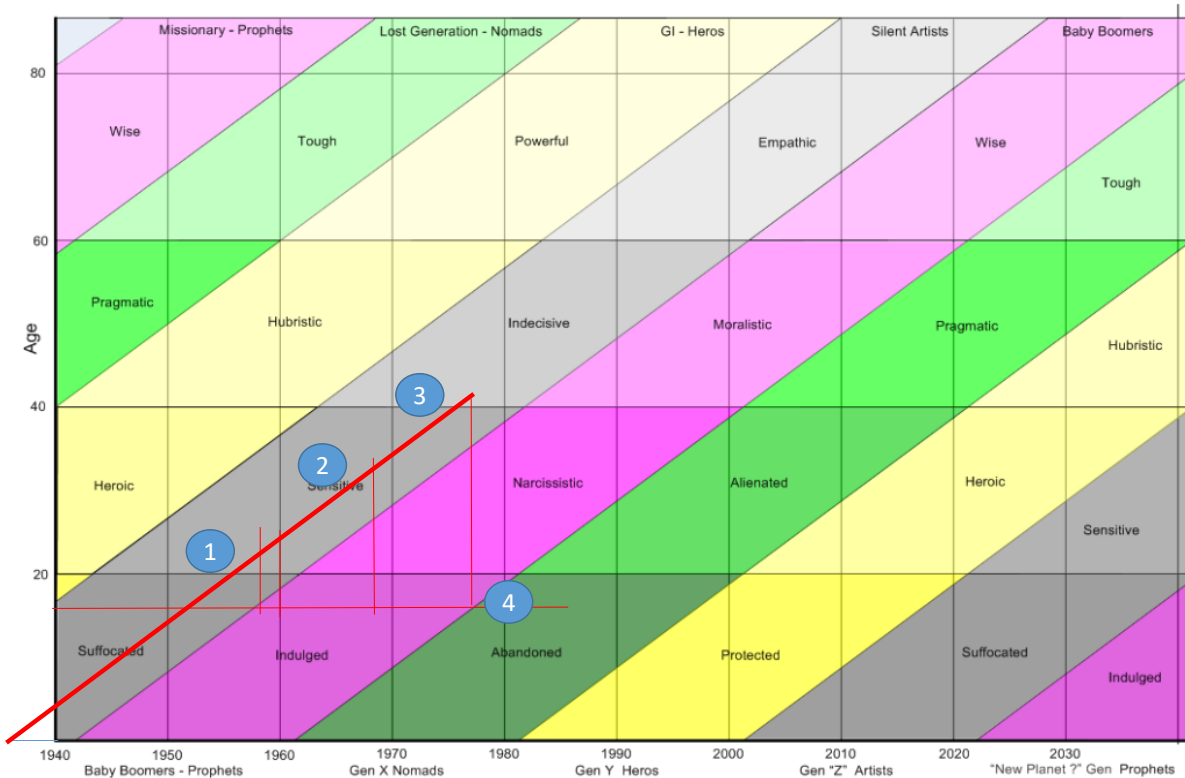
Elvis II – (1960-7) – Bad-Movie-Elvis. Elvis joined the US Army in 1958 and effectively put his career on hold until he received his honourable discharge in 1960. At which point his Hubristic-Hero-Huckster manager, Colonel Tom Parker convinced Elvis that his future was in the movies. In fairness, the first couple of films were pretty good. The next forty were, to put it mildly, 'critically derided'. Not that that stopped them from being successful. The new generation of Baby Boomer Prophet teenagers needed something to spend their money on, and Elvis singles and films seemed to fit the bill.

Elvis III – (1968-73) – Rocker-Elvis – by 1967, even Elvis himself had grown sick of his 'travelogue' movies. Parker had dragged him away from his musical roots and the kids had moved on to 'real' music. The Beatles, Rolling Stones, The Who were where it was at. It was time for a re-invention. The 1968 comeback concert, with a leather-clad Elvis, brought him a whole new fan-base. The second half of the Baby-Boomer Prophet wave. Suddenly it was cool to like The King again.

Elvis IV – (1974-7) – Las Vegas Elvis – the new-found surge in Boomer interest was bound to come to an end. The Nomads were coming. Punk rock. In any event, Presley's attempted escape from Parker was short-lived. The Colonel encouraged Elvis to make the fans come to him by taking up long-term residencies in Las Vegas. Out goes the black leather, in come weight-gain, over-prescribed medication and white jump-suits. This was a difficult Elvis to like unless you'd been brought up with him at the Elvis I or II phases and had stuck faithfully by. When The King died in less than salubrious fashion in 1977, it was all over. Except for what happened when John Lennon was asked by the media to make a comment on Presley's death. His usual acerbic response was to declare that the real Elvis had died the day he joined the Army. The words unlocked the door for the authenticity-

seeking Nomads to re-visit Elvis I... the 'real' Elvis. And another new cohort of fans is brought on board.

Here's what that looks like on the GenerationDNA map:



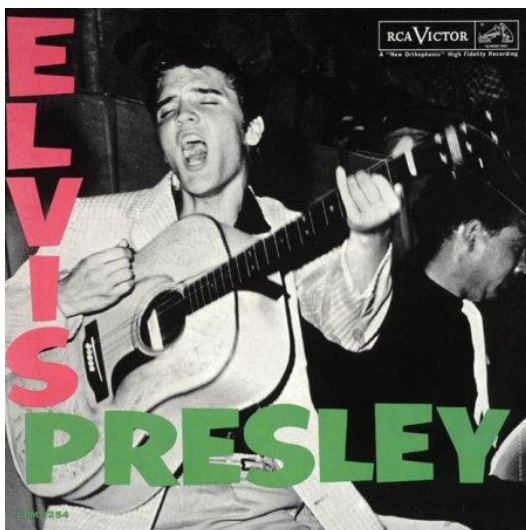
Simple when you know how.

Here's the summary:

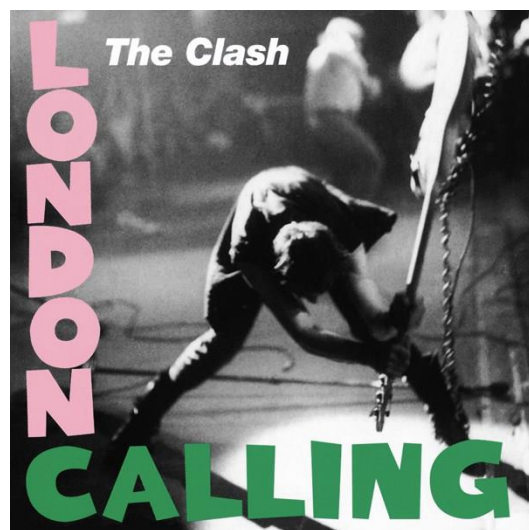
Artist (Silent) Generation – remember Elvis (I) as the hero of their youth.

Boomer Prophets – remember the white jumpsuit Elvis (any jumpsuit-wearing Elvis impersonator is guaranteed to be from this cohort)

Nomads – thank Lennon for giving them permission to go back and admire Elvis I (and see Colonel Tom Parker as Public Enemy Number One). Highly symbolic moment:



Elvis Presley debut album (1956)



The Clash, London Calling album (1979)

As for the subsequent Generation Y Heroes and the current Generation Z Artists, their main awareness of The King is most likely to come from their grand-parents. Which means that Elvis is a usually a man in a rhinestone-covered, gleaming white jumpsuit. Amen.

Biology – Phytochromes



Farmers and gardeners have known for hundreds of years how responsive plants are to temperature: warm winters cause many trees and flowers to bud early, something humans have long used to predict weather and harvest times for the coming year.

The latest research pinpoints for the first time the molecular mechanism in plants that reacts to temperature - often triggering the buds of spring we long to see at the end of winter.

Researchers have revealed that molecules called phytochromes - used by plants to detect light during the day - actually change their function in darkness to become cellular temperature gauges that measure the heat of the night.

The new findings, published today in the journal *Science*, show that phytochromes control genetic switches in response to temperature as well as light to dictate plant development.

At night, these molecules change states, and the pace at which they change is "directly proportional to temperature" say scientists, who compare phytochromes to mercury in a thermometer. The warmer it is, the faster the molecular change -- stimulating plant growth.

With weather and temperatures set to become ever more unpredictable due to climate change, researchers say the discovery that this light-sensing molecule moonlights as the internal thermometer in plant cells could help us breed tougher crops.

"It is estimated that agricultural yields will need to double by 2050, but climate change is a major threat to such targets. Key crops such as wheat and rice are sensitive to high temperatures. Thermal stress reduces crop yields by around 10% for every one degree increase in temperature," says lead researcher Dr Philip Wigge from Cambridge's Sainsbury Laboratory.

"Discovering the molecules that allow plants to sense temperature has the potential to accelerate the breeding of crops resilient to thermal stress and climate change."

In their active state, phytochrome molecules bind themselves to DNA to restrict plant growth. During the day, sunlight activates the molecules, slowing down growth.

If a plant finds itself in shade, phytochromes are quickly inactivated - enabling it to grow faster to find sunlight again. This is how plants compete to escape each other's shade. "Light driven changes to phytochrome activity occur very fast, in less than a second," says Wigge.

At night, however, it's a different story. Instead of a rapid deactivation following sundown, the molecules gradually change from their active to inactive state. This is called "dark reversion."

"Just as mercury rises in a thermometer, the rate at which phytochromes revert to their inactive state during the night is a direct measure of temperature," says Wigge.

"The lower the temperature, the slower phytochromes revert to inactivity, so the molecules spend more time in their active, growth-suppressing state. This is why plants are slower to grow in winter.

"Warm temperatures accelerate dark reversion, so that phytochromes rapidly reach an inactive state and detach themselves from DNA - allowing genes to be expressed and plant growth to resume."

Wigge believes phytochrome thermo-sensing evolved at a later stage, and co-opted the biological network already used for light-based growth during the downtime of night.

Some plants mainly use day-length as an indicator of the season. Other species, such as daffodils, have considerable temperature sensitivity, and can flower months in advance during a warm winter.

In fact, the discovery of the dual role of phytochromes provides the science behind a well-known rhyme long used to predict the coming season: Oak before Ash we'll have a splash, Ash before Oak we're in for a soak.

Wigge explains: "Oak trees rely much more on temperature, likely using phytochromes as thermometers to dictate development, whereas Ash trees rely on measuring day length to determine their seasonal timing.

"A warmer spring, and consequently a higher likeliness of a hot summer, will result in Oak leafing before Ash. A cold spring will see the opposite. As the British know only too well, a colder summer is likely to be a rain-soaked one."

The new findings are the culmination of twelve years of research involving scientists from Germany, Argentina and the US, as well as the Cambridge team. The work was done in a model system, a mustard plant called Arabidopsis, but Wigge says the phytochrome genes necessary for temperature sensing are found in crop plants as well.

"Recent advances in plant genetics now mean that scientists are able to rapidly identify the genes controlling these processes in crop plants, and even alter their activity using precise molecular 'scalpels'," adds Wigge.

"Cambridge is uniquely well-positioned to do this kind of research as we have outstanding collaborators nearby who work on more applied aspects of plant biology, and can help us transfer this new knowledge into the field."

From a contradiction-solving perspective, the evolution of a dual function (Principle 15) phytochrome represents an elegant solution to a productivity-versus-adaptability conflict. It also looks like a very nice example of an evolutionary jump along the Mono-Bi-Poly trend – a molecule that evolved to perform one (light-sensing) function, taking on a second (temperature sensing) function that – very efficiently – acted upon the same growth accelerating/decelerating response function.

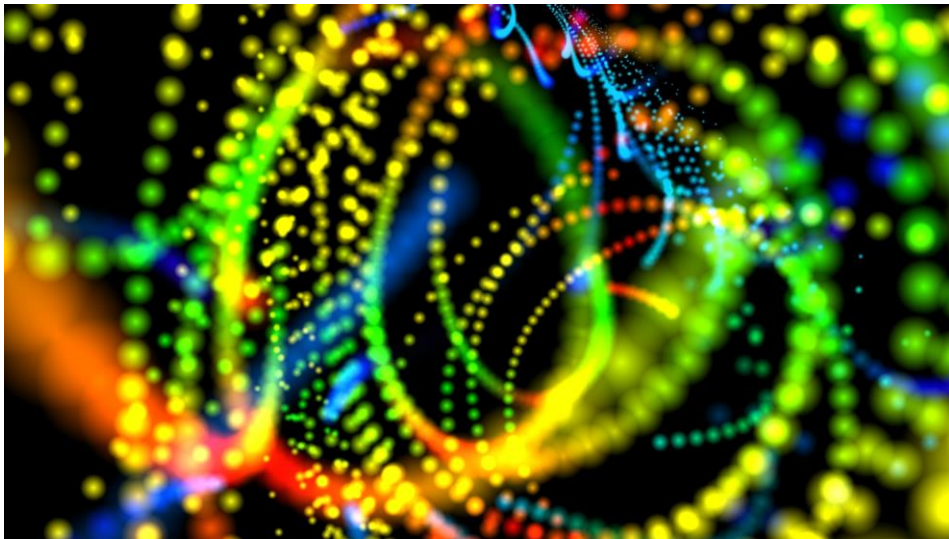
Journal Reference:

J.-H. Jung, M. Domijan, C. Klose, S. Biswas, D. Ezer, M. Gao, A. K. Khattak, M. S. Box, V. Charoensawan, S. Cortijo, M. Kumar, A. Grant, J. C. W. Locke, E. Schafer, K. E. Jaeger, P. A. Wigge. **Phytochromes function as thermosensors in Arabidopsis**. *Science*, 2016; DOI: [10.1126/science.aaf6005](https://doi.org/10.1126/science.aaf6005)

Short Thort

“In like manner, if I let myself believe anything on insufficient evidence, there may be no great harm done by the mere belief; it may be true after all, or I may never have occasion to exhibit it in outward acts. But I cannot help doing this great wrong towards Man, that I make myself credulous. The danger to society is not merely that it should believe wrong things, though that is great enough; but that it should become credulous, and lose the habit of testing things and inquiring into them; for then it must sink back into savagery.”

William Kingdon Clifford



“There is nothing more deceptive than an obvious fact.”

Arthur Conan Doyle, The Boscombe Valley Mystery

News

TIES

Darrell will be presenting two one-day ‘TRIZ For Schools’ workshops at the prestigious TIES Educator Conference in Minneapolis during December. The workshops will take place on the 12th and 13th of the month. More details and booking at the conference website: <http://ties2016.ties.k12.mn.us/>

India

Darrell’s next trips to India look like they will be the weeks beginning 20 February and 27 March. Cities to be visited will probably include Mumbai, Pune and Bengaluru. About half of the available dates are already committed, but if you’d like to have him come and do something with you, there is currently some available time. Speak to Darrell directly to explore possibilities.

University Of Warwick

Academic accreditation of TRIZ continues to expand in the UK. We are happy to announce that the University of Warwick has just approved a 10credit TRIZ certification module based on our SI curriculum for their Masters degree programme. The first week-

long session looks like it will be scheduled for the second quarter of 2017. More details as the relevant calendars crystallise.

DTU Managing For Growth

It looks like a new cohort of MfG delegates will embark on the prestigious 100-day programme at the Danish Technical University Business School, starting in early 2017. Darrell will be over at the University to teach the two-day Voice-Of-Customer-Voice-Of-System workshop on 27 and 28 February. More details at the Business School website.

New Projects

This month's new projects from around the Network:

- Agriculture – TrenDNA study
- Utility – TrenDNA study
- FMCG – PanSensic study
- FMCG – New Product Development Fuzzy-Front-End project
- IT – SI Certification Workshops
- Automotive – ICMM assessment & Journey planning
- Automotive – SI workshops
- Construction – Innovation Strategy workshops
- Utility – SI workshops
- Pharmaceutical – SI workshops