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In this month's issue:

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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Teaching The Different Spiral Dynamic Levels

A few months ago we featured an article highlighting the experimental findings of Spiral Dynamics founder, Dr Clare Graves, on a series of experiments to determine if there was any correlation between thinking-modes and creative problem solving ability ('Some People *Are* More Creative Than Others', Issue 64). The article sparked a lot of reader response along the lines of 'how does this knowledge affect the way I teach TRIZ?' This article is an attempt to begin answering that question.

The majority of the article reviews what Clare Graves had to say on the subject of teaching anything to people centred at each of the eight main thinking modes. Following this review, we will present a summary of implications and suggestions for the specific teaching of TRIZ and Systematic Innovation. First up though, a stroll through the different modes:

Beige: Survival Mode
(Virtually no Beige in the Workforce)
This thinking mode is akin to Maslow's first hierarchy level. There is little more awareness than the problems of sustenance, illness, reproduction & disputes, and so any kind of education or training needs to be based on a *Nurturant* model:

- Provide unencumbered ministration to the imperative, periodic, psychological needs
- Sustenance must be provided
- Failure to nurture will result in death of the managed.

Speaking frankly, this person is highly unlikely to either be at work, or, more specifically, in your TRIZ session.

Purple: Tribal Mode
(Not much Purple in the Workforce ~1-5%)
Will work hard and long when properly managed and the work is not negated by their superstitions or taboos. Education and training needs to be built around a *'Friendly Parent'* model:

- Require close and immediate supervision: The manager must accept and accommodate the Purple way of life, guiding by becoming a role-model through adopting their way of thinking and acting, making work fun and pleasant
- The Feudal thinker must be isolated from anyone who will not accept their way of life, who scoffs or is competitive
- To a degree BO's can be "negatively motivated" by the use or threat of force – so long as it doesn't come in to conflict with strong second level taboos.

Red: Feudal Mode
(around 10% of adult population)
('The hardcore, the rough, tough unemployed' in Graves' words)
A Red subordinate knows how to do the job, shows pride and personal ability in the task, and has to feel free to come and go as desired. There is a problem, however, in that Red's egocentrism & short attention span won't allow him to hold himself in long enough usually to let someone else finish a sentence. They normally have attempted and failed to get into "our world" and are now absolutely, firmly convinced that the whole world is organised to keep them out. Work, education and training needs to be built around a *'Tough Paternalistic'* model:

- Wherever a Red centred thinker works, the work must be organised to suit that person or you will lose them.
- Every person brought in to administer an education program must understand how to work with Red people and provide them with an ongoing positive experience.
- Short attention span means Reds need work variety: Package at least 5-7 activities in 15-20 minute units. Highly structured lessons with the teacher moving promptly between each.
- Closely prescribed limits of behaviour are a necessary part of any training programme.
- The educator/trainer must establish and uphold a tough, competent, 'no-fool' image or the subordinate will do exactly as they please.
- The educator/trainer assigns tasks in this "tough" manner – providing: enough detail to define the end results, limits to subordinate discretion, and a completion date. He then keeps out of things unless asked.
- The educator/trainer's trust should be based on performance or he will lose respect and the Red thinker will try to take advantage. The teacher, therefore, never admits a mistake.
- Teacher stops undesired behaviour and/or errors but never discusses it or punishes for its happening. They must be dispassionate and candidly say "I told you not to do that", refusing to discuss it, never punishing and then rewarding positive responses.
- Red thinkers are egocentric, impulsive and hedonistic – for them the best answer to any problem is the one that brings immediate pleasure, regardless of what happens to anyone else. Positive responses are rewarded ASAP

Bear in mind across all of this that in his career, Graves worked a lot with criminal – and therefore largely Red – minds. His conclusion was that it was almost impossible to teach these thinking types anything.

Blue: Order Mode
(around 30% of adult population)
Blue thinkers believe the role of each human is predestined. That people are born into classes of unequal rank, with those born with more have the vested responsibility to supply the needs of others and regulate them through fatherly concern. They choose

autocracy, not democracy. Work, education and training needs to be built around either a *'Paternalistic'* or '*Benevolently Authoritarian/Moralistic Prescriptive'* model:

- Provide the routine, structure the task, define and clarify the regulations and represent the organisation
- Rules are prescribed for everyone and all things – security comes through sacrifice and submission
- Failure to teach Blue consistently with their expectations results in work deterioration. If the teacher is perceived to not be fulfilling the proper role of providing order and regulation, it becomes the duty to unseat that teacher. This will tend to be done through neurotic or psychotic behaviour or unconscious sabotage of the productive effect.
- Watch the student until you find an environment that they are in equilibrium in – then do not vary from this environment; they need a predictable work setting.
- When attempting to get the student to do something new, the authority must suggest the shift, accepting that the Blue will at first reject the idea. The authority must quietly insist Blue considers it and consistently supervise the change once they finally accept it.
- If you begin to get negative manifestations, backtrack as fast as possible to try and find out what you are doing to cause the negative reaction.
- Blue believes the biggest sin you can do in this world is to question authority. The curriculum must build on what the person believes and must not be so difficult that students aren't able to achieve a 'successful' outcome.
- Blue learns best when punished for doing the wrong thing; establishing strict guidelines and then stopping negative behaviour/errors as they happen.
- Blue also learns best through rote repetition and instruction.
- Woolly or vague 'answers' at the end of exercises will be viewed with disdain.
- The instructor must be a respected authority, e.g. the highest academically qualified rather than the tutor with the greatest expertise.

Orange: Scientific Mode

(around 30-40% of adult population)

('They see life, and thus learning, as a game that has precise rules that if mastered will enable them to win' in Graves words)

Orange thinkers tend to see themselves as superior to and as the organiser of the productive energies present in lesser men. They are convinced they engineer human behaviour. As such, rules and regulations have no inherent sanctity to Orange, and will be manoeuvred as the situation requires. Orange thinkers expect compensation as a result of accomplishment. Job and education situation should allow considerable flexibility and opportunity for individual initiative. Work, education and training therefore need to be built around a '*By Objectives'* model:

- Expression of ambition must be controlled. The teacher should always be discreet and never too trusting.
- Employ a system of control which prescribes that managerially determined ends and means are proper and that it is necessary to accomplish organizational goals through coercion, reward and threat.
- Education often viewed as a bargaining situation. Three essential items, therefore: A) rewards, B) sanctions, C) defined boundaries with latitude within the boundaries. Goals and objectives need to be shown to the student along with the associated rewards for their accomplishment. Once the rewards are deemed 'acceptable', the boundaries must be clearly communicated. The teacher must not then tolerate boundary violation. Once the bargain has been made, Orange is self-managing and

prefers not to be controlled. The only supervision required is to check for boundary violation.
- Major motivating factors: The patterning of stimulation, changing and challenging ideational content, and the degree to which the outcomes meet the person's expectations.
- Doesn't have to be tied to need and immediate rewards if Orange is allowed to control his own learning. Visibility of some form of longer term justification and benefit will, however, always be helpful.
- The individual must be allowed to experience things for him or herself in order to learn. Working through prescribed menus of options is a good way to get Orange exploring within a range and 'making their own mind up' about which is best.
- Competitive learning between individuals or teams is likely to be successful if adjudication means are demonstrably fair.
- There should be an opportunity for Orange to present what they have learned back to others – they, in effect, becoming the teacher.

Green: Communitarian Mode
(around 10-20% of adult population)
Green thinkers believe in belonging, adjusting and togetherness. An increasingly frequent problem inside organisations and education establishments is that many managers and educators are forced to remain at the Order and Scientific thinking levels, while their subordinates and students are likely to have moved on to Communitarian modes. This discrepancy can cause a lot of conflict, confusion and cynicism inside those organisations. Looking beyond this potential problem area, the Green thinker's energy is heavily consumed in the fear of being disliked. Unlike the Blue person, they don't believe it is a moral duty to do their best, nor does they believe that the work is the measure of the man as is the case at Orange. The Green thinker must be socially motivated through his or her group. The new big danger emerging from this model is that the group become enamoured with the group decision-making process and nothing ever gets done. Work, education and training for Green needs to be built around a '*Participative/Collaborative'* model:
- Green wants to work *with* the teacher, leader, manager, etc ('Organisations will prosper when all play a role in the education process')
- The teacher must be open to the group's values and become a group member – they have the equal 'right' as a group member to offer suggestions as to what the group should consider or do. Consensus, majority rule and sensitivity training are valued.
- Teacher must be open and nondirective and ready to go along with what the group decides is the best course of action.
- If the group process slows, Green slows their work pace and turn to satisfy their social needs. While this won't increase human effort in the group unless the group puts itself under more pressure, it will keep effort from deteriorating more.
- Worst case: teacher is negatively non-group, viewing the Green state as evidence of people "going soft" and then attempting to combat it through directive, authoritarian management. Result: Passive resistance causing productivity and performance to tumble.
- Green thinkers will judge for themselves whether the teacher has expertise. If they are deemed not to have it, they're not going to get anywhere.
- The teacher must respect the Green thinker as an equal, just without the expertise that the teacher is trying to share. They must use a methodology of openness, candidness and honesty.

- The teacher is needed to provide the framework for thinking that the person lacks.

Yellow: Holarchy Mode and **Turquoise: Holistic Mode**
(collectively <1% of adult population)
Yellow thinking mode seeks a sense of personal competence. Thinkers at this level believe that they should make the decisions wherever they are competent to make it, and believe that the most capable in the prevailing context should be the leader/teacher in that context. Both Yellow and Turquoise are highly self-directed and will avoid any type of relationship where others try to dominate. Neither is motivated by threat of coercion, by pecuniary motives beyond a certain point, nor by status or prestige symbols and often not by a need for social approval either. Work, education and training for Yellow and Turquoise needs to be built around an '*Exploratory/Big-Picture'* model:

- The teacher is largely there to provide an initial road map defining where the group is trying to get to. The group will then best be left to determine how and who will be responsible for the journey. The teacher's responsibility then is to facilitate accomplishment of the goals.
- The organisation and management must be open, transparent and honest. 'Full disclosure' of facts and holes is important.
- The teacher's role is also to rework the structure so that goals are achieved, utilizing people as they are, not as someone wishes or perceives them to be.
- It is useless to try to get the Yellow thinker to subordinate their desires to those of the organisation. If they cannot get the acceptance they desire, they will build a non-organisational world for themselves, retire into it, do a passable but not excellent job, and wait for managerial change to occur.
- Yellow thinkers are reluctant to 'waste' their precious energy until a valid reason has been given and the freedom to do things as they like has been granted.
- Once 'interested' and engaged, there is nothing that Yellow and Turquoise think they cannot achieve. Apparently impossible engaging challenges are the dream of these thinkers.
- Although Graves had a lot less data on Turquoise, an important distinction with Yellow is that this thinker has a more finely tuned sense of intuition. Getting them to rationalise and explain this intuition needs to be done carefully since if the activity is not perceived to be interesting or 'adding value', it is highly likely to be treated with contempt.

Hopefully one of the main images emerging from these mini portraits is one of complexity and conflict. The preferred learning styles for one thinking mode are often the polar opposite of those of another. At the very least, this makes any trainer's job a tricky one as it is highly unlikely that any given group will be centred in just one of the thinking levels. And even if this situation ever did arise, there is a further complicating issue relating to whether people are open to learning. Assuming that they are (they came to the workshop, right?), and assuming that our job is to teach them some new problem solving tools (as opposed to trying to get them to change their way of thinking from one level to another), here are some of the things we can suggest will work best in the TRIZ/Systematic Innovation context:

	Theory	Tools	Templates	Exercises	Processes
Tribal	No	Hide the complexity	Essential	one 'right' answer	1 or 2 step procedures
Feudal	'world's best'	Quick hits, cards, games	Essential	A clear 'best' answer	<4 step procedures
Order	'world's finest problem solvers'	Matrix, 9-windows, radar plots, Patent database No PI tools!	Essential	'Best answer' depends on context	Sequential (ARIZ!)
Scientific	'3 million data points'	'tools should adapt to you'	Flexible, 'feel free to adapt'	Open questions, real problems, 'patentable'	Building blocks to be sequenced as you see fit
Communitarian	'here's what we've found *'so far'*	Segment the group according to what fits who. Emphasis on definition over solution	Team decides & possibly divides into sub-groups some with templates, some without	Meaningful problems where learning points emerge from the debate and discussion	flow-charts, if/then gates, divergent/convergent cycles, 'Thinking Hats'
Holarchy/Holistic	'all theories are wrong; some are useful'	'think of this as a start point; if you think you can improve it, please do so'	No	Relevant problems with no known solution; the bigger the better	'self-correcting'

Revising The Rhythm Co-ordination Trend

If you are one of those people that has always been a little troubled by the final 'travelling wave' stage of the Rhythm Co-ordination trend (Figure 1), you are not alone. The logic behind the inclusion of this fourth stage has always been a little contrived; sure it relates to vibration and rhythm in some way, but how come it comes after 'resonance'? More seriously, it is nigh on impossible to show how any single engineered system has progressed through all four stages of the trend. The aim of this article, then, is to explore the trend in a little more detail and to reveal our 'blinding flash of the obvious' suggestion for making the trend more logical, useful and use-able.

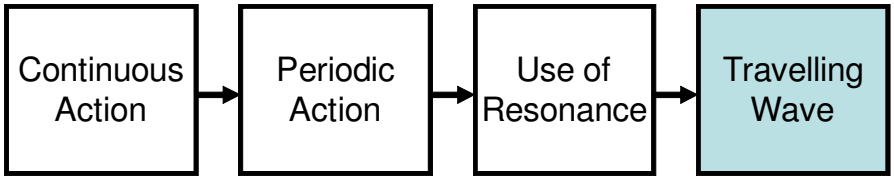


Figure 1: TRIZ 'Rhythm Co-ordination' Trend

The start of the blinding flash came during a recent study of laser technology, and particularly the use of pulsed lasers. One of the strong drivers in pulsed lasers is to get shorter and shorter pulses. One of the easiest ways to obtain shorter pulses, it transpires, is to use the harmonics of the fundamental wavelength. Take this example from a recent US patent (7,288,775):

*YAG **laser** has its fundamental wavelength at 1064 nm, but the second order harmonics (532 nm), third order harmonics (355 nm), fourth order harmonics (266 nm), fifth order harmonics (212.8 nm) and the like are being used in processing after wave transformation. At present, mainly used are the second and third order harmonics, but in view of higher processing efficiency and smaller deterioration on processing, UV radiations are preferred, and the use of fourth order harmonics is now under consideration for practical use. Preference to fifth order harmonics and to shorter wavelengths is under way.*

Higher order harmonics of YAG lasers are also characterized by that their pulse widths can be extremely shortened. At present, radiations with pulse widths ranging from nanoseconds (10.sup.-9 second) to picoseconds (10.sup.-12 second) are being used, but it is believed that radiations with pulse widths in the order of femtoseconds (10.sup.-15 second) will be used in future. By employing light with such short pulse widths, the influence of heat can be eliminated. Thus, in addition to the use of shorter wavelengths, the use of shorter pulses is an important tendency in the art.

Stage 2 of the blinding flash of the obvious came pretty quickly. Especially for the musicians in the team. The key connection word here is 'harmonics'. Harmonics play an indispensable role in music. Harmonics and the interplay of different harmonics gives us the timbre of different voices and instruments and with the interplay of different notes and their harmonics, the basis of what makes a melody interesting. Figure 2, for example, shows us a frequency-amplitude graph for a typical piano key. When we play a note (say middle C for arguments sake) we don't just get a high amplitude, 'first harmonic' signal at 261.625Hz, but we also excite a second harmonic at double this frequency; and a third at triple, etc. The relative amplitudes of theses harmonics is what allows us to recognize that we are listening to a piano rather than any other type of instrument.

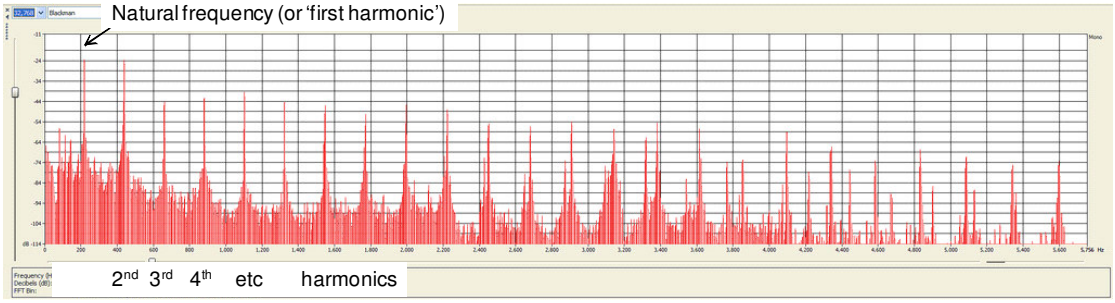


Figure 2: Harmonics Produced By Striking A Piano Key

Musicians and laser engineers tend not to have that much in common, but 'harmonics' is one of the things they very definitely share an intense interest in. A quick search on the US patent database on the word further reveals that quite a few other industries are also beginning to appreciate their value. Searching on the word 'harmonic' in the title of a US patent will reveal over a thousand inventors who have made the connection.

The common factor, then, behind all of them is that, like resonance, harmonics provide us with another free resource in a system. Resonance finds itself at the third stage of the Rhythm Co-ordination trend because sooner or later, once engineers have learned that pulsing is better than continuous, they work out that pulsing at resonant frequency creates a useful lever effect, where a small input signal gets amplified to produce a big output. Everything already has its own resonant (natural) frequency, and thus everything possesses a 'free' resource that can be used to deliver a useful lever effect. What the 'harmonic' word is reminding us is that not only does everything have a natural frequency, but also a whole sequence of harmonics. And all of them for free.

Our very simple proposal, therefore, for revising the Rhythm Co-ordination trend is to replace the existing 'travelling wave' fourth stage with one that merely mentions the word 'harmonics'. To our mind this makes a more logical progression. Firstly in terms of the way that systems actually evolve – i.e. once we have thought to make use of resonance, we are later on highly likely to identify some kind of additional benefit in also employing the harmonics of that resonance. Secondly it gives us problem solvers a generic term that appears to make more sense from an ideation perspective. 'How could you make positive use of the harmonics?' – based on the tests we've done – is far more helpful than asking people to think about travelling waves.

The revised trend sequence is thus presented in Figure 3:

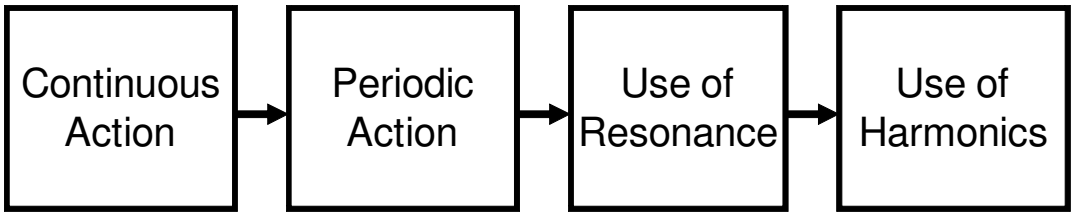


Figure 3: Proposed Re-Formulated Rhythm Co-ordination Trend

One of the biggest downsides of having a blinding flash of the obvious yourself, is that when you show others the outcome they tend to respond with comments along the lines 'well, of course, that's totally obvious'. Almost as if the Figure 3 picture is something they've had in their mind all along. This 'obviousness' is something we ought to take as a

good thing. The fact that it immediately *seems* obvious, is countered however by the fact that we've never been in a problem solving session where people have used the current form of the trend and found themselves thinking about how they can make positive use of harmonics. In its new form, there will hopefully now be an opportunity to ask these questions. And as a consequence, according to the 1000+ inventors who have already done so, found new benefits and new patentable solutions.

As with all of the other trends we've brought together, what we've tried to do in the Figure 3 version is use the words that will be the most useful ones to include in a search of the patent database. 'Harmonics' turns out to be a great one to get to some very illuminating examples of the sorts of things harmonics can do for us. Table 1 summarises some of the main reasons why those 1000+ inventors have made the jump and started making use of harmonics:

Table 1: Resonance-To-Harmonics – Reasons For Jumps

Increased adaptability and flexibility of use
Improved measurement capability and accuracy
Enhanced lever effect
Improved system responsiveness
Increased system efficiency

Finally, just in case you're one of those people who actually liked the old 'travelling wave' version of the Trend, fear not, for there is a consistency in the whole story. Another recent US patent for a novel propulsion device for tiny in-body medical sensors provides us with a useful insight. US7,317,275 was granted last month to a surgeon at Columbia University hospital in New York – Figure 4. The invention makes use of harmonic vibration to cause the sensor device to move along a surface. As can be seen from the 'bristles' (labeled '50' in the picture), what we appear to have here is a travelling wave system. The device moves in the same way that a millipede or other similar insect moves. Or at least partially it does. What we also have in this invention though is, firstly, the utilization of resonance to turn a small input signal into a large motion of the bristles, and then, secondly, making use of the harmonics allows the direction and motion of the device to be controlled more accurately.

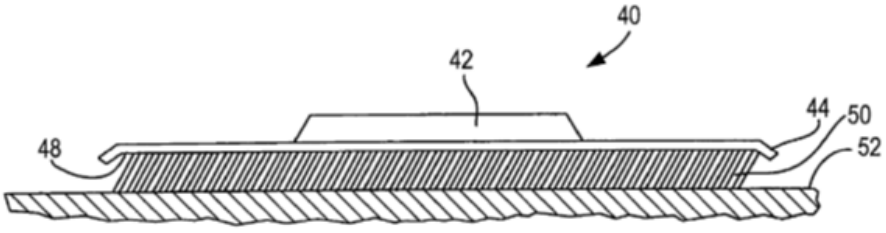


Figure 4: US7,317,275 'Harmonic Propulsion And Harmonic Controller'

Here, then, is a travelling wave device that has made use of both resonance and harmonics. As such it is a clear example of the new version of the trend. The only missing piece now is the idea present in all travelling wave devices that something that is static becomes dynamized. As such a 'travelling wave' is as much an example of the Dynamization trend as it is the Rhythm Co-ordination trend. As we know from the Dynamization trend, anything that is immobile will tend to become dynamic. In such a way, a static resonant frequency will likely be engineered to become dynamic and movable. The typical travelling wave solution, useful as it is, is not a good example of the fourth

stage of the Rhythm Co-ordination trend since, not all travelling wave devices have made use of either resonance or harmonics. Far better, therefore, to take travelling wave out of the Trends as a generic stage, and to merely note that it is an illustration of the Dynamization trend and – possibly – the Rhythm Co-ordination trend. That detail aside, the job from here, is to see how much use you can make of harmonics in the systems you are responsible for. One thing is for sure, there's a pile of patents to be had.

Humour – The Vista 'Wow'

Despite an apparently constant stream of automatic downloads of patches supposed to fix the myriad glitches in Windows Vista, the 'breakthrough new operating system' continues to be a talking point for all the wrong reasons. Spot the person shaking their head pitifully at their laptop in the airport and guaranteed there's a person desperately trying to machete their way through the Vista jungle and failing. Bill Gates, as ever, wins by three falls and a submission.

Someone recently passed us a copy of this photograph, taken at the big launch event for Vista way back in the dim distant past (time passes by so quickly when you're sitting watching your computer download it's 9th 'upgrade' of the day).

Methinks that none of the people sitting on that prestigious panel is thinking that 'the wow starts now'. Body language reveals all. This was no epoch-making event they've found themselves at; it's a wake. They already tried the software and they know what's coming. Wave your credibility goodbye, gents, it ain't ever coming back.

Patent of the Month – Ultra-High Pressure Generation

There were several good candidates for the Patent of the month award this month. Anyone interested in low-cost, screen-printable nano-lens should take a look at the latest patent from US company Nanoventions – US7,333,268. Those more interested in hyper-realistic sound reproduction might instead wish to head towards US7,333,622, granted to inventors at the University of California. Both simple and elegant ideas. Our eventually chosen winner, however, is Professor Yasushi Kawashima at Tokai University in Japan. Professor Kawashima is a frequent inventor and source of a number of excellent patents. His latest, *Method and device for generating ultra-high pressure* was granted as US7,332,727 on February 19:

A pressure source material is loaded into a space having constraint device 1, which is formed partly by optically transparent material 1a, 1b, and is disrupted under volume constraint. Light energy is externally supplied to the pressure source material constrained in the space through the optically transparent material by employing the device to apply light energy. The disruption of atomic bonds in the pressure source material is induced by heating through the supplied energy. Exceptionally high pressures are generated in the space by the use of expansive forces arising from the disruption of atomic bonds. Such a configuration can implement ultrahigh pressure abilities that has not been achieved, so far.

The focus of the patent is intended to be quite broad, but thinking about the sorts of pressures required to manufacture industrial diamond will set the context quite well. To give a brief flavor of the extent of the capability jump offered by the Professor, we are talking about pressures in the Tera-Pascal range, and the invention disclosure reports a 'three to four times order of magnitude improvement' in the duration the high pressure is able to be maintained. Add into that story a parallel conflict between pressure and the volume of material that is required to be raised to the elevated pressure, and the story behind the invention looks like a very clear three-way fight between pressure, volume and duration of action. From a Matrix2003 perspective, here's how others have sought to challenge such conflicts:

IMPROVING PARAMETERS YOU HAVE SELECTED:

Stress/Pressure (19)

WORSENING PARAMETERS YOU HAVE SELECTED:

Volume of Stationary Object (8) and Duration of Action of Stationary Object (13)

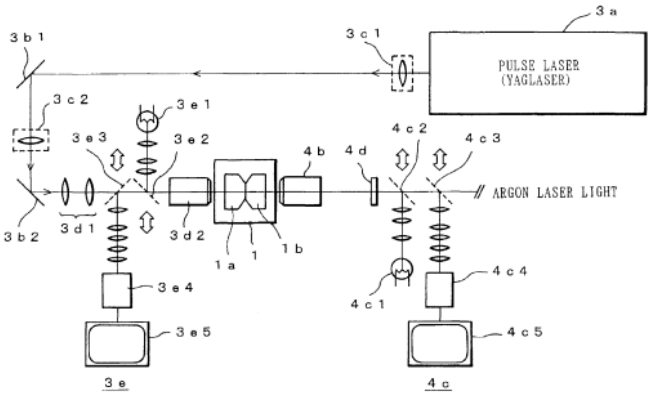
SUGGESTED INVENTIVE PRINCIPLES:

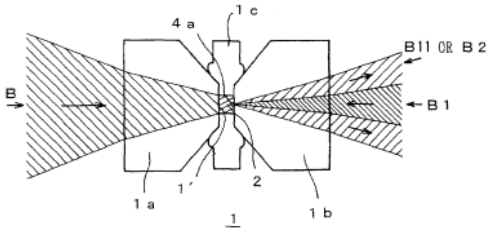
35, 3, 14, 17, 4, 40, 9, 2, 30, 5, 24, 12

What Professor Kawashima has done to make his three-order-of-magnitude jump is concisely described in Claim 1 of the disclosure:

1. A method for generating ultra-high pressure comprising the steps of, loading a pressure source material, which is a part of a device, under volume constraint in a space partly surrounded by an optically transparent material; supplying optical energy to the pressure source material with a pulsed laser beam; splitting the pulsed laser beam with an optical splitting means into plural parts to be applied to the pressure source material from plural directions; disrupting atomic bonds of the pressure source material by heat of optical energy externally supplied to said pressure source material through said optically transparent material; separating atoms of the pressure source material from each other to fly freely under volume constraint; expanding said pressure source material under volume constraint through the disruption of the atomic bonds; and generating ultra-high pressure within said space using expansive force of said pressure source material arising

from the disruption of atomic bonds.





Let's try and unravel the inventive steps present in this system: Perhaps most obvious is the use of a pulsed laser (Principle 19, Periodic Action). The laser is then divided into 'plural parts' (Principle 1, Segmentation), to be applied to the pressure source materials from 'plural directions' (Principle 17, Another Dimension). The laser is transmitted to the source material through an optically transparent material (Principle 32, Colour Change – specifically 32B, change transparency), such that the source material is heated sufficiently to disrupt its atomic bonds (Principle 35, Parameter Changes), which then, because the optically transparent material has a fixed position, causes the pressure to rise.

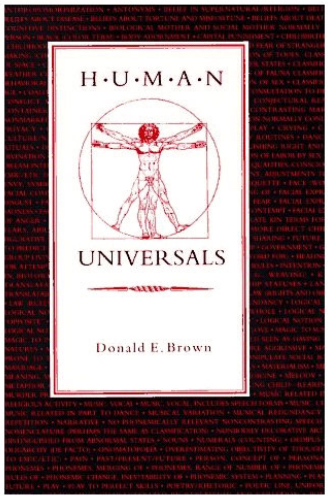
All in all, the Matrix has not done such a good job of reproducing what has happened in this patent. There is an argument to say that the 'optically transparent material', because it has to perform two functions – volume constraint and allowing laser pulses through – is an example of Principle 5, Merging, but this is not nearly such a convincing connection to the eventual answer as that which comes from Principle 32.

The patent in fact represents one of a number of laser-related patents where the Matrix is beginning to show a fair degree of weakness. This weakness is particularly apparent in situations where the laser is being configured to make use of either or both of 'transparency' or – more usually – operation at the atomic level. Both features are clearly in evidence in this patent.

The weakness of the Matrix here should not distract us from the elegance of the invention, however. Updating the Matrix to account for this emerging new family of laser innovations is easy. Creating Tera-Pascal pressures is not so easy. Or rather it wasn't until Professor Kawashima turned his attention to the subject. All in all, an extremely elegant solution to an important problem.

Best of the Month – Human Universals

It is rare indeed for us to be recommending any kind of reading that is more than a decade old. Especially in the rapidly (r)evolving field of human psychology. The fact that our choice this month is currently out of print, doesn't appear to do much to help make a case in its favour. Nevertheless, because it is both a fine read and that rare thing, a book with some actual underlying research underpinning its contents, we are recommending 'Human Universals' by University of California anthropology professor, Donald E Brown.



"Human universals" is a term used in anthropology and evolutionary psychology to refer to behavioral or cognitive traits common to all neurologically normal humans. The notion of human universals was partially formulated as a challenge to cultural relativism, a predominant view of human nature in the late 20th century, which some psychologists and anthropologists see as greatly exaggerating the variance among members of the human species. Biologists frequently, indeed, tend to divide the world into 'lumpers' and 'splitters'. Lumpers tend to look for the similarity between things, while splitters tend to focus on differences. TRIZ is essentially a piece of 'lumper' research – making the argument that by abstracting your problem to a generalized framework, someone, somewhere will have already solved that problem, most probably in another field. Human Universals is another piece of 'lumper' research. First published in 1991, professor of anthropology Donald Brown listed hundreds of human universals in an effort to emphasize the fundamental cognitive commonality between members of the human species. Some of these human universals include incest avoidance, territoriality, fear of death, rituals, childcare, pretend play, mourning, food sharing, kin groups, social structure, collective decision making, etiquette, envy, weapons, aesthetics, and many more. All in all, Brown's book catalogues over 400 such 'universals'.

Wider recognition of human universals has led to a sort of mini-revolution in psychology, which has begun to take more input from the harder sciences of anthropology and biology, and less from the ubiquitous pop-psychology of the 20th century. One of the greatest popularizers of the notion of human universals in recent years, and quite probably the most likely place that you might already have come across the 'universals' concept, has been cognitive scientist Steven Pinker. In particular his book 'The Blank Slate' (another useful if long-winded text), which makes copious use of Brown's thinking and classification scheme.

Now, on the one hand, 400+ ‘human universals’ is a big number. On the other, it is surprisingly small. In effect what Brown is suggesting with his ‘lumper’ thesis is that across the whole of mankind – whether geographically, culturally or age – there are certain what’s and how’s that are found in all of us. What we end up with is, like TRIZ, a rigorous check-list of resources. Each of the listed human universals is potentially something that can be tapped into and used in the design of better products, services, advertising campaigns, you name it. If, in other words, a large part of the ‘Voice of the Customer’ listening job is about knowing what to be listening out for, then Donald Brown has provided us with at least the start of a very good road map. As such, we recommend it at the very least as a useful piece in any kind of Theory of Everything jigsaw puzzle.

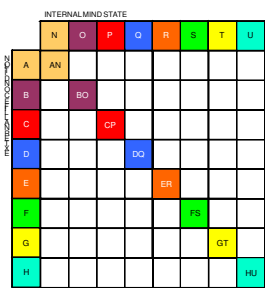
From our perspective, integration of that piece into the puzzle has already advanced to the next stage through a piece of work we’ve started to segment and map Brown’s universals into the different levels of human thinking as defined in Spiral Dynamics. In theory what we end up with when we finish this work is, instead of one list of 400 universals, eight shorter lists of universals for each of the eight characterisable types of thinking. More on that subject no doubt in the coming months. In the meantime, assuming you can find a copy of the book in your local second-hand store, the 220 pages of Brown’s work are well worth hunting for.

Conference Report – Spiral Dynamics Certification Workshop

This seven-day (!) event was held in rural Wiltshire during the latter part of January and early February of this year. The workshop is only run once a year in the UK and so the event was quickly sold-out at its maximum limit of 25 delegates. Most of these were from the NLP and caring-professions, and so a person like myself, still possessing the last vestiges of 'engineer'ness about them, was seen by everyone else as something of an oddity. The main reason for the once-a-year rarity of the workshop was that it was given by one of the author's of the main Spiral Dynamics book, Chris Cowan. Chris was accompanied by Natasha Todorovic, his subsequent co-author in editing the life work of Clare Graves, the originator of the Spiral Dynamics research and philosophy. Given this connection, both workshop leaders were teaching the subject very much with a Gravesian perspective. This is an important point to note since Cowan has now diverged from his original Spiral Dynamics co-author, Don Beck, with Cowan heading along a 'let's be faithful to the originator' route, and Beck now seemingly travelling along a 'forget the past, it's all about getting the world to Yellow thinking' road. Given this context, there were strong similarities between the way the workshop was taught and the Soviet versions of TRIZ. Very much a case of 'it is not for us to question what Graves said, but rather to applaud his magnificence'. This trait tended to become more than a little wearing after the end of the second day. As did the very Green-thinking delegates, who spent what felt like an eternity discussing and debating points that to non-Green participants felt like trivial irrelevances. The point where 90% of the room started spontaneously singing along to a recording of John Lennon's diabolically awful song 'Imagine' probably counts as some kind of an all time low in workshop history. Such, though, is the world of public workshops.

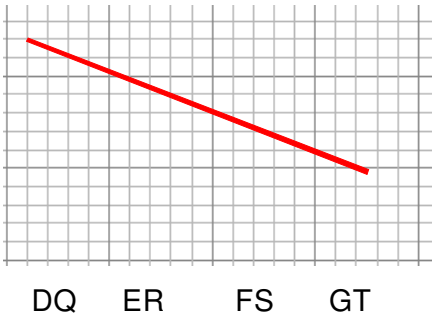
All in all, it was still a very worthwhile experience. Hearing things from source is always a good thing, even if the source is more researcher than teacher. Plus, assuming I complete my project assignment, I become a certified Spiral Dynamics practitioner. The past part of that honour being that I get access to the various measurement instruments developed by Cowan to help assess what thinking levels and how amenable to change people are.

There were also several emerging nuggets that it was difficult to extract from the books. Perhaps the most significance was the reasoning behind Graves' use of letter-pairs rather than colours to describe the different thinking modes. Thus 'Red' thinking mode was described as 'CP' by Graves. The distinction is important because Graves was trying to make the point that there were two aspects to the thinking mode story. One being the internal thinking mode ('P'); the other being the external 'life conditions' in which the person was living ('C'). Accepting that problems tend to occur due to conflicts and tensions, this internal-external divide opens up the possibility that not only do different colours conflict with each other, but we can all of us experience tensions when our internal thinking patterns fail to match our external life conditions. Although it was never drawn as such by Graves (or Cowan & Todorovic for that matter), I've found that a really good way to think about these types of conflict possibility is to construct an internal-external matrix of the form shown here:

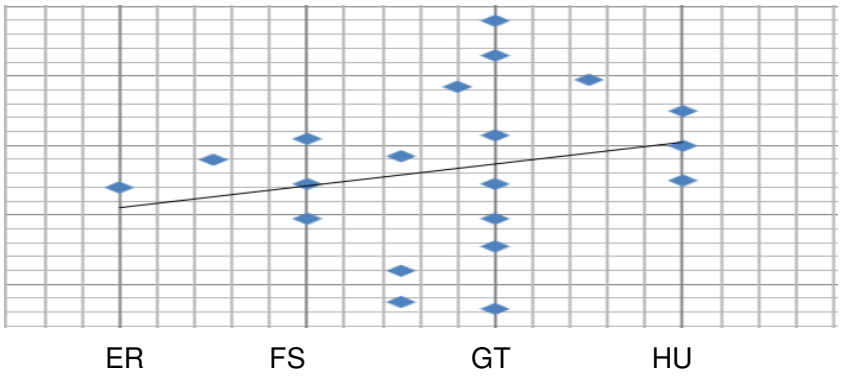


More on the significance of this in future article no doubt. In the meantime, one of the things this picture brought up in the actual workshop when I tried to suggest it as a way of modeling a system, was a complete lack of interest from either Cowan or Todorovic. Not that I'm suggesting it is a great step forward, or even 'right', but rather my concern was their frozen 'don't change Graves' attitude. (For those that were in attendance, think of Victor Fey's 'don't touch TRIZ' diatribe at one of the European TRIZ conferences as a very close analogy to what I experienced).

One of the problems caused by this kind of closed mind is that, for some people, matters can rapidly devolve into a 'right, let's see how ridiculous I can make these people look' bun-fight. Alas, I was that person. Another case in point: during Day 6 we were exploring some of Graves experiments to find correlations between the different thinking modes and social attitudes. Some of the data looked a tad flakey – few data points; non objective questions; no control groups, etc. One of which was an apparent correlation between thinking mode and 'response to authoritarianism'. Here's what Graves data said:



Which essentially translates as 'as people move from Blue to Orange to Green to Yellow thinking modes, they become less and less accepting of authoritarian attitudes. As it turned out, all of the delegates on the workshop had been asked to fill in a questionnaire on authoritarian attitudes at the beginning of the workshop. As it also turned out, we had all done lots of work and assessment in the previous 5 days to identify and map which thinking mode we were all centred at. In other words, everyone had a data-point that we could plot onto the same graph as Graves drew. If I said that I had to spend 10 minutes failing to convince Cowan and Todorovic that we already had the data and wouldn't it be a good idea to plot it. Or that I subsequently had to sneak a piece of paper around the group during a break in order to get their data, it might suggest that there was a strong whiff of defensiveness in the air. When I finally got to draw the graph, the reason started to become evident:



At best, what a mathematician would conclude from this picture was that the correlation between thinking level and response to authoritarianism was weak. If you accepted the

results of a linear regression from the highly scattered data, you'd conclude that the correlation was the opposite of the one Graves found. As to whether our data-points were more or fewer than Graves, neither Cowan nor Todorovic would discuss.

If this thought leaves a slightly unpleasant taste in your mouth, you're in pretty good company. As we dug deeper and deeper into the whole data issue in fact, the resemblance to the Soviet TRIZ story grew to sound not just similar but identical. Which, all things being equal, is probably a pretty good conclusion to my overall feelings of the workshop: Exactly as with TRIZ, Spiral Dynamics is the brain-child of one very smart person. That person (Altshuller or Graves) acquired sufficient data to build a hypothesis. Then, as more data gets added, fewer and fewer people around the subject seek to question the initial hypothesis. Is TRIZ 'right'? Is Spiral Dynamics? Or are they both simply good hypotheses that remain valid until something better comes along, and that our job is to view them as 'start points' rather than ends? As an almost certified Spiral Dynamics practitioner, my vote goes with the latter.

Investments – Oleophobic Materials

MIT engineers have designed a unique class of material structures that can repel oils, a novel discovery that could have applications in aviation, space travel and hazardous waste cleanup. Such materials could be used to help protect parts of airplanes or rockets that are vulnerable to damage from being soaked in fuel, like rubber gaskets and o-rings.

"These are vulnerable points in many aerospace applications," said Robert Cohen, the St. Laurent Professor of Chemical Engineering and an author of a paper on the work that appeared in the Dec. 7 issue of Science.

"It would be nice if you could spill gasoline on a fabric or a gasket or other surface and find that instead of spreading, it just rolled off," Cohen said.

Creating a strongly oil-repelling, or "oleophobic" material, has been challenging for scientists, and there are no natural examples of such a material.

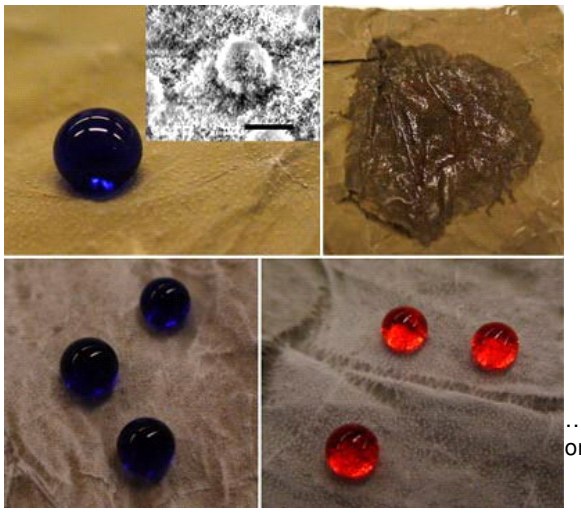
"Nature has developed a lot of methods for waterproofing, but not so much oil-proofing," said Gareth McKinley, MIT School of Engineering Professor of Teaching Innovation in the Department of Mechanical Engineering and a member of the research team. "The conventional wisdom was that it couldn't be done on a large scale without very special lithographic processes."

The tendency of oils and other hydrocarbons to spread out over surfaces is due to their very low surface tension (a measure of the attraction between molecules of the same substance).

Water, on the other hand, has a very high surface tension and tends to form droplets. For example, beads of water appear on a freshly waxed car (however, over a period of time, oil and grease contaminate the surface and the repellency fades). That difference in surface tension also explains why water will roll off the feathers of a duck, but a duck coated in oil must be washed with soap to remove it.

SEM micrograph of Lotus leaf

water droplet on surface of Lotus leaf…



…same leaf wetted by a drop of hexadecane…

…same leaf coated with new MIT material. Water droplet still beads up.

…hexadecane also beads up on this new MIT material

The MIT team overcame the surface-tension problem by designing a type of material composed of specially prepared microfibers that essentially cushion droplets of liquid, allowing them to sit, intact, just above the material's surface.

When oil droplets land on the material, which resembles a thin fabric or tissue paper, they rest atop the fibers and pockets of air trapped between the fibers. The large contact angle between the droplet and the fibers prevents the liquid from touching the bottom of the surface and wetting it.

The microfibers are a blend of a specially synthesized molecule called fluoroPOSS, which has an extremely low surface energy, and a common polymer. They can be readily deposited onto many types of surfaces, including metal, glass, plastic and even biological surfaces such as plant leaves, using a process known as electrospinning.

The researchers have also developed some dimensionless design parameters that can predict how stable the oleophobicity, or oil-resistance, between a particular liquid and a surface will be. These design equations are based on structural considerations, particularly the re-entrant nature (or concavity) of the surface roughness, and on three other factors: the liquid's surface tension, the spacing of the fibers and the contact angle between the liquid and a flat surface.

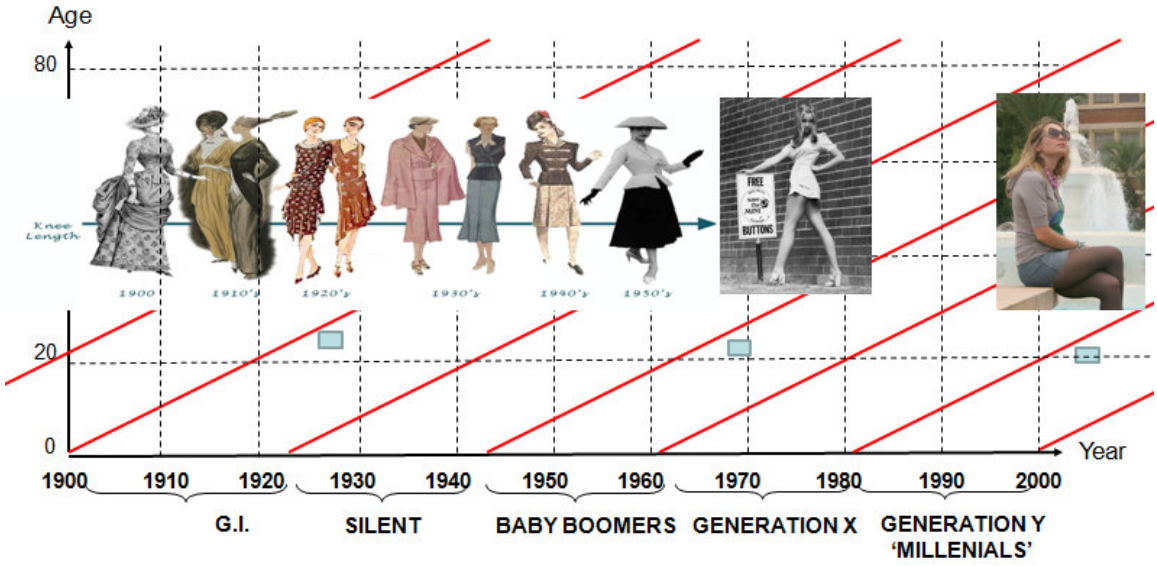
Using these relationships, the researchers can design fiber mats that are optimized to repel different hydrocarbons. They have already created a nonwoven fabric that can separate water and octane (jet fuel), which they believe could be useful for hazardous waste cleanup.

The Air Force, which funded the research and developed the fluoroPOSS molecules, is interested in using the new materials to protect components of airplanes and rockets from jet fuel.

Although it is not yet clear that USAF will be the first commercial customer for the new capability, it seems more than likely that there will be a host of applications for this new class of materials. The future’s bright; the future’s oleophobic. In more ways than one come to think of it.

Generational Cycles – Skirt Length

Older readers may remember a great scene in the 1960 original film of HG Wells' science-fiction classic The Time Machine, where Rod Taylor's time-travelling hero sits in his machine skimming through the years of the 20th Century looking at the women's fashion shop across the street from his house and watching as the skirt length on the mannequins rose and fell. In the interests of scientific exploration, we recently conducted our own version of the skirt length story. The result that emerged is quite intriguing:

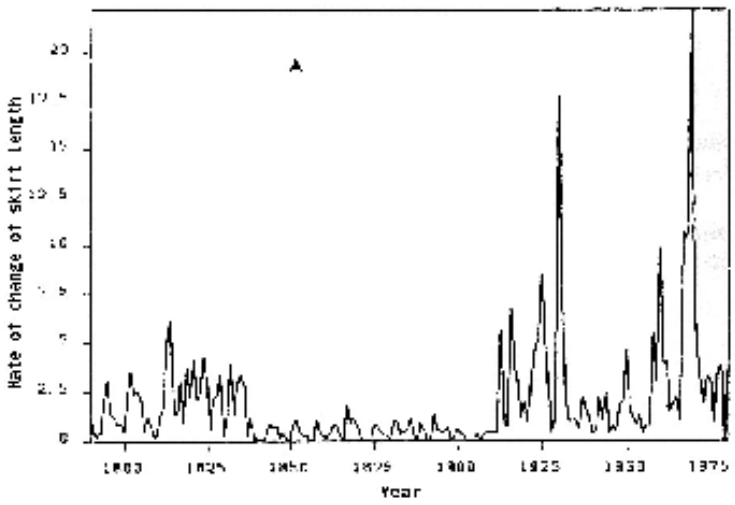


The blue bars represent periods when skirt lengths have been at their shortest relative to the various Western generations living during the twentieth century. Can you spot a pattern?

If we had drawn the picture a couple of years ago, I think it would have been a fairly safe bet to predict the re-emergence of short skirts that we are currently seeing in the West. The pattern appears to be driven by a two-generation cycle with alternating Hero (GI and Generation Y) and Prophet (Boomer) generation archetypes opting for the short skirt option during their early adulthood. Both of these generation archetypes tend to be the two most rebellious of the four known archetypes. In the case of both generations, there is probably a lot to do with rebellion against parents, and in the case of the Hero generations, a strong desire to live a hedonistic pedal-to-the-floor lifestyle.

Attempts to travel further back in time to the 19th Century and earlier cannot sensibly be done without taking into account other societal trends during that period. Highly likely to be relevant are, first, a much more immature fashion industry – fashion only really being relevant to a small proportion of the richest members of society. Secondly, of course, is the fact that women were less likely to have the freedom to dress beyond the rules of either their parents or society as a whole prior to emancipation. Nevertheless, the following graph illustrates that there have indeed been earlier periods when the rate of change of skirt length was more volatile than the norm. The graph clearly shows the 1920s and 1960s shifts. It also shows an earlier period of volatility around the 1810-1820s. This is the period when the 'Transcendental' generation was in its early prime. And prepared to shockingly reveal their ankles to the world. Transcendentals were another Prophet generation, so at least in this respect the trend pattern remains consistent. By way of a

crude reference point, the Transcendentals were a generation reading Jane Austen's Pride And Prejudice and as such seeing powerful female role-model characters like Elizabeth Bennet for the first time.



For reasons as yet unexplained, there was no similar volatility during the period mid-way between the Transcendentals and the GI generation Flappers. The graph too only has data going up to the highly turbulent sixties mini-skirt boom and so it doesn't get to include the current rapid reduction in lengths. Assuming the 20th Century, two-generation pattern continues, though, we can expect the current high levels of leg exposure to be relatively short-lived. And, like a distant comet, destined not to be seen again for around another 40-44 years. You have been warned.

Biology – Crocodilian Digestion

Thanks to good friend and frequent collaborator Ellen Domb for finding this month's amazing story.

Here's the essence of the crocodilian problem: Crocodiles and alligators are among nature's most fearsome predators. When the opportunity arises, crocodilians will gorge, voluntarily consuming meals weighing up to 23 percent of their own body weight. This is analogous to a 130-pound woman eating, at one sitting, a hamburger weighing 30 pounds. But what to do with all of that food? If they do not digest their meal quickly, crocodilians risk death from within, or if they are young, by predators.

While it has long been known that reptiles have the ability to shunt blood past their lungs, the physiological function of this ability is poorly understood. In a breakthrough article for the March/April 2008 issue of Physiological and Biochemical Zoology, "The Right-to-Left Shunt of Crocodilians Serves Digestion," Professor C.G. Farmer and her colleagues at the University of Utah, along with the Utah Artificial Heart Institute, were able to demonstrate through their experiments with American alligators that the bypass function is central in their digestion process, and ultimately, their survival.

After feasting, crocodilians like to find a warm place to lie down while they digest their meal. Although on the outside this behavior seems ordinary, inside their bodies an extraordinary event takes place. During this period of digestion crocodilians divert blood through a special vessel that bypasses the lung, named the left aorta. Humans, other mammals, and birds lack this special vessel, and so all blood pumped by the right side of the heart flows through the pulmonary artery into the lungs, where accumulated carbon dioxide is removed from the blood into the gases of the lungs.

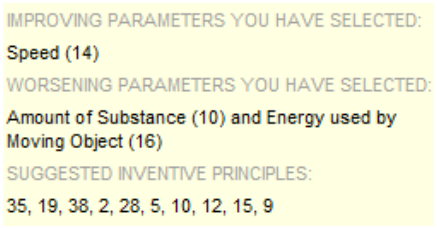
Crocodilians can chose not to use the left aorta, in which case their cardiovascular system is very much like the mammalian system. However, when crocodilians are digesting a meal, they chose to shunt and direct CO2-rich blood straight to the stomach, where glands make use of the CO2 to form gastric acid and bicarbonate. Consequently this shunt enables crocodilians to secrete gastric acid at a rate that is approximately 10 times the highest rates measured in mammals. If crocodilians are deprived of this ability to sidestep their lungs, their rates of acid secretion drop significantly and their ability to dissolve bone, a regular part of their normal diet, is impaired.

There are many reasons crocodilians may need this super secretion. First, these huge meals, which are stored in the stomach while they are gradually broken down, would putrefy due to the overgrowth of bacteria without the constant acid bath that inhibits bacterial growth.

A second reason may be related to the hunting tactics of crocodilians. Concealed below the water's surface, crocodilians stealthily approach animals that have come to drink, spring upon their prey, and drag them into the water and drown them. This powerful burst of activity generates an extraordinary amount of lactic acid in their muscles, which, unless cleared rapidly from the body, can be lethal. The shunting of this acidic blood past the lungs and to the stomach allows the acid to quickly leave the blood and provides the blood with bicarbonate, an important buffer.

Last but not least is the possibility that the shunt helps runts. Within the first year of hatching over 50 percent of young crocodilians end up as somebody's lunch, but the bigger they get the less likely they are to be eaten. Crocodilians are cold-blooded animals that rely on basking in the sun for warmth, and a warm belly is essential for high rates of acid secretion, good digestion, and rapid growth, but basking sites are not always plentiful and the biggest animals dominate these sites. Thus it may be critical for little crocodilians to make hay while the sun shines; that is, to rapidly secrete acid while they have the opportunity to get warm.

In addition to trying to understand why crocodilian's have evolved this amazing by-pass solution, it is also instructive to explore exactly how such a solution might have evolved in the first place. At every stage in the evolution of a natural system, the new solution needs to be fitter than the previous solution, otherwise there is no evolutionary advantage and therefore the new solution will tend not to persist. This is a particularly interesting situation since there have had to be multiple evolution jumps in order to create this solution. Specifically there has had to be a jump when the first 'special vessel' able to bypass blood appeared, there has had to be another jump in so far as at some point CO2 in the blood began to be used as a resource to make gastric acid, and, related to this point, the gland used to convert the CO2 into gastric acid had to appear. Most likely to appear first was the utilization of CO2 as a gastric acid constituent, since to a lesser extent other animals also make use of the same reaction. Increasing the amount of CO2 used appears to correlate closely with the basic desire to be able to digest faster when the amount of food being consumed is high. This conflict looks something like:



The key connection to the CO2/gastric acid solution here then comes from the reference to Principle 38, 'Enriched Atmosphere'. It is also useful to note the presence of Principles 15, Dynamics and 19, Periodic Action as connections to the idea of switching the CO2 input up only when necessary.

Regarding the evolution of the aorta by-pass in more detail, we need to think about the new problem that emerges once CO2 levels in the blood rise. The CO2 is clearly doing something useful in the stomach, but elsewhere in the body, it is a poison. We want CO2 and we don't want CO2. A physical contradiction that we can resolve by separation in time

– we want the CO2 when we are digesting and we don't want it when we are not. Separation in time solutions will again lead us to Principles 15 and 19 as solutions. We can also separate this contradiction in space too in that we want CO2 in the stomach, but we don't want it elsewhere. This is perhaps where the use of Principle 1, Segmentation can be seen most clearly through the emergence of the bypass system.

Whichever way around everything happened, though, it shouldn't take away from the amazing capability evolved in what is one of the world's most long-lived species.

Short Thort

'People thought it was asinine for me to change my swing after I won the Masters by twelve shots… Why would you want to change that? Well, I thought I could become better… I've always taken risks to try to become a better golfer, and that's one of the things that has gotten me this far.'

'I knew I wasn't in the greatest position in my swing at the Masters, but my timing was great, so I got away with it. And I made almost every putt. You can have a wonderful week like that even when your swing isn't sound. But can you still contend in tournaments with that swing when you're timing isn't good? Will it hold up over a long period of time? The answer to those questions, with the swing I had, was no. And I wanted to change that.'

Tiger Woods
8 major titles before 2002
No majors 03/04 – rebuilding swing
2 majors – 05/06

News

Hands-On Systematic Innovation

We are happy to announce that our partners in Taiwan have put together an 'International Student Edition' of our Hands-On Systematic Innovation books. The books are printed in a paperback cover, and available to all registered students in the Greater China region. Interested readers should click on the 'Taiwan' button on the Links page of the website.

Certification Workshops

It's always nice to be able to write the words 'full' and 'sold out' on workshops, and particularly so when we are talking about advanced-level certification workshops in the UK. Those are exactly the words we are happy to announce for the ongoing public certification programme. As a consequence of the success of this series, we will be commencing a new round of certification workshops shortly. The first, introductory level workshop will be held on the 1st and 2nd of July at our Clevedon office.

Trend Briefings

Due to the success of the market trend briefing sessions looking at Western, Chinese and Indian trend patterns, we are soon hoping to be able to offer trend information packs to our research and cooperation partners. The big idea behind these packs is that they are able to serve as the source material for what we hope will be a series of public trend-watch briefing sessions. We know this is a busy area, but based on the feedback we've received from clients so far, believe that we have some unique and valuable insights to offer on the subject. And, of course, it's a lot easier for audiences to understand than some of the TRIZ/Systematic Innovation material… although, of course, the main idea is that one should ultimately connect to the other. Contact Darrell for more details.