A PRELIMINARY REPORT INVESTIGATING TEAM CREATIVITY USING MEDITATION AS A TEMPLATE FOR CO-EVOLUTIONARY DESIGN PROCESS

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1. Introduction

It is generally accepted that 'novelty' is the prime indicator of creativity. It is also accepted that novelty in any kind of design often occurs as a result of inspiration and integration of data from outside the field of original expert knowledge. However, a review of 'creativity' tools quickly shows that none deal rigorously with the process of resolving contradictory or multi-dimensional or multi-disciplinary information [1]. In other words, we lack appropriate tools for facilitating the process of creative information- or knowledge transfer.

There are, however, tools in other areas of human endeavour, which deal very well with this process –in particular, certain types of meditation. All types of meditation can be classed as tools which, according to existing literature in educational, cognitive and neuro- psychology, will to a greater or lesser extent, change our habitual response to stimuli and data and subsequently enable us greater choices, less fixation and more freedom in our use of information [eg. 2; 3; 4; 5; 6]. They integrate contradictory information via co-evolutionary mind and body processes, to progress a given problem or stale situation.

Certainly, if existing western tools for 'creativity' do not fulfil our needs throughout the design process, then we need to find other templates for improvement. And certainly, some traditional eastern tools might fill this need –either directly, as a whole, in their original state; or in part, as inspiration. Thus a preliminary empirical investigation was carried out in 2003-4, to determine the scope and limits of teaching meditation to engineers, as a tool to aid creativity –in particular the integration of externally sourced or multi-disciplinary data. The tool chosen for the investigation involves a process of co-evolutionary information transfer, which is closely aligned to known processes of manufacture and design. A simple outline of the setting and results is presented in this paper.

2. The Definition and Measurement of Creativity

2 .1 Scope of previous research

Modern *research* in psychology moved through a focus on the individual – in areas of personality and cognition during the 1950's- 70's, onto awareness of environments and social contexts of teams and organizations in the 1980's and 90's [see for example reviews by 7; 8; 9; 10]. But in spite, or perhaps even because of this breadth of investigation, there is no agreed *definition* of 'creativity' amongst the different research communities. Recently, Gardner [11,12] and Csikszentmihalyi [13, 14, 15, 16, 17, 18] made the important

contribution that 'creativity' is probably contextual, merges both social and individual judgments and needs and includes a spectrum of potential intellectual constituents and practical effects.

Concurrently, there is also no direct *measure* for 'creativity'. In a comprehensive literature review, Beattie [10] offers detailed suggestions for the format of assessment tasks and the criteria required for judgements in a review of over 200 instruments developed for this purpose. However, as Sternberg and Lubart [19] also realized, none of these are really able to measure the concept adequately. It seems we can only judge 'creativity' case by case – and not as a 'thing' in itself, but only by its possible constituent elements, experience, activity or effects.

2.2 The elements, experience, activity and effects

Regarding the *elements* and *experience* of creativity, we know from existing literature reviews of yet more literature reviews that the key characteristics in individuals include: openness to experience; independence; self-confidence; willingness to take risk; sense of humour or playfulness; enjoyment of experimentation; sensitivity; lack of a feeling of being threatened; personal courage; unconventionality; flexibility; preference for complexity; goal orientation; internal control; originality; self-reliance; persistance [20]. There must also be intellectual ability; a prior knowledge set; styles of thinking known to the individual or group; scope for personality; intrinsic motivation and environmental support [19].

Further, as Csikszentmihalyi [17] discovered, the *activity* in which one is involved must have nine elements: clear goals, immediate feedback, balance between challenges and skills, merging of action and awareness, elimination of distractions, lack of fear of failure, lack of self-consciousness, distortion of sense of time and enjoyment for its own sake. This leads to a state of so-called 'flow', which is felt by individuals and teams to be an effortless, yet highly focused state of consciousness while stretched to capacity during moments of discovery.

Finally of course, the *effects* of combining internal and external stimuli cannot be nebulous or non-rational, however complex and difficult their interrelations are to explain to outsiders. The creator must also be able to make new explorations, combinations and transformations that are recognized by his peers or society as being both novel [21] and useful [17].

2.3 Multi-disciplinarity, novelty and knowledge transfer

Over the last decade, all scientific communities have become aware that introduction of multi-disciplinary information or knowledge is crucially important for advancing the state of the art. Biomimetic design for instance, combines biology and engineering, deciphering the mechanism whereby shark skin functions to inform Olympic swimsuit design, and so on.

The initial insight that typifies novelty in evolution or 'creative' adaptation of products and processes in a habitual physical or 'thought environment', can be instigated by even small provocation. It merely requires a matching of data or equivalence of patterns to be identified in the body or mind of the creator. And this can happen in an instant.

In this study, the sole psychometric measurement carried out through all phases of investigation, tested for improvements in participant ability to find symbolic, meaningful connections between previously unrelated data or events. This provided some interesting

results [section 4.1], but it is important that we do not get side-tracked with these simple indicators of effect.

And it is important that we do not get side-tracked with investigating all the complex human factors involved, such as the elements and experiences listed in section 2.2 –although these were also observed in this study [outlined in section 4.2].

More importantly, we must realize that all new, contradictory, perhaps multi-functional, multi-national or multi-disciplinary information must be integrated into the existing skill set or information set. This integration is unlikely to be instantaneous, as the transfer of even one bit of information will have knock-on ramifications for all bodies of knowledge involved. Knowledge transfer [and its management] is thus a process, not an instant.

The only way to address the question of how or where 'creativity' exists, in a long process of solution-finding or in a long process of knowledge transfer in science or design, is by looking at the process itself. This is further discussed in section 3.3.

2.4 Action research, meditation and co-evolution

Rigorous statistical measurement is best in simple, quasi-static or huge volume situations, and this investigation aimed to find changes in the whole mode of behaviour of a very small sample of participants. Thus any benefit a meditative tool could provide for enhancing 'creativity' would be best understood not from a perspective of mathematics, but from self-reflection, self-assessment and self-reporting by participants. This was especially true because the mode of enquiry and presentation of the meditative tool also evolved as investigation continued, as described further in this section.

The stages of action research seem to be good descriptors of what happens in modern design environments [eg. 22; 23; 24; 25; 26] and it is perhaps for this reason that action research has been introduced as a valid method for the study of design [26; 27; 28]. It is also important that action research meditation and co-evolutionary design are understood to operate by the same principles and patterns –described further in section 3.2. It is because of this coincidence that action research provides the best possible framework for teaching the meditative tool in modern western environments.

The field of action research practitioners calls their tool a 'conceptual process model'. We know it broadly proceeds via self-organizing cycles or spirals of development including phases of observation, diagnosis and therapeutic suggestion [29, 30]. Generally, the method makes no excuses that there is no final, definitive answer to a stated investigatory problem. It completely accepts that researcher and participants will and must change during the course of investigation, since the mere act of asking questions and hearing answers and making sense of them is an intervention [31]. The research thus accounts for emergent patterns, as the question being investigated is defined and re-defined several times over the life of the program. It is continuously self-sceptical and imaginative, both on part of the researcher and the participants in the enquiry, so as to develop deeper understanding and enable diagnostic action to be intrinsic to the process of solution, rather than an end-effect.

What is more, as the researcher becomes experienced in the technique, the conceptual difference between 'action' and 'research' elements dissolves – the cycles of participatory reflection, action, learning and new informed action become negligible [31]. Most importantly, the speed of the cycle enables the reciprocal learning and knowledge that is exchanged via reflective thought to develop to a point where disagreement can almost cease

to exist and instead, individuals and teams find shared meaning [31]. This is the so-called state of creative 'flow' in individuals and teams [16, 17, 18], which sets the stage for a critical moment of transformation where the all-important imaginative or 'creative leap' takes place – from seeing the data 'as it is', to seeing 'what could be' [31].

3. Setting of the investigations

A total of three phases of investigation were run, lasting 3 months each – providing 'snapshots' of a process, which usually takes many years to master. For these, small groups (of 5-15) participants met weekly at their host institution and meditated daily in their homes, according to the structure of investigation and meditation outlined below. Participants were novices –they had not previously meditated. They were also self-selected, following invitations given in: (1) 4th year engineering design at the University of Bath (2) 2nd year psychology at the University of Bath and (3) Mature-age 'Key-skills' classes at the City of Bristol College. Numbers varied from start to finish of each investigation, due again to self-selection, as participants admitted to their disinterest in the programme and thus no statistical significance of overall results was determined. However, at the same time this implies that information received from participants is quite critically reported and a reasonable reflection of true events, rather than exaggerated – which might have been the case, if participants stood to gain professional or academic kudos from their continued presence –for example from admitting the extent of their participation or experiences. A fourth and final investigation was run lasting one week. This involved testing a team from the London Diamond Way meditation centre who had been practising more than 3 years, while they were involved in running an event at a dedicated retreat centre.

3.1 Investigation structure

The setup of the investigation was designed to allow all nine criteria of activity necessary to promote the high achievement and creative 'flow' of Csikszentmihalyi [17]**.**

Participants were given clear, but only very general, information on the *goals, limits* and potential benefits of using the meditative tool in the initial meeting –enough to alleviate any unnecessary fears, but too little to prevent creation of false hopes. For investigational phases 1-3, an exact schedule was followed for presentation of the tool and testing of participants, both for clarity of the activity on part of the participants and for ease of assessment by myself. In outline, participants were introduced to the investigation and were given the first symbolic equivalents test. They then met weekly with the researcher for one hour of discussion and Q & A on any issues which may have arisen during the week. They were also presented with new information on another aspect of the meditative tool. For the first 4 weeks, they were given one new meditation per week. They were asked to meditate daily, on their own for a minimum of 10 minutes, ensuring by definition that they had at least 10 minutes a day *free from distraction*. Thereafter, there were asked to choose their favourite meditation and concentrate on that, for the remainder of the investigation. Participants were asked to keep diaries of their experience during and between sessions, according to a select list of criteria (described below). Participant diaries were collected in the 12th week of investigation, when the second symbolic equivalents test was given. Electroencephalographic (EEG/brainwave) and electrocardiographic (ECG/heartbeat) testing was also done before and after each 3-month phase, in order to determine whether lasting physiographic changes occurred, but elucidation of these is beyond the scope of this paper and obviously less relevant to engineering design, than psychology.

Feedback about participant progress or perceived lack thereof was provided 'on tap' through email or phone contact, and all other information given verbally at weekly meetings during the different phases varied, depending on participant questions. Participants were provided with 'safe space', to allow for *lack of self-consciousness*, in that they were not required to provide verbal information on their experience to others at weekly meetings. In addition, they were continually reassured there was 'no right answer', and that they *could not fail*, at the very least because everything they did –both by testing/experiencing the meditative tool in the first place and then also by recording their experience would be useful, if not immediately obvious, by contributing to the scientific community and databases of research on creativity and the mind.

Participants keeping diaries were asked to assess quite general, work-related or process-related changes in the following abilities, during their three months practise;

i. Could they work better and complete tasks on time
ii. Could they better identify what tasks would help solve a problem
iii. Could they use more strategies and resources to explore their problems
iv. Could they get necessary support for things they find difficult
v. Could they put together information from different sources
vi. Did they exchange more information and find common objectives with others
vii. Did they get better at sustaining their own motivation
viii. Did they get better at taking the lead in making things happen
ix. Were they calmer or more confident?

Since they were novices, the testing of the meditative tool was a *challenge, rather than a skill* for all participants, and this was the most difficult aspect of the investigation. However, the structure of the meditative tool itself is such that it is designed to promote *suspension of the sense of time and space* [described below], and so *enjoyment or reward*, which is not dependent on any other extrinsic variables, is also built into the tool.

In order to determine the broadest possible scope in which this tool could be used, I also made notes according to whether participants exhibited characteristics described for creative individuals by Craft [20], as detailed in section 2.2. I noted in passing whether participants reported basic physiological changes, according to what could be expected from pre-existing research on the effects of meditation [eg. review 3] –for examples on levels of stress and calm [adrenaline, body temperature], on pain or loss of sleep. In addition, I also noted in passing how quickly, whether or when team members opened up to each other, supported each other and achieved basic levels of interactional synchrony [ie. unified body movements], indicating they felt trust and resonance in communication (eg. 32; 33; 34; 35). This became a diary of meetings and conversations, which was correlated with participant diaries and other information [ie from EEG/ECG], at the conclusion of each investigational phase. My observation and evaluation of this data changed as the project progressed, as it became more obvious what was or was not important for both inciting and measuring progress in individuals over short-time frames, and much of this information is still largely tacit. However just as the third phase of investigation was informed and improved by mistakes made earlier, it is natural that any tacit understanding will become explicit in the thesis regarding how the meditative tool can be adapted for future use in design.

3.2 General meditation structure

There are many different types of meditation in different traditions. They have different goals, and use different sets of images, sounds or body movements. In the west, non-Buddhists have usually heard there are two vastly different types – meditations which focus on calming the body and breath and seem to induce 'relaxation', and meditations which mostly focus on using the brain and involve 'analysis' or insight. Ideally, however, *both* these two types or mechanisms of practise are integrated in a single path, the underlying structure of which starts with the motivation[s] of the practitioner and ends with her view of the world.
This is certainly true in the Diamond Way tradition of Tibetan Buddhism, from which the four meditative tools used in this investigation are derived. In the most complex of these, there are seven distinct stages of the process. These are called: A) Four thoughts B) Refuge C) Building up phase D) Blessing phase – body, speech and mind E) Completion, melting or dissolution phase F) Activation phase G) Dedication.

We can roughly but usefully translate these stages into terms we know from studies on organizational complexity [36; 37], and from the structure of the design process according to Pahl and Beitz's form and function model [38], among others which are well-accepted [eg. 39]. Thus:

A. We define our current situation [point of origin] and coincident motivation for moving, transforming or changing something. That means we determine our *needs and/or tasks*. In western psychology, motivation is usually established by focussing on the pathology of being stuck in the current situation –ie. the 'problem'. In contrast, the meditative tool used here focuses on the mirror image –the ultimate goal or most positive outcomes of moving from the current situation.

B. We develop or are given [and accept] *specifications* for a template of the desired goal [point of solution]. This goal does not exist arbitrarily, as some philosophical point. It is an overall function which has a high level of internal structure –both geometric and psycho-social, with which we can identify.

C. In the first cycle of action, we create a *conceptual design*, by setting up the gross template of the solution as a mirror opposite our existing situation. The goal is not arbitrarily fixed in some space we cannot see and do not know how to find. Its internal structure, as well as the structure we form in relation to it, both create a map for transforming our current situation or 'the space where we are' into the ideal 'space where we want to be'. The map outline is very simple –we mentally diverge from our starting point and converge on our desired finishing point, just like the eye does, when it looks at objects apparently located behind a physical mirror, in a diamond shape.

D. In the next cycle of action, we map the details from the template onto the existing situation. That means we carry out iterations of convergence and divergence for all subsystems of the overall form – material, communication and information systems. In terms of Pahl and Beitz [38], we select building blocks or *combinations of solution principles* to fulfil the overall function.

E. We overlay the complete template of the solution on the existing structure, in its current context, trying to 'melt' or 'dissolve' the boundaries between them. This is the stage of detailed design, *concept variants*, or *form variant* or *embodiment design*. In the meditation, this is the point at which we do or do not achieve a transparency of the point of origin and the goal.

F. We create a best fit of the template in the current context. This is the last cycle of action and critical reflection, determining *the final layout or prototype*, fitting the template to the situation.

G. Finally, we imagine a general application or *manufacture* of the template for all other systems, which are like ours and might benefit from using the same map.

3.3 Co-evolutionary structure of meditation

Historically, making a connection between 'problem and solution' or 'template and reality', or 'knowledge and concept' or any other datasets that do not originally fit together involves three major steps (and skills) – (i) abstracting patterns from the original complex datasets, (ii) recognizing and evaluating similarities or useful differences between them, and (ii) mapping the selected, abstracted data onto a template, which has been previously established as a goal. The process is iterative and can be mathematically described [eg. 22; 41, 42, 43, 44] as well as intuitively understood or consciously exploited in drama, music and literature.

The process can also be usefully represented geometrically –in the simplest case by an equilateral triangle [41, 42], with conflicting or dialectic components along one leg, and the ideal, final, desired goal, target or solution at the apex. We can easily see the resolution of any two dualistically separated concepts in their unity at the apex. The problem situation must naturally be defined in a similar way –as the apex of a triangle which disperses into rays of conflicting or dialectic components that create its opposing leg. Next, we must combine the triangles and find the steps of problem identification, divergence, convergence and solution-finding. Thus we draw the process of resolving contradiction or integrating multi-disciplinary information as two triangles end-to-end or back-to-back.

In modern environments and real product development time, the ideal scenario for the meditative process would likely be just one run of the process – from a single point of complete problem definition to a single point of complete solution –the *diamond* shape, or indeed just one step –transcending the process altogether [45]. If we increase the speed or streamline the cycles of action and critical reflection within action research, the distinction between problem and solution ceases to exist –as practitioners of action research have already discovered [31 –and see section 2.4]. Buddhist teachings also say that the 'creative leap' or point at which 'problem-solution' distinctions or the 'me-you divide' or co-evolutionary paths of thought are unified can happen at any time in meditation. This is the ideal point of irreducible meaning to which homologous analogy or 'solution-space – problem-space interchange' will lead [see also 22].

It is not impossible that a single iteration of the process will lead to the perfect result in meditation or design –but it is unlikely that this ideal scenario can be achieved in real life. We know from Pahl and Beitz's [38] template for the process of engineering design that the path of creating any material thing is not linear in two dimensions, moving once from a problem to its solution, but always diverges and converges in arrays of thought, idea, concept or material prototype –from points of understanding to confusion to editing and back to consensus, for instance … like a series of diamonds strung into a necklace.

The process of meditation has yet more important and additional information, compared with action research–it is not merely cyclic either, keeping us stuck in iterations of a circle. We can say that the process is at first apparently *mirrored,* due to the symmetry of task and goal. But in practise, the mirror becomes non-existent [at step E]. This does not mean that we reduce the diamond to a point and achieve instantly enlightened product design after all. It means

information from the conceptual, imagined or projected solution-space re-informs the problem-space, and vice versa, producing 'co-evolution' of both. It means the process is, in fact, bi-directional.

The most potentially useful thing about the meditative tool, which places it above any abstracted process we currently use in design or manufacture or as backdrop to the field of 'creativity' tools, is that it involves the whole person in the *process from inside*. The point of the tool is not just to know what the ideal solution should be, nor merely how the ideal process should work, but to embody it and its associated ideal functions [which arguably involve the diamond-shaped, co-evolving symmetry at every level of operation], such that *we become the process*, and it becomes ultimately second nature to act out the ideal process in any given situation, without effort.

4. Trends in the investigation

4.1 Symbolic equivalents

The only psychometric test which proved insightful as investigation progressed, and was simple enough to run in a time-frame which suited participants (under 15 minutes), was one where participants are asked to produce a symbolically equivalent image of a presented stimulus – called a 'symbolic equivalents test'. This was originally created by Barron [46], and has many forms. It can be specially created or adapted to suit any situation – the main variable in the test is the interpretation of the researcher, so as long as the original symbols and the criteria for evaluation are consistent across the group of tests, the results are valid –it does not matter what these criteria are.

I used a test, which is widely available, of six simple shapes arranged in a particular order in a 3x2 grid –respectively a large and small circle, triangle, large and small cross, and an S-shape. Theses symbols are understood in Jungian psychology and greek geometry to be 'archetypal'. In order of appearance, the circle stands for 'sense of wholeness' –so a large one represents one's 'worldview', a small one represents our 'sense of self'. Next, the geometry of the triangle represents 'relationship', as we know from triads of religious or spiritual tradition and hence symbolizes our 'sense of family/team'. The cross represents 'duality and its resolution', an act which takes place at great cross-roads of choice or decision-making –thus a large cross represents our 'sense of immediacy' during minor crises [eg. at board meetings] and general 'attitude to life', while a small cross stands for bridges which are still in the distance, such as 'death/conclusions'. Finally, the figure 'S' represents 'movement' or 'flow' and is used to understand our attitude towards 'creativity/sex'.

Participants are asked to draw recognizable pictures on top of these symbols, thus ensuring that the pictures they create are symbolically equivalent to the original shapes and can be used to interpret their attitudes to world, self, team etc, as described above. At the same time, they must provide a 2-3 word label for their picture, which is inevitably both concrete and poetic.

Given free range to fill out the test without prompting, in whatever way they felt appropriate, participants over all phases of investigation drew pictures in only ten broad categories, all of which can be considered archetypal at level above the geometric – (i) the sun, (ii) the moon, (iii) the world, (iv) a face, (v) a person, (vi) flowers, (vii) non-directed flying things, (viii) arrows, (ix) circular and (x) prismatic shapes.

The comparisons of 'before' and 'after' meditation pictures show individual progressions in attitude or thought-pattern over each phase of three months. For all four phases of investigation, the most significant change in participant attitude shows up in the view of the family/team. 75% of experienced meditators drew arrow-like shapes, labelling them as 'direction', and implying that they shared a goal with their team. Most non-meditators, on the other hand, tended to draw non-directed flying things, implying there was no goal-orientation, focus or in their team. Overall phases of investigation, meditators were two times more likely to show a directed, team-focus and sense of belonging to their team than non-meditators.

4.2 Diary entries and weekly conversations

Since this was an exploratory study, it was impractical to observe each of the potential elements, experiences, acts and effects of meditation on 'creativity' or information transfer in detail, so this section provides a mere overview of the most interesting trends in diary entries and verbal reports.

Anxiety, stress or calm
All thirty participants who took part in the 4 phases of the investigation reported feeling calmer, and as a result more lucid, at some stage during the investigation. Twenty participants reported feeling less stressed for significant periods of their day or week, between meditation sessions, and many were surprised that colleagues and friends commented favourably on their more relaxed attitude. Two novices felt as relaxed as if they had 'been on a holiday', after each individual meditation session. Two other novices found that after several weeks, they were spontaneously able to control their panic attacks or nervous physical twitch, leading to increased confidence in social situations, which they directly attributed to being calmer from meditating.

Sleep and dreams
Three novice participants found it significant that they needed less sleep since they started meditating, and that their dreams were more vivid. In the final phase of investigation, the ten experienced meditators also reported that they slept very little.

Insight, better understanding of external demands
Many found that the period of withdrawal from daily stimuli during the 10-minute period of meditation led to extraordinary or unanticipated insights into their design projects or university studies.

Trust and support of others in team
As investigation progressed, participants who originally spoke to each other indirectly, or through me, started talking directly to each other. As each team member learnt that others were having similar experiences or worries and fears, trust deepened and participants started to meet each other outside the investigational situation, to exchange information and ideas.

Goal orientation, internal control, persistence, sustaining motivation, leadership
Participants took the investigation itself as a challenge, and all thirty who finished the investigation need to renew and sustain their motivation to do so several times, when it seemed to them that results were not forthcoming. All participants learnt to temper their premature judgements and evaluation of unknown outcomes.

Openness and enjoyment of experimentation, sense of humour or playfulness, ability and wish to communicate, lack of feeling threatened, self-reliance, self-confidence, courage
Participants in all phases of the investigation certainly became more open to investigation with the meditation, as time went on. The effects of this on their daily life were not determined. They also became more self-confident in their team, as time went on, although, except for the group of meditators (see also below), this did not translate into significant project activity.

Basic interactional synchrony and resonance in communication
As each investigation progressed, the level of synchronous body movement during weekly team meetings increased a small amount. The team of experienced meditators exhibited the highest degree of resonance.

5. Conclusion

Fluid response to information is a highly desirable characteristic in modern design environments, where a high level of multi-disciplinary knowledge transfer is a likely contributor to producing novel design under time-pressure, yet fixation of concepts is a concern.

Meditation from the Diamond Way Buddhist tradition is a tool, which involves the process of unifying separate but co-evolving paths of thought, and aims to streamline a habitual and complex response to data. It aims to enable greater choices and freedom in our use of information. Its ability to do so lies partly in its internal structure, which was outlined in sections 3.2 and 3.3.

This investigation aimed to refine methods for use of the tool with design teams, to achieve maximum benefit in shortest possible time. The preliminary evidence outlined in section 4 indicates that meditation can help students of engineering design [and other subjects] feel calmer under stress and enhance lucidity or awareness during moments of decision-making. It also indicates that long-time meditators are more likely to understand the goals of their team and feel as if they are benefiting others, than non-meditators.

Much of the potential of the tool remains untapped and untested. However, these results provide the backdrop for a supposition that meditation could prove to be a useful template for maximizing creativity in any co-evolutionary process, including designing in teams.

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