Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes

CREATIVE EMOTIONAL REASONING

C²LEARN PROJECT DELIVERABLE NO. D2.1.1

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3.0	30/04/2013	UEDIN	Final draft with minor changes.

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Abbreviations used

A) Abbreviated names of the project consortium partners

Abbreviation	Explanation
EA	Ellinogermaniki Agogi, Greece (coordinator)
UEDIN	The University Of Edinburgh, UK
OU	The Open University, UK
NCSR-D	National Centre For Scientific Research "Demokritos", Greece
UoM	Universita ta Malta, Malta
SGI	Serious Games Interactive, Denmark
BMUKK	Bundesministerium Für Unterricht, Kunst Und Kultur, Austria

B) Other abbreviations in alphabetical order

Abbreviation	Explanation
C^{2}Learn	Acronym of the project (full title: Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes)
DoW	Description of Work (Annex I of the Grant agreement no. 318480)
EC	European Commission
FP7	The Seventh Framework Programme for Research and Technological Development (2007-2013)
ICT	Information and Communications Technologies
M#	#th month of the project (M1=November 2012)
TEL	Technology-Enhanced Learning

Abbreviation	Explanation
CER	Creative Emotional Reasoning
LTC^2	C^{2}Learn's Lateral Thinking
SLT	Semantic Lateral Thinking
DLT	Diagrammatic Lateral Thinking
ELT	Emotive Lateral Thinking
WHC	Wise Humanising Creativity
LDS	Living Dialogic Space
LT	Lateral Thinking
BT	Brainstorming technique
DR	Diagrammatic reasoning
ELJ^1	First Order Emotive Lateral Judgment
ELJ^2	Second Order Emotive Lateral Judgment

Executive summary

C²Learn at a glance

C²Learn (www.c2learn.eu) is a three-year research project supported by the European Commission through the Seventh Framework Programme (FP7), in the theme of Information and Communications Technologies (ICT) and particularly in the area of Technology-Enhanced Learning (TEL) (FP7 grant agreement no 318480). The project started on 1st November 2012 with the aim to shed new light on, and propose and test concrete ways in which our current understanding of creativity in education and creative thinking, on the one hand, and technology-enhanced learning tools and digital games, on the other hand, can be fruitfully combined to provide young learners and their teachers with innovative opportunities for creative learning. The project designs an innovative digital gaming and social networking environment incorporating diverse computational tools, the use of which can foster co-creativity in learning processes in the context of both formal and informal educational settings. The C²Learn environment is envisioned as an open-world 'sandbox' (non-linear) virtual space enabling learners to freely explore ideas, concepts, and the shared knowledge available on the semantic web and the communities that they are part of. This innovation is co-designed, implemented and tested in systematic interaction and exchange with stakeholders following participatory design and participative evaluation principles. This happens in and around school communities covering a learner age spectrum from 10 to 18+ years.

About this document

Deliverable 2.1.1 is the first instalment of a document explicating the key concepts and principles relating to Creative Emotional Reasoning. CER is a non-linear thinking methodology, developed primarily by UEDIN, to be implemented in C²Learn's computational tools. We first explore the notion of creativity as it applies to the project's specific needs, and based on these remarks we develop our non-linear thinking theory. The presentation of the theory consists of two parts: The first deals with its origins and conceptual foundations, whereas the second consists of an analysis (including techniques, proto-techniques and processes) of the three kinds of non-linear thought comprising CER, i.e. Semantic, Diagrammatic and Emotive Lateral Thinking.

0   Introduction

Deliverable 2.1.1 seeks to explicate the key concepts and principles constituting **Creative Emotional Reasoning** (**CER**). This introductory note aims at a first acquaintance with the main theoretical terminology used throughout the Deliverable, which will help the reader better orient him/herself within the main body of the text, accompanied by a brief overview of the Deliverable's each main section and subdivisions.

0.1   BASIC TERMINOLOGY

CER is an umbrella term and refers to *a principled, unifying theory of non-linear thinking techniques[1] that foster co-creativity, and the theory's implementation within C²Learn's computational tools*.[2]

Non-linear thinking is a rather broad genus, encompassing different types of thinking processes, connected more through family resemblances, rather than a single over-arching feature shared by all. For the purposes of this Deliverable though, we can give a possible description as follows: Thinking characterized by the use of imagination, spontaneity, flexibility, attention to intuitions, perceptions, and feelings, construction of associations, in order to arrive at an insight or understanding, relying less on reasoning that can be classified as logical/deductive.[3]

For **C²Learn** we are creating a particular type of non-linear thinking methodology hereby termed as: **C²Learn's Lateral Thinking** (**LTC²**)[4]. In creating it we are using de Bono's **Lateral Thinking** (**LT**), as well as various **Brainstorming techniques** (**BTs**) - all falling within the genus of non-linear thinking - as a starting basis. We are developing them further by providing a more rigorous categorization, unifying techniques in more comprehensive wholes and doing away with redundancies, tailoring them to suit C²Learn's educational needs, and also, most crucially, expanding this kind of analysis to incorporate diagrammatic and emotive reasoning processes. Accordingly LTC² is divided into three distinct, yet interrelated, kinds: [1] **Semantic Lateral Thinking** (**SLT**) [2] **Diagrammatic Lateral Thinking** (**DLT**) and [3] **Emotive Lateral Thinking** (**ELT**).

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[1] Developed primarily by the University of Edinburgh (UEDIN), with important contributions and support from our partners in the Open University (OU), Ellinogermaniki Agogi (EA) and the National Centre for Scientific Research "Demokritos" (NCSR-D).

[2] Developed primarily by NCSR-D with contributions by the University of Malta (UoM), Serious Games Interactive (SGI) and support by UEDIN.

[3] See for example De Bono E., *Serious creativity: Using the power of lateral thinking to create new ideas*, New York: HarperCollins Publishers, 1992, and Csikszentmihalyi M., *Creativity: Flow and the psychology of discovery and invention*, New York: HarperCollins Publishers, 1996. Of course, as in most human thinking processes, the boundaries between non-linear/deductive are blurred, and usually one will deploy a mixture of both. See e.g. Katz A., "Creativity in the cerebral hemispheres", in Runco M. A. (Ed.), *Creativity research handbook*, Cresskill, NJ: Hampton Press 1997.

[4] Formally CER and LTC² differ in that the first term includes the implementation of the theory into the computational tools, whereas the latter refers only to the theoretical aspect of the work. For practical reasons, though, these two terms can be understood as equivalent.

Note:

Synergies are essential within a multi-faceted, inter-discipline project such as *C²Learn*. One very important such synergy is being built with the OU team, our partners in the explication of the theory grounding the project. It consists of a merging of our theoretical approaches, an on-going process, which has already reached some important landmarks. Two of the key terms from OU's perspective, i.e. **Wise Humanising Creativity** (**WHC**) and **Living Dialogic Space** (**LDS**) are specifically addressed in Sections [1.3] and [2.3] respectively, but evidence of more minor merging can be found in other sections too.

0.2   BRIEF OVERVIEW OF CONTENTS

Deliverable 2.1.1 is divided into three parts (plus an Appendix):

[1] Creativity: Consists of a brief exposition of some current issues primarily in the philosophical literature on creativity (Section [1.1]), as an introduction to the concept, and for the purposes of acquiring terminology that will aid us in defining creativity within the context of CER (Section [1.2]). There is a brief exposition of WHC and its relation to CER (Section [1.3]) at the end.

[2] C²Learn's Lateral Thinking: Consists of three sections. Section [2.1] is an overview of the origins of LTC^2. We examine the basic tenets of LT and indicative BTs, with a well-known example analysed for each one (Section [2.1.1] and [2.1.2] respectively). In Section [2.2] we provide the foundations for LTC^2, and subsequently situate it within the larger framework of LDS (Section [2.3]).

[3] LTC^2 techniques: This is the main part of the Deliverable. We examine and ground theoretically the three kinds of LTC^2. Section [3.1] explicates SLT. SLT is the most fully developed of the three kinds, as it is the basis upon which the other two kinds rest. An analysis of the four major techniques comprising SLT is provided. In Sections [3.2] and [3.3] we examine the fundamental principles guiding DLT and ELT respectively, and provide proto-techniques and processes as building blocks for the production of more elaborate techniques

In the **Appendix** we provide a short description of our plans for future work within the *C²Learn* project.

Note:

In [*Figure 1*] below, an overall terminological layout is provided - including the points of theoretical synergy with OU – that can serve as a conceptual map, to aid in the comprehension of the Deliverable's contents.
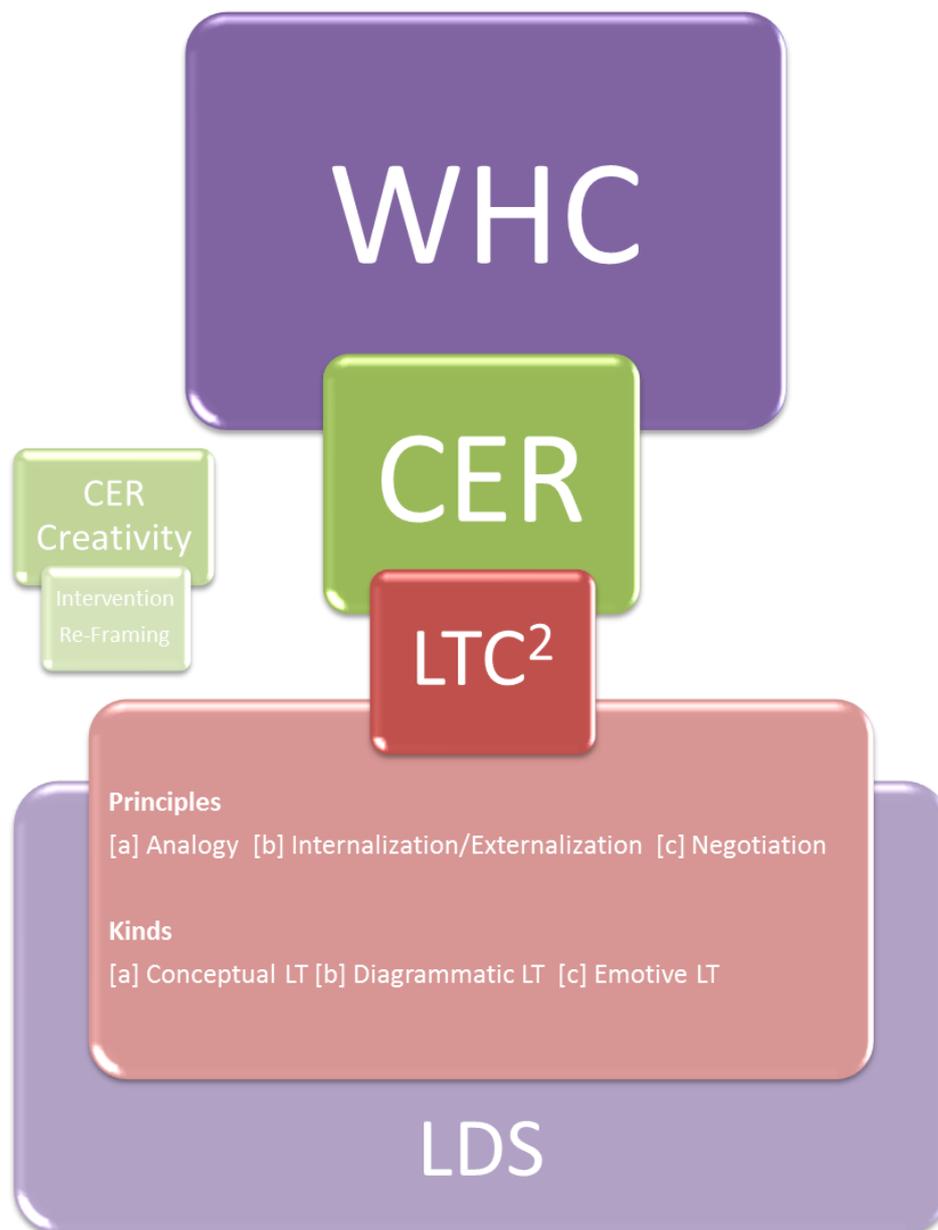
Figure 1: Layout of key theoretical terms of Deliverable 2.1.1

1   Creativity

The C^{2}Learn project aims to introduce an innovative digital gaming and social networking environment incorporating diverse tools, the use of which can foster co-creativity in learning processes in the context of both formal and informal educational settings.

It is therefore of great importance to reach an adequately deep understanding of the main notion involved in this endeavour, namely *creativity*, primarily from a philosophical perspective which is the UEDIN team's main area of expertise. To that end we will begin with a very brief overview of some key philosophical issues in the relevant literature (expanding somewhat to other disciples too) that will provide us with some of the tools to address the issue of creativity within *C^{2}Learn*, with particular focus on *Creative Emotional Reasoning* (**CER**) (Section [1.2]). We will then move on to situate CER creativity within the larger framework of *Wise Humanising Creativity* (**WHC**) (Section [1.3]).

1.1   A PHILOSOPHICAL APPROACH TO CREATIVITY

Creativity, within the discipline of philosophy, was long sidelined or restricted to the domain of art and aesthetics, but is now blooming into a self-sustainable and wide-reaching field of philosophical research. Plato's view of inspiration as a kind of madness – an activity of the gods within us[6] – had exercised a deep influence over the centuries, pushing creativity to the edges of rational enquiry, and enshrining it within a quasi-mystical halo. In modern times psychology, and later on cognitive science has paved much of the way towards a scientific understanding of creativity, and philosophy is also currently expanding its research interests and methods to provide its own distinct insights.

The most basic level of enquiry on creativity concerns its definition. Kant's essential commentary on creativity: "since there can also be original nonsense, its [the genius'] products must at the same time be models, i.e. exemplary"[7], has guided much of today's research. This statement already contains, in more implicit form, two of the leading notions that are most commonly put forth as the defining characteristic of a creative artefact (be it an idea, item etc.), i.e. that it must be *novel*[8] and *valuable*. By 'novel' one usually means new, never before encountered.[9] An interesting distinction here is between *P-creative* ideas, i.e. psychological novelty, referring to an idea that is new to the person that produced it, and *H-creative*, which are P-creative with the added caveat that the idea has never occurred in history before.[10] 'Valuable' can have many meanings such as useful, beautiful,

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[5] Shaw G. B., *Back to Methusehla*, New York: Brentano's, 1921, p. 6

[6] Plato, "Ion", *Plato: The Collected Dialogues*, Eds. Hamilton E. & Cairns H., Princeton, NJ: Princeton UP, 1961.

[7] Kant I., *Critique of the Power of Judgment*, Trans. Guyer P. & Matthews E., Cambridge: Cambridge UP, 2000.

[8] E.g. Hausman C., "Criteria of Creativity", *The Idea of Creativity*, Eds. Krausz M., Dutton D. & Bardsley K., Leiden: Brill, 2009.

[9] Boden M., *The Creative Mind: Myths and Mechanisms*, London: Routledge, 2004. An interesting question that arises here is whether the notion of 'novelty' in itself (i.e. irrespectively of whether one adds 'valuable' to it), contains an evaluative dimension, which is not completely captured in the notion of 'new', 'never-before-encountered'.

[10] Ibid.

interesting,[11] appropriate[12] etc. Primarily, this clause seeks to guard from the intrusion of 'original nonsense', counting as creative. Others have also argued that **surprising**[13] should be included in the definition, as an extra qualification of novelty.

The problem of 'malevolent creativity' is also thematized in the literature. Original terrorist attacks[14], or inventive ways to torture other people[15] present serious obstacles in defining creativity. The common-sense view tends to be that there is something creative about such horrible acts, yet this creates problems to our understanding of the "valuable" clause mentioned above. What is valuable about a - otherwise ingenious – terrorist attack? How are we to understand this ascription of value? On the other hand, as was mentioned above, excluding the "valuable" clause threatens to allow nonsense to be creative. Some theorists deny such acts the status of creativity, and rather speak of ingenuity in destruction[16]. Others though would claim that this goes against the common-sense understanding of such acts.[17] What is clear is that ethico-cultural concerns can become very important when evaluating an act as creative or not.

It is indicative of past great thinkers to focus their accounts on the highly exceptional individual as a model of the creative process, a prejudice that in some ways is still evident today in the most common-sense understanding of the word, but which is constantly undermined as modern research focuses equally on every-day, and more social forms of creativity.[18] A number of distinctions have been developed, relating to the different levels of creativity. Every-day creativity is usually referred to as **little-c** creativity, and juxtaposed to **big-c** creativity which refers more to high creativity and genius. Others have further developed the scale by introducing **mini-c**[19] (the way one creatively makes sense

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[11] Ibid.

[12] Sternberg R. J., ed. *Handbook of Creativity*, Cambridge: Cambridge UP, 1999.

[13] Novitz D., "Creativity and Constraint", *Australasian Journal of Philosophy* 77.1, 1999.

[14] Beaney M., *Imagination and Creativity*, Milton Keynes: Open UP, 2005.

[15] McLaren R. B., "The Dark Side of Creativity", *Encyclopedia of Creativity* vol. 1., Pritzker S. R. & Runco M.A. (Eds), San Diego, CA: Academic Press, 1999

[16] Novitz D., "Creativity and Constraint", *Australasian Journal of Philosophy* 77.1, 1999 and Novitz, D., "Explanations of Creativity", *The Creation of Art: New Essays in Philosophical Aesthetics*, Gaut B. & Livingston P (Eds), Cambridge: Cambridge UP, 2003

[17] Cropley D. H., Kaufman J. C. & Cropley A. J.,"Malevolent Creativity: A Functional Model of Creativity in Terrorism and Crime", *Creativity Research Journal* 20.2, 2008

[18] E.g. see Craft A. & Jeffrey B., 'The Universalization of Creativity', in Craft A., Jeffrey B. & Leibling M., *Creativity in Education,* London: Continuum, 2001 and Simonton D. K., *Greatness: Who makes history and why*, The Guilford Press, 1994.

[19] Beghetto R. A. & Kaufman J. C., "Toward a broader conception of creativity: A case for 'mini-c' creativity", *Psychology of Aesthetics, Creativity, and the Arts 1*2, 2007.

of the world) as well as **middle-c**,[20] as an in-between term between little and big. (There is even the idea of a **pro-c**[21] creativity specific to profession related activities).

Figure 2: The paradigm of the 'lone genius' as the exclusive bearer of creativity has come to an end.

Agency is central to any account of creativity. The most common understanding of a creative agency restricts it to human action. There are though researchers who would disagree. Take the case of a tree.[22] In some ways a tree can be considered as a creative agent. It is obviously alive, exhibits growth, reproduces and interacts with its environment. The way it deploys its branches and roots, to make the best possible use of light and other natural resources, can be understood as a creative solution to the particular problem of nourishment. Also the resulting distribution of braches, i.e. the canopy of the tree, is what human observers experience as the beauty and majesty of the tree. Still many would argue that much is missing that would qualify a tree as an agent, namely beliefs, desires and other essential types of intentional states.[23] One may therefore question whether changes in a tree's condition, even if self-produced, can constitute *acts* in the full sense of the word.

It may be argued that the modern use of the word creativity was actually invented in the 19th century as an attempt to merge the different notions of innovation in science and the arts.[24] This is related to a major field of controversy concerning the comparison of creativity's operation between domains. Kant for example would like to restrict it to art as the genius is not-rule governed, but the "great mind" of science is[25]. Others disagree on the basis that both artistic and scientific creativity can be

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[20] Moran S., "Creativity in school", in Littleton K., Wood C., and Straarman J. K. (Eds.), *International handbook of psychology in education*, Emerald: Bingley, 2011.

[21] Beghetto R. A. & Kaufman J. C., "Beyond Big and Little: The Four C Model of Creativity", *Review of General Psychology* 13(1), 2009.

[22] Arnheim R., "What it Means to be Creative", *British Journal of Aesthetics 41.1*, 2001.

[23] Gaut B., "*Creativity and Imagination*", *The Creation of Art: New Essays in Philosophical Aesthetics*, Gaut B. & Livingston P. (Eds), Cambridge: Cambridge UP, 2003.

[24] Weiner R., *Creativity and Beyond: Cultures, Values, and* Change, Albany, NY: State University of New York Press, 2000.

[25] Kant I., *Critique of the Power of Judgment*, Trans. Guyer P. & Matthews E., Cambridge: Cambridge UP, 2000.

seen a matter of problem solving/finding[26]. This relates to the issue of discovery vs. creation, with some claiming that parallel discovery in science shows that genuine creativity can only happen in art (where the idea of a work of art being created by someone else seems absurd). Platonists would object claiming that works of arts are also discoverable, but only by those uniquely constituted to discover them.[27]

The constitutive connection between imagination and creativity had already been observed by Kant[28]. The central role of imagination has led contemporary researchers to investigate the connections between children's' pretend-play and adult creativity,[29] which has led some theorists to posit a distinction between *passive* (or unbidden) creativity (unbidden occurrence of ideas) and *active* (or bidden) creativity (one tries different approaches) with imagination being identified as the vehicle for the latter.[30] Others would disagree with this distinction maintaining that imagination, especially in children, is more characterized by passivity (unbidden)[31] or is a mixture of both[32].

A further distinction is that between *combinatorial*, *exploratory* and *transformational* creativity.[33] *Combinatorial* creativity refers to the production of novel ideas by associating previously un-linked or indirectly linked ideas. Analogy is the most basic form of this kind of creativity. *Exploratory* creativity relies on the notion of a 'conceptual space', some culturally accepted style of thinking, that is in some way regulated and restrained by a set of largely implicit generative rules. The creative agent thus moves through the space in exploration of what is already there, which may lead to the discovery both of the limits and the potentials of the given space. The rarest kind of creativity is *transformational*, which opens up a completely new space of possibilities, by altering or disregarding some of the implicit or explicit defining dimensions and rules of the conceptual space, thus allowing for ideas and solutions that could not have been generated up till then.[34]

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[26] Briskman L., "Creative Product and Creative Process in Science and Art", *The Idea of Creativity*, Eds. Krausz M., Dutton D. & Bardsley K., Leiden: Brill, 2009.

[27] Kivy P., "Platonism in Music: Another Kind of Defense", *The Fine Art of Repetition: Essays in the Philosophy of Music*, Cambridge: Cambridge UP, 1993.

[28] Kant I., *Critique of the Power of Judgment*, Trans. Guyer P. & Matthews E., Cambridge: Cambridge UP, 2000.

[29] Carruthers P., *The Architecture of the Mind: Massive Modularity and the Flexibility of Thought*, Oxford: Clarendon Press, 2006.

[30] Beaney M., *Imagination and Creativity*, Milton Keynes: Open UP, 2005 and Gaut B., '*Creativity and Imagination*', *The Creation of Art: New Essays in Philosophical Aesthetics*, Gaut B. & Livingston P. (Eds), Cambridge: Cambridge UP, 2003.

[31] Warnock M., *Schools of Thought*, London: Faber, 1977.

[32] De Bono E., *The Use of Lateral Thinking*, Penguin Books, 1990.

[33] Boden M., *The Creative Mind: Myths and Mechanisms*, London: Routledge, 2004.

[34] It is interesting here to note the parallels with the Kuhnian idea of a *paradigm shift* in a scientific world-view, which in a sense, amounts to us inhabiting a different world. See Kuhn T. S., *The Structure of Scientific Revolutions*, University of Chicago Press, 1996.

1.2   CREATIVITY WITHIN CREATIVE EMOTIONAL REASONING

C²Learn seeks to foster creativity through non-linear thinking. CER is our applied methodology for achieving this goal. It is therefore important to understand creativity within CER, before examining the more comprehensive creativity framework within which CER operates (Section [1.3]).

Within the context of CER the creative act is understood as ***an intervention that results in re-framing***. To come to terms with this definition it is important to first examine how agency is viewed in this context. Agency is usually understood as a causal effect resulting from some human action, usually opposed to an inanimate cause. Within CER we understand agency in connection to a frame. Frames are everywhere, and can be loosely understood as systems of established routine, that divide the world into bounded, meaning-bearing sub-worlds. ***Agency is an intervention from outside a particular frame***. This means that an agent cannot be fully encapsulated within a particular frame, but is a form of interaction with that frame. This has the upshot, that certain events, such as an asteroid hitting the earth can be understood as agency, whereas some individual human actions which are wholly within a frame cannot. These counterintuitive consequences are, we believe, counter-balanced by the fact that this definition captures the elusive nature of agency, i.e. as an act which cannot be fully explicated deterministically (within the boundaries of an established routine). Let us not forget that even in everyday life we are not ready to ascribe agency in every kind of individual human action. Automatic reflex gestures, are an easy example, but think also of more complex phenomena such as an individual protestor within a large block of people. (Is the individual still the agent in such a case or has the whole block of people assumed the role of the agent?)

There are also *C²Learn* specific reasons for following this type of definition: [i] We obviously want to encapsulate most of the common-sense understanding of an agent as the human individual that acts, in this case the individual player. This interpretation is still possible within the boundaries of the above definition. [ii] We recognize that people frequently submerge their agency - understood in common-sense individualistic terms - in larger social groups: families, teams, firms etc. This is particularly important within the context of *C²Learn* where co-creativity, interpreted here as creativity between two or more humans, is an essential constituent. A whole group of students or even a wider web-based community for example, can thus be understood as an agent. [iii] Co-creativity can also be understood in terms of interaction between human and machine. It is thus important that our definition of an agent encompasses this possibility too. An individual human player, or group of players, equipped or interacting with the *C²Learn* computational tools, form an interventional unit, able to act creatively.

As frames depend on a notion of routine, ***re-framing*** can be understood as a disruption to an established routine. The threshold between agency and creative agency is not fixed, and depends on an evaluation of the disruption produced. The notions of a 'frame' and 'disruption' open up the space for further specifications of creativity along some of the axis mentioned above (Section [1.1]), i.e. that of novelty, usefulness etc. As *C²Learn* is still in the early stages of development it is important to leave these options open. The use of these concepts provides further benefits and opportunities. In assessing creativity we want to take advantage of both, the human evaluator, as well as the inherent capabilities of the computational tools. The computational tools that will be developed within the context of *C²Learn* will have the capacity to log many different kinds of data that can then be used in our evaluation of the players' performances. A frame is the equivalent (in social/logical parlance) of the data-space that the computational tools use as basis against which a new artefact (idea/solution/item) is to be evaluated. The definition/use of this data-space requires the specification of metrics of evaluation. It is important therefore that our approach to creativity, i.e. through the notion of intervention to a frame, can incorporate further specification when required. If

for example one chooses 'novel' as one of the metrics, then a frame would consist of all the artefacts that have appeared up to the time the new artefact emerges. A 'disruption' will consist of a new entity, not included in that space.

Figure 3: Creativity as disruption of established routine

Using some of the terminology that was introduced in Section [1.1] we can say that CER creativity falls in the spectrum of *mini-c* and *little-c*. In the *active*/*passive* debate, we would hold a middle ground acknowledging that such boundaries are not easily fixed. An interesting question arises if we try to apply the three-part distinction of creativity between *combinatorial*, *exploratory* and *transformational*. As CER rests primarily on analogy (see Section [2.2.1]), combinatorial is the most obvious candidate. Nevertheless, the use of *e-transformation* in DLT (see Section [3.2.3]) offers us the possibility for exploratory creativity. Similarly, the *Escapism* technique in SLT (see [Section 3.1.3]) and *Second-Order Emotive Judgment* in ELT (see Section [3.3]) may facilitate types of transformational creativity. Given the user group specifications and overall nature of the C²Learn project, it is safer to expect *P* rather than *H* type of creativity, i.e. the ideas/solutions that will be generated will mostly be new to the agent him/herself, rather than history as a whole. Note though that as agent can encompass a whole group, and include human-machine interaction (with the possibility of computer-controlled large data-bases storing, and assisting to evaluate, all and any new artefacts), the boundaries between *H* and *P* type can become quite blurred.

1.3   WISE HUMANISING CREATIVITY

CER is best understood as a particular manifestation of a more comprehensive creativity framework, that of WHC. WHC is a product of our partners' work from the OU team, and has become a point of synergy in our joined theoretical approach towards creativity. The foundations for this synergy have emerged, and continue to develop as our approaches merge through discussions, debates, constructive criticism and as both teams delve deeper into the particular demands the *C²Learn* project makes of our theoretical frameworks. It is therefore important to become acquainted with the concept of WHC.

WHC is informed by Chappell, Craft, Rolfe and Jobbins'[35] as well as Chappell's[36] work on humanising creativity, primarily in the foci of *little* and *mini-c*. It is an active process of change guided by

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[35] Chappell K., Craft A., Rolfe L. & Jobbins, V., "Humanising Creativity: valuing our journeys of becoming", *International Journal of Education and the Arts*, *13(8) 1*-35, 2012, retrieved 11.01.13 from http://www.ijea.org/v13n8/.

compassion and reference to shared values. Change derives from people's collaborative thinking and shared action. This imaginatively develops new ideas, which are valuable to those people and their community. Humanising creativity engages empathy, shared ownership, risky emotional journeys, negotiating conflict and difference, social responsibility and rigorous intention. In particular the collaborative and communal elements of humanising creativity will be important within *C²Learn*.

WHC is also informed by the notion of 'wise, creative trusteeship'[37], which attends to the impact of change, and encourages collectively-oriented responsibility and behaviours. It draws on the Berlin Wisdom Paradigm (e.g. Baltes and Kunzmann[38]), together with work by Sternberg[39]. These schools of thought recognise that wisdom can be understood as acknowledging multiplicity of perspectives on experience, knowledge and understanding, translated into appropriate courses of action which acknowledge multiple needs as well as understandings, in other words an orientation toward the common good. Wise creativity involves attending to potential impacts of the ever-expanding, multi-perspectival space of idea generation and exploration. WHC acknowledges, then, the complex multiplicity of impact, and how this is interpreted. Multiple perspectives are held at individual, collaborative and communal levels and so permeate culture. WHC recognises that creative outcomes are both made by, and themselves make, the creator/s. This perspective on creativity is positioned against marketized, individualized and culture-blind creativity, and embraces creative stewardship toward perceived collective or common good. Since such common good is contested, the values inherent in creative impact are more visible and debateable by those involved. The imperative in *C²Learn* is to create an environment that allows young people to generate, explore and harness new ideas, sensitised to multiple perspectives, through gameplay itself.

Ultimately, WHC within *C²Learn* seeks to fuel the potential for quiet revolutions[40]. Such revolutions aim to be critical, yet ethically grounded and align personal with wider values. A quiet revolution has the potential to be a form of collaborative and collective endeavour that assumes commitment to excellence and engaged involvement by adults and children alike. It brings an ethos positioned away from overly-individualized action, and from views of childhood, youth and education shaped purely by competition and individualism. The aim is to provide strategies that build on children's playful capacities in online spaces and nurture their capacities to resist or at least live differently within the digital and other settings they inhabit and make.

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[36] Chappell K., "Towards Humanising Creativity", *UNESCO Observator*y, E-Journal Special Issue on *Creativity, policy and practice discourses: productive tensions in the new millenium* Volume 1, Issue 3, 2008, http://www.abp.unimelb.edu.au/unesco/ejournal/vol-one-issue-three.html (20 February 2012).

[37] Craft A., "Trusteeship, wisdom and the creative future of education?", *UNESCO Observatory*, E-Journal, Volume 1, Issue 3, Special Issue: *Creativity, policy and practice discourses: productive tensions in the new millennium*, 2008.

[38] Baltes P. B. & Kunzmann U., "Wisdom", *Psychologist, 16,* 2003, and Baltes P. B. & Kunzmann U., "The two faces of wisdom: Wisdom as a general theory of knowledge and judgement vs. wisdom as everyday realization in people and products", *Human Development, 47,* 2004.

[39] Sternberg R. J., "A balance theory of wisdom", *Review of General Psychology, 2,* 1998 and Sternberg R. J., "Words to the wise?", *Human Development, 47,* 2004.

[40] Chappell K., Rolfe L., Craft A. & Jobbins V., *Close Encounters*, Trentham Books, 2011.

Figure 4: Creativity through playful collaboration, within a multiplicity of perspectives

From the above it becomes clear that CER can be a valuable aid in bringing about the stated aims of WHC. Multiple perspectives, negotiation, and collaborative activities within a social context are all essential to CER, as it will become evident throughout this Deliverable. WHC brings forth a much needed ethico-cultural dimension, with its emphasis on compassion, empathy, a strong communal understanding and respect of difference, as well as the sharing of values. CER, therefore, can not only help shape such a creative environment, but also is in need of just such conditions, and ethical guidance, in order to flourish and reach its highest potential.

2   C²Learn's Lateral Thinking

"The difficulty lies, not in the new __ideas__, but in escaping from the old ones…"[41]

We will first survey **Lateral Thinking** (**LT**) and **Brainstorming Techniques** (**BTs**) in order to extract the basic tenets and guidelines upon which they are based (Section [2.1]). These guidelines form the conceptual origin of **C²Learn's Lateral Thinking** (**LTC²**), whose foundations are subsequently explored (Section [2.2]). We end by situating LTC² within the **Living Dialogic Space** (**LDS**) framework, a major point of synergy between the UEDIN and OU teams, and draw some important conclusions about the future of LTC² (Section [2.3]).

2.1   LTC² ORIGINS

Both LT and BTs fall within the wider genus of non-linear thinking processes. They are constituted primarily by individual techniques, though points of similarity and interrelatedness can be discerned, as well as some theoretical foundations.

2.1.1   LATERAL THINKING

Lateral thinking is solving seemingly insoluble problems through an __indirect__, __creative__ approach. The term was coined in 1967 by __Edward de Bono__. LT is closely related to humour, insight and creativity.[42] One of its main contentions is that it is a skill that can be taught.[43]

"Thinking outside the box" is a phrase very often used in relation to LT. There are strong connections between this phrase and a popular puzzle called the **Nine-dots-puzzle**,[44] considered as a paradigmatic case of lateral thinking. The puzzle's challenge is to connect the dots by drawing four straight lines, with no interruption, that manage to pass through each one of the nine dots. The catch is that one is not allowed to ever lift the pencil from the paper. At first it looks impossible, but the solution becomes evident, if one understands that one may draw the lines outside the confines of the square-box area that the arrangement of the dots seems to define [*Figure 5*]. The phrase "thinking outside the box" is a meta-statement, of the solution itself. The difficulty of the puzzle lies with us. We imagine a square boundary surrounding the dots. We are thus, self-confined within an unspecified, imaginary and invisible boundary. There is no explicit mention of staying within the square-box area in the formulation of the challenge. The restriction is one that we implicitly impose on ourselves. LT trains us to identify and overcome the hardest kinds of boundaries, the ones that were never *really* there.

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[41] Keynes J. M., *The General Theory of Employment, Interest and Money*, London: Macmillan, 1936 (2007), Preface.

[42] De Bono E., *Lateral thinking: creativity step by step*, New York: Harper & Row, 1970.

[43] Ibid.

[44] The puzzle's first appearance is in Loyd S., *Cyclopedia of Puzzles*, The Lamb Publishing Company, 1914, but the phrase is a later invention.
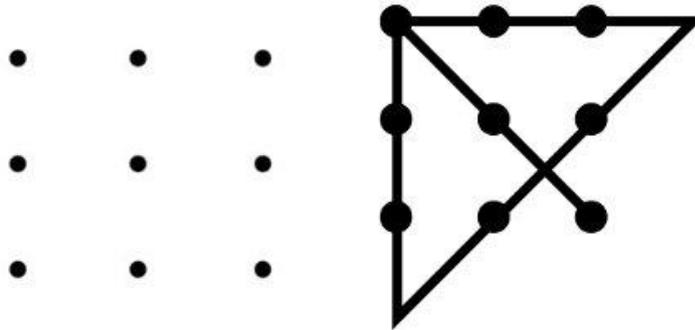
Figure 5: The Nine Dot Puzzled solved

It is important to distinguish lateral thinking from both [a] *vertical thinking* which consists of logical analysis, working out the solution deductively from some given data and [b] *horizontal thinking*, the completely free use of imagination resulting in an overabundance of ideas without taking into account the need for implementation, which requires details and structure.[45] Lateral thinking fully engages the imagination, always supporting itself though with a plurality of structured methods for every step of an idea's development; from its initial conception to its final articulation and even post-production evolution.

LT is premised on the use of alternatives (follow abnormal or counterintuitive paths), shift of attention (from one area/element of a problem to another or overall concern), non-sequential reasoning (start from different points and combine them, disassociate established links) and negate the natural selection process (follow paths that may seem not just counterintuitive, but even wrong).[46]

LT's basic approach is to encourage the player to follow what seem as unnatural paths of thought, thus effecting changes in perspective and occasioning new associations. This is best illustrated by an example of a well-known LT technique.

Example: The *Six Thinking Hats*[47]

The ***Six Thinking Hats*** is a lateral thinking process developed by Edward de Bono, premised on the idea that the human mind thinks in ways, which can be challenged deliberately. This allows for the creation of a structured method for approaching problems or creative challenges. A ***hat*** is a thinking function/role's symbolic expression, which the participant is asked to wear, i.e. employ (they can of course also be represented by real props). A ***hat*** does not represent a natural way of thinking so each one is best used for a limited amount of time. The ***hats*** between them are distinguished by their colour, thus each colour corresponds to a different function/role. There are six such *hats* [*Figure 6*][48].

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[45] De Bono E., *Lateral thinking: creativity step by step*, New York: Harper & Row, 1970.

[46] Ibid.

[47] De Bono E., *Six Thinking Hats*, Back Bay Books, 1999.

[48] Image reproduced from http://amyrozelmartin.com/2012/11/6-thinking-hats-by-edward-de-bono/.

The Six Hats:

The White Hat: calls for information known or needed. "The facts, just the facts."

The Yellow Hat: symbolizes brightness and optimism. You can explore the positives and probe for value and benefit

The Black Hat: signifies caution and critical thinking - do not overuse! Why something may not work

The Green Hat: focuses on creativity, possibilities, alternatives and new ideas. It is an opportunity to express new concepts and new perceptions - lateral thinking could be used here

The Blue Hat: is used to manage the thinking process. It ensures that the 'Six Thinking Hats' guidelines are observed.

The Red Hat: signifies feelings, hunches and intuition - the place where emotions are placed without explanation

Figure 6: Function of each of the Six Hats

2.1.2 BRAINSTORMING TECHNIQUES

Brainstorming refers to a family of group creativity enhancing techniques, facilitating the production of solutions to some specific problem or creative challenge, by gathering and processing ideas contributed by its members in a primarily spontaneous manner. The basic techniques of brainstorming can also be practiced individually.

These kind of techniques originated in the work-environment, specifically the advertising sector. Alex Faickney Osborn was an advertising executive who delineated the core principles of brainstorming in his book *Applied Imagination*.[49] There he stipulated four such principles:

[i] *Quantity focused*: The maxim here is '*quantity breeds quality*'. More ideas generated means more chances of producing an effective and innovative solution. It is meant to facilitate production, and provide a basic orientation for the brainstorming activities.

[ii] *Criticism should be withheld*: The focus should be on extending, supplementing and generally building on ideas, rather than criticizing them. All critical activity should be 'bracketed', until a specific point in the process dedicated to just such activities. This is meant to enhance a sense of freedom in the participants, to generate unorthodox ideas.

[iii] *Unusual ideas are welcomed*: To get an effective amount of ideas, unorthodox, divergent ideas are welcomed and sought after. Participants are encouraged to adopt different, new perspectives in viewing the problem, suspend assumptions customarily held.

[iv] *Ideas should be combined and improved*: The motto here is "*1+1=3*". Good ideas can be combined and improved through the process of association.

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[49] Osborn A. F., *Applied imagination: Principles and procedures of creative problem solving*, New York: Charles Scribner's Sons, 1963.

These principles guide mostly the primary function of BTs which is creativity facilitation within a group. A basic tenet of all BTs is that structuring group activity in a specific way, following the above guidelines, will in itself create an environment of creative output. Processes are then defined, which regulate the input of ideas. There are many such processes to choose from, but an illustrative example will show some important characteristics shared by most of them.

Example: The *Round Robin*[50]

The ***Round-Robin*** technique primarily addresses the issue of certain participants being more vocal, authoritative or dominant and thus monopolizing the session and steering it in only one direction; or on the contrary participants who are too shy and scared to voice their opinions, and thus do not participate efficiently. To solve this, the participants, after hearing the problem and thinking on it, write their answer on piece of paper, while at the same time saying it out loud. They then pass the paper to the person on their left. This way each ones gets to voice their opinion and has to hear everyone else's equally. After the paper has passed through everyone the participants repeat this procedure this time writing down answers that were not mentioned on the first round. This procedure is repeated until the end of the session.

The fundamental characteristics, shared by most BTs, discernible in this example are:

[i] The structure of the process ensures that everyone voices an opinion.

[ii] The structure of the process ensures that all opinions are formulated within conditions bestowing them equal status and allocating (at least procedurally) equal attention to them from the group.

[iii] The structure of the process regulates the flow of ideas, by both providing space for their manifestation (there are clearly defined phases for the formulation and articulation of ideas), and setting up micro-conditions and restrains that coax the participants to contribute.

[iv] The structure of the process addresses some particular problem in group dynamics. In this case it is the problem of some participants being more active/vocal/dominant than others.

[v] The structure of the process ensures that ideas which would otherwise be lost to self-criticism and doubt are actually stated. This is, for example, achieved by the fact that participants are expected to contribute at particular times and within particular time limits.

The other level at which BTs work is very much similar to LT. That means they encourage the participant to follow unnatural, or counterintuitive paths of inquiry and deliberation in order to arrive at previously unexplored regions of idea-possibilities. One characteristic example illustrates this basic approach.

Example: *SCAMPER*[51]

SCAMPER is an acronym and stands for a list of conceptual actions, connected to groups of questions. By answering the types of questions subsumed under each concept, the participant is provided with stimuli that allow him/her to re-view the problem in unexpected and unusual ways. The basic tenet driving the ***SCAMPRER*** technique is that 'the new is a modification of the old'.

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[50] The description is based on http://adriandobre.com/2010/12/04/round-robin-brainstorming-creative-problem-solving-technique/.

[51] Eberle B., *Scamper Combined Edition*, Prufrock Press Inc., 2008. A description can also be found at http://litemind.com/scamper/.

The 8 conceptual actions are: **S**ubstitute• **C**ombine • **A**dapt (or Alter) • **M**odify (or Magnify) • **P**ut to other uses • **E**liminate (or Minify) • **R**everse (or Rearrange). [*Figure 7*][52]
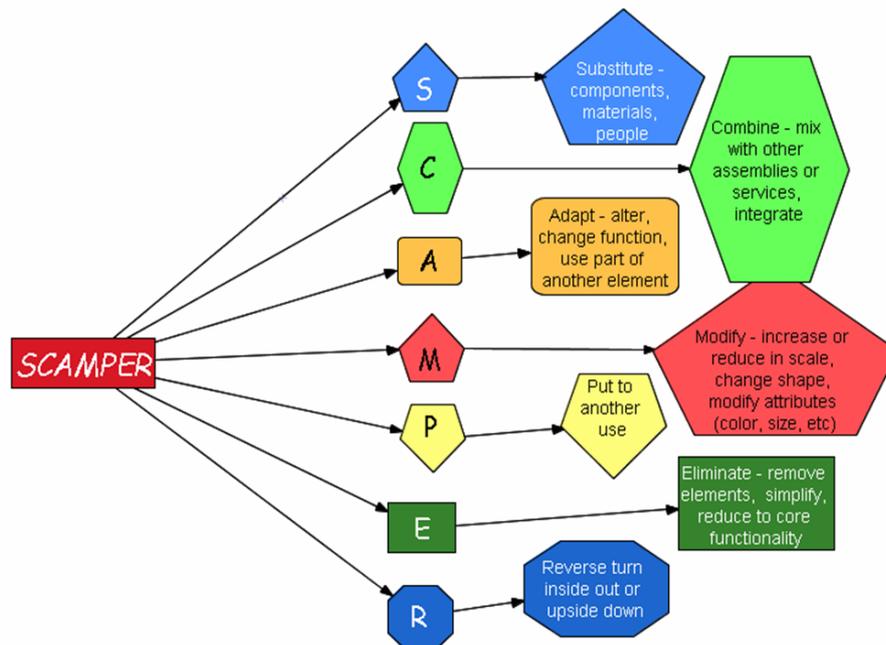

Figure 7: The SCAMPER technique

So, for example typical questions that fall under [**M**odify] are: "What would happen if one modified the process in some way?" or "What would happen if one exaggerated this or that feature or component?" and so on. For [**C**ombine] they might be: "What materials, features, processes, people, products or components related to the problem can one combine?" or "Where are the points of potential synergy with the elements of a known solution?" etc.

2.2   LTC² FOUNDATIONS

The most fundamental characteristic of LTC² is that it constitutes an ***educational tool/method***. The distinction here is subtle but important, as BTs in general are more focused on productivity. The actual novelty value of the solutions/ideas that the players will generate by engaging with C²Learn is not what *fundamentally* concerns us. We seek to provide tools that foster co-creativity, i.e. that teach student-players to engage in non-linear, imaginative thinking. We evaluate the creative output in order to assess whether our goal has been achieved. Our goal (at least within the CER/LTC² perspective) is to transmit these techniques, so that they may become valuable thought-tools.[53]

We follow LT's main idea of encouraging the player to explore lateral reasoning pathways that may at first strike one as unnatural and counterintuitive, but actually reveal important new possibilities for

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[52] Image reproduced from http://staff.emints.org/~falloons/xmodres/addresources/scaffold/scamper.html.

[53] De Bono E., *Teach Your Child How to Think*, Penguin books, 1994. Also very interesting in this respect is Chi M. T. H., Bassok M., Lewis M. W., Reimann P., & Glaser R., "Self-explanations: how students study and use examples in learning to solve problems", *Cognitive Science* 15, 1989, where it is argued that strong students tend to ask themselves questions as soon as they find something they do not understand, as opposed to weak students; and that one can teach weaker students to be strong by teaching them to ask the appropriate questions. LTC2 is very much based on the idea of teaching a player to ask the appropriate questions, that may create lateral paths.

ideas, and uncover hidden (because never explicitly thematised) aspects of a given problem or creative challenge. We expand upon this basic tenet, though, by distinguishing between three kinds of LT: *Semantic*, *Diagrammatic* and *Emotive*, covered in detail in Section [3]. The means to introduce these lateral paths is through the use of *Po*.

Po is a term coined by Edward de Bono.[54] It connotes an idea which opens up a space for new ideas and solutions to develop. It is extracted from words such as *suppose*, *hypothesis*, *po*tential, *po*ssibility and *po*etry.[55] All of these words contain the syllable *po*, and can connote openness, opportunity, playfulness. So *Po* is a tool, an operator meant to provoke, and dislocate from habitual patterns and forms, as well as disassociate established connections.

In term of the creativity framework expounded in Section [1.], a *Po* is a **disruptive element** and a medium of **intervention**. The habitual pattern of thought is disrupted in order to achieve a **re-framing**. The techniques expounded in Section [3] take the notion of *Po* as their starting point and expand on it primarily by classifying it into different kinds. Disruption is possible in more than one ways, and each one seeks to employ different paths of creative stimulation. SLT forms the basis of our understanding for LTC² techniques in general. A *Po*, in this case, is some conceptual element. In SLT we explore the use of specific *Po* such as a random stimulus, the use of counterfactuals etc. (Section [3.1.2]). Diagrams (Section [3.2]), but also First/Second Order Emotive Judgments (Section [3.3.]) are also included in our understanding of this concept.

It is interesting to merge the notion of *Po*, with that of a **game environment**. We can thus begin to construct a versatile conceptual tool that can further guide our research and function as an additional point of synergy between the partners of *C²Learn*. A **Po Environment,** is a provocative environment, it provokes creativity through lateral thought. It emerges within WHC, using as its building blocks the theoretical tools and concrete techniques of LTC². The fundamental principle behind it is to treat the environment, the game world, as a method. What this means on the theoretical level, is that it allows us to approach creativity holistically, i.e. we allow creativity to emerge out of the environment itself. Practically it becomes a tool to tie all the different lateral thinking exercises, offering a 3-dimensional engagement to the player. And by these three dimensions of engagement, we do not mean length/height/depth, but concept, image and emotion. To "think outside the box" the player will need to fully immerse him or herself in this 3-dimensional sand-box of a world.

All the activities in LTC² are constructed following three basic principles. These principles represent fundamental proto-activities that characterize abstractly the core activities of LTC².

[i] *Analogy*: The use of analogy allows one to move from one object (which can be an item, a person, a situation or a concept) to another, on the basis of some usually direct or structural equivalence/similarity, guided by the purposes to which the user is committed to.[56] It has been linked to creativity[57], and it is our main tools in constructing lateral pathways. The diverse functionality of

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[54] De Bono E., *PO: A device for Successful Thinking*, Simon & Schuster, 1972 and De Bono E., *Po: Beyond Yes and No*, Penguin Books, 1990.

[55] In ancient Maori the word *po* refers to the primal chaos, formlessness out of which order and being emerged.

[56] Holyoak K. J. & Thagart P., *Mental Leaps: Analogy in Creative Thought*, Massachusets: MIT Press, 1996. These three constraints do not function rigidly, but more as diverse pressures. In ELT (Section [3.3.2]) we will also examine the possible use of emotive equivalences.

[57] See e.g. Boden M., *The Creative Mind: Myths and Mechanisms*, London: Routledge, 2004 or Duch W. & Pilichowski M., "Experiments with Computational Creativity", *Neural Information Processing Letters and Reviews* vol. 11, 2007. Also see Aupperle K. E. & Karimalis G. N., "Using metaphors to facilitate cooperation and resolve

analogy stemming primarily from its fluidity in managing equivalence/similarity, as well as its applicability on any kind content, make it ideal for disrupting ramified patterns of thought.

[ii] *Internalization/Externalization*: Multiplicity of perspectives is essential to LTC².[58] Internalization refers to the process of engaging with a new/foreign perspective, understanding it, exploring its potential and creating associations with the knowledge and belief-framework one inhabits. Externalization refers to the process of expressing a perspective. Articulating one's ideas as they relate to a given problem or creative challenge, as well being able to verbally thematize areas of one's own knowledge and belief-framework, are crucial steps in all the LTC2 techniques.[59]

[iii] *Negotiation*: Multiplicity of perspectives calls also for the ability to negotiate between them. This means both on the conceptual and the interpersonal level, in order to achieve constructive fusion, and understanding of difference.

What we primarily borrow from BTs is their group-interaction organizational structures. All the techniques include a phase for what can be termed as **Brainstorming activities**, where the group engages with the different types of *Po*. The exact nature of these structures cannot be at this time determined as it depends heavily on the nature that *C²Learn*'s gaming environment(s) will take. The standard models assume a Group Leader that manages the process, and specific phases that regulate the interaction. Our theoretical fusion with the OU team's perspective, specifically their notion of LDS provides some very interesting possibilities (Section [2.3] below).

2.3   LIVING DIALOGIC SPACE

Within C²Learn the OU team will methodologically seek to develop **Living Dialogic Spaces** that enable high participation and shared control. LDS involve high participation by students and adults, debate and difference, partiality, openness to action, working from the 'bottom up', emancipation, as well as embodied and verbalised idea exchange. Such LDS should enable a dynamic of both standing back and stepping forward pedagogically with acute sensitivity[60] within and outside the open-ended sandbox or game-world. Drawing on all of the above will mean the C²Learn team valuing learner agency, standing back, offering time and space and also at times engaging with learners by 'meddling in the middle' to co-conceptualise and co-construct.[61]

The main mechanisms via which living dialogic spaces are produced are creative learning conversations. The conversations were developed by university researchers as distinct from the usual hierarchical, top-down power conversations expected within schools and in their relationships with

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conflict: Examining the case of Disneyland Paris", *Journal of Change Management*, 2(1), 2001, for the use of metaphors in creating solutions, which are very much related to analogy.

[58] De Bono E., *Lateral thinking: creativity step by step*, New York: Harper & Row, 1970. Also Sternberg R. J., ed. *Handbook of Creativity*, Cambridge: Cambridge UP, 1999.

[59] As well as in their assessment later on. The players will have to be able to articulate their decision making processes in order to fully evaluate their progress and creative output.

[60] Cremin T., Burnard P. & Craft A., "Pedagogy and possibility thinking in the early years", *Thinking Skills and Creativity* 1(2), 2006.

[61] Craft A., Chappell K., Rolfe L. & Jobbins V., "Reflective creative partnerships as 'meddling in the middle': developing practice", *Reflective Practice: International and Multidisciplinary Perspectives*, 2012, http://dx.doi.org/10.1080/14623943.2012.670624.

Universities. Their purpose within C²Learn will be to flatten out hierarchies and to open up spaces that promote a sense of equality. The aim is to allow practitioners, students and others to become researchers and game-players oriented toward action.[62] Opportunities to engage in LDS will, of course, need to infuse the scenarios embedded in the game.

The 'living' in LDS requires open shared spaces where potentiality is extrapolated, shaped and constructed.[63] We refer to space created by the learning conversations as Living Space, acknowledging the inhabiting, the embodiment, openness, lack of closure and thus capacity for change inherent in the creative learning conversations which will be used within C²Learn. Applying Wegerif's [64] interpretation of Bakhtin's ideas it will be important that shared enquiry is encouraged in which answers give rise to further questions, thus forming an iterative chain of questions and answers. C²Learn participants will be nurtured into dialogues which include the ability to really listen to others, and even change your mind and argue against your own position by identifying with the space of dialogue.

Intuition, feelings and empathy within LDS enable *ownership* (and flattened hierarchies with complex distributed leadership), *difference and dialogue* (cyclical learning conversations that acknowledge tensions, and stretch partners to riskier yet more collective endeavour) and *quality* (inherent in which is rigour including self-critique).

All LTC² techniques[65] are situated within such open spaces. LDS type of communication is of course essential and completely in tune with the fundamental tenets/methods of LTC². Furthermore, LDS presents us with the opportunity to creatively construct new brainstorming structures tailored to C²Learn's needs. LDS is embodied in fluid hierarchies, which can be a very interesting new tool to introduce in the traditionally more rigid brainstorming organizational structures. In conjunction with the scenarios, and type of game environment(s) to be created, we can construct more original organizational structures to make full use of the LDS environment, as well as facilitate and expand the use of LTC² techniques.

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[62] Apperley T. & Beavis C., "Literacy into Action: Digital Games as Action and Text in the English and Literacy Classroom", *Pedagogies* 6 (2), 2011.

[63] Lefebvre H., "The production of space", Oxford/Cambridge, MA: Wiley-Blackwell, 1991.

[64] Wegerif R., *Mind expanding: Teaching for thinking and creativity in primary education*, Maidenhead: Open University Press, 2010.

[65] Formally the correct term here is CER as this section takes implementation into account. To avoid unnecessary confusion, and as the two terms are practically equivalent, we retain the use of LTC².

3   LTC² techniques

LTC² techniques are classified into three kinds, corresponding to the tripartite division of LTC² itself, i.e. SLT, DLT and ELT. SLT is the most fully developed of the three kinds and also provides the basic coordinates guiding the construction of the other two. All three kinds of techniques make use, albeit differently in each case, of the *Po* tool. We can therefore distinguish between **conceptual**, **diagrammatic** and **emotive Po** (SLT in particular being more fully developed provides different types of *conceptual Po*).

The challenges a player will face within the **C²Learn** environment can take many forms, the specifics of which are still under development. We can draw, though, a vague, yet important distinction between **problems** and **tasks**. This distinction is, of course, not in any way rigorous, but what it gestures at is a distinction in the forms a gaming challenge can take. Under **problem** we can include the most common sense understanding of the term, i.e. a challenge that requires concrete reasoning, and has a terminus that may be classified as a solution (e.g. "Build a structure that can house x number of villagers, using only z number/type of material"); whereas a **task** may be understood as a more loosely defined recreational challenge, with a terminus that cannot be classified unambiguously as a solution (e.g. "Create and manage a prosperous rural settlement" or even more loosely defined "Given these tools, let's see what you can create"). Obviously a problem can be broken down into tasks, and vice versa, and from a purely conceptual standpoint, each term can be understood as subsumed under the other. In a gaming environment, though, the distinction becomes more concrete. A game, that poses a specific problem to be solved, amounts to a very different experience, to a game presenting one with more loosely defined tasks to fulfil or explore. LTC² techniques are defined in such a way as to encompass both, but clearly as they require the challenges to be reasoning-friendly, they are most suited for challenges that fall somewhere in the middle of the spectrum.

The techniques assume as default the existence of a **Group Leader**, which is customarily identified as the **Educator**. It is important, though, to leave the option open, as other members of the group may occupy this position (Section [2.3]). It is even conceivable that this position may change radically within more fluid hierarchies.

3.1   SEMANTIC LATERAL THINKING

"Concepts lead us to make investigations,

are the expression of our interest, and direct our interest."[66]

Semantic Lateral Thinking (**SLT**) involves the use of different *conceptual Po*. It is probably the most easily accessible kind of LTC^2, elements of which one may have already used without prior training. It also serves as the model for the other kinds of LTC^2.

SLT is divided into four over-arching techniques. They are:

Random Stimulus

Re-Conceptualization

Escapism

Role-Play

The structure of the presentation[67] is as follows:

First the *Core Principles* of each technique are presented highlighting the path of creativity that each one seeks to explore. Then a *Basic Model* is provided exhibiting the structure of the exercise, and then broken down in terms of a table. This is followed by an *Example* showcasing the core principles in actual reasoning. We have chosen to use the same problem/task for all the techniques, turning it into a constant that will help highlight the differences between the techniques. According to LTC^2's overall approach (Section [2.2]), the techniques are here understood and treated as primarily teaching tools. What is here highlighted, is not novelty of solutions/ideas, but *internalization/externalization*, *analogical reasoning* and *negotiation between possibilities/viewpoints*, which comprise the fundamental principles of LTC^2. Lastly we present some interesting *Variations of the Basic Structure* that can be used to construct more complex exercises.

Note:

The layout expanded above is not used for the presentation of the *Role Play* technique. Only the *Core Principles* and the *Example* are provided, as this particular technique's structure and further details, will largely depend on the particular characteristics that the game environment will have. Our collaboration with OU will be paramount in the further development of this technique, as the use of roles in the creative and self-creative processes is a central part of their work.

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[66] Wittgenstein L., *Philosophical Investigations*, Oxford: Blackwell Publishers Ltd., 2001, p. 128

[67] The presentation was a product of UEDIN's collaboration primarily with NCSR-D, with additional input from OU and EA.

Table 1: Terms used in the analysis of SLT techniques
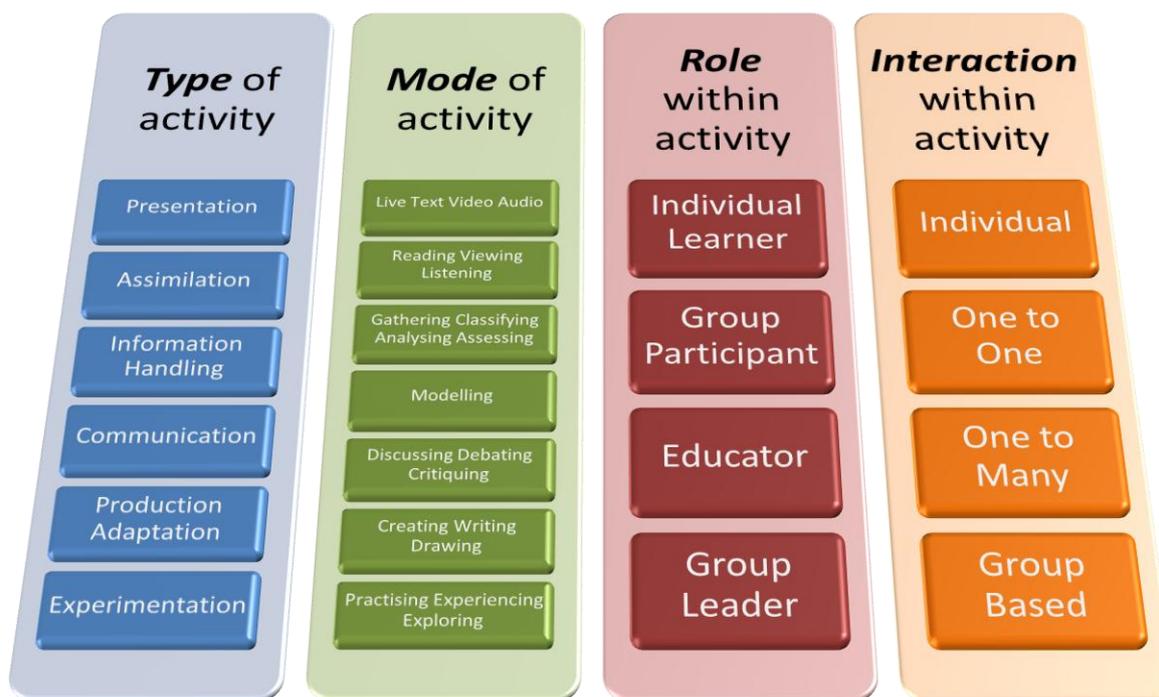
3.1.1 RANDOM STIMULUS

Core Principles

The **Random Stimulus** is a SLT technique. Its main principle is the introduction of a **foreign conceptual element** with the purpose of **disrupting** preconceived notions and habitual patterns of thought, by forcing the user/participant to **integrate/exploit** the foreign element in the production of a solution/idea, and bringing together disparate domains.[68] Randomness is the main guarantor of foreignness and hence of stimulation of creativity.

Randomness is the main guarantor of foreignness and hence of stimulation of creativity. The use of an impartial generator of random stimuli is important here. The spirit of the technique lies in disruption, adaptation and consequent exploitation. Foreignness in this context has two main dimensions: **[1]** It is important that the player feels that he/she has to somehow integrate/exploit an element which is introduced completely from without, whose introduction is in no way under the player's control. In some ways an intruder has to be reconceptualised as a friendly aid; and **[2]** the new element should, at least initially, be as unconnected as possible to the subject/type/structure of the problem. Randomness gives us the best chances of achieving that by making sure that no unconscious/unobserved pre-established analogies, preferences and connections creep in the selection of the stimulus.

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[68] Beaney M., *Imagination and Creativity*, Milton Keynes: Open UP, 2005.

Basic Model

After the introduction of the problem, a *random stimulus* (see Note [ii]) is provided and the players are asked to use it creatively in their reasoning/imaginative processes. The process is usually understood to involve an intermediary step consisting of a *bridging idea*. This idea is not the final solution/idea one seeks, but constitutes the analogical stepping-stone between the stimulus and the problem/task, to be exploited in the production of a new solution/idea.

- [1] • Presentation of Problem/Task
- [2] • Introduction of Random Stimulus
- [3] • Discussion/Brainstorming for New Solution/Idea
- [4] • Presentation of New Solution/Idea
- [5] • Evaluation of New Solution/Idea
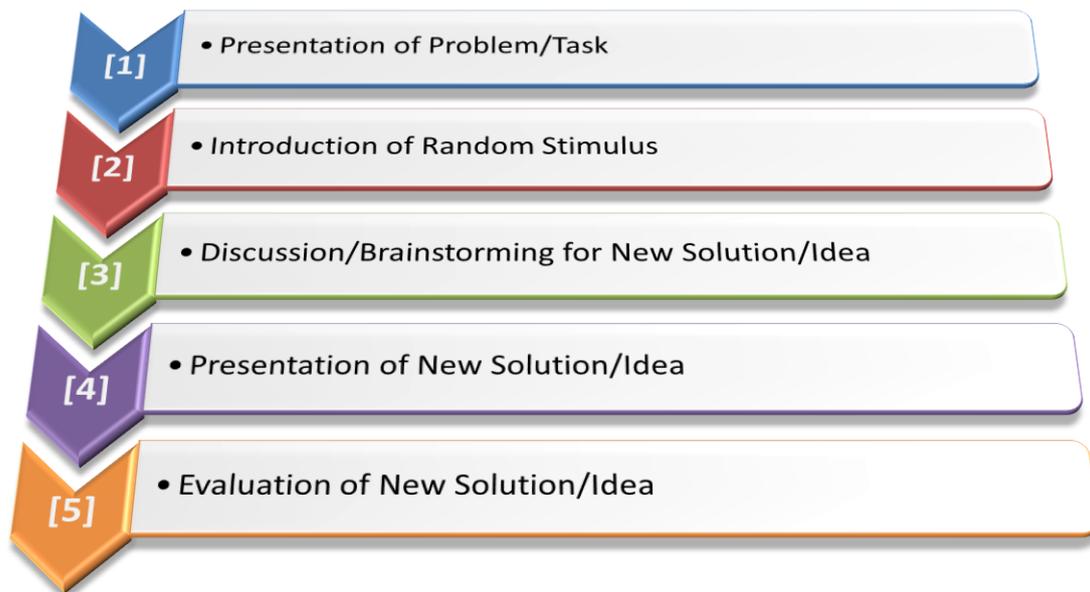
Figure 8: The basic structure of Random Stimulus

Table 2: Analysis of Random Stimulus

Activity	Type	Mode	Role	Interaction
[1]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2]	Assimilation	Reading Viewing Listening	Individual Learner or Group Participant	Individual or Group Based
[3]	Communication	Discussing Debating Critiquing	Individual Learner or Group Participant	Individual or Group Based
[3]	Production Adaptation	Creating Writing Drawing	Individual Learner or Group Participant	Individual or Group Based
[3]	Information Handling	Gathering Classifying Analyzing Assessing	Individual Learner or Group Participant	Individual or Group Based
[4]	Presentation	Live Text Video Audio	Individual Learner or Group Participant	Individual or Group Based
[5]	Information Handling	Gathering Classifying Analyzing Assessing	Educator or Group Leader	One to One or One to Many

Notes:

[i] In **Activity [1]** the Educator/Group Leader presents the problem or task at hand, in person within the classroom, or via text or a video/audio recording.

The possibility of Peer-to-Peer assignment of problems/tasks may be explored, but as assessment is a crucial part of the process, caution is recommendable. A fine balance will have to be struck between what is allowed to pass as an acceptable problem/task, and the freedom granted by Peer-to-Peer assignment, otherwise the problems/tasks may reach a point where it will be impossible to assess the players' performance. Of course a free from of play with only Peer-to-Peer assignment is perfectly possible as a subsequent expansion of the core project.

[ii] The activities collectively referred to as **Activity [2]**, constitute the introduction of the *random stimulus*. The Educator/Group Leader presents the stimulus to be used in person within the classroom, or via text or a video/audio recording. A random generator is used and the stimulus can consist of a random *word*, *rule*, *fact* (piece of information), *text*, *web-site*, *analogy*, *picture* etc. Control over the pool of available stimuli is the main means for scaling the difficulty of this type of exercises/tasks. The decision to alter the difficulty of the exercise/task thus falls to the Educator/Group Leader. (The Individual Learner takes these decisions on his/her own.) It may be helpful to provide ready-made scaling options for the educator/Group Leader to choose from, when using the random stimulus generator. The second part of **Activity [2]** consists in the assimilation of the random stimulus by the individual or group.

[iii] The activities collectively referred to as **Activity [3]**, constitute the main *Brainstorming activities*, represented by the following schema. This process is *iterative*, consisting of cycles.[69] Each cycle has a *time constraint*. The amount of cycles and time allocated for each cycle is decided by the Educator/Group Leader.

The three phases [*Figure 9*] represent the basic stages of any *Brainstorming* type of activity. After a communicative activity (discussion/debate/critique) a candidate solution is produced (or adapted) and then assessed by the group. The three phases are repeated as necessary. In the case of an Individual Learner the communicative activity takes the form of deliberation, with the participant aiming at multiplying his/her own points of views, i.e. simulating the conditions of a dialogue.
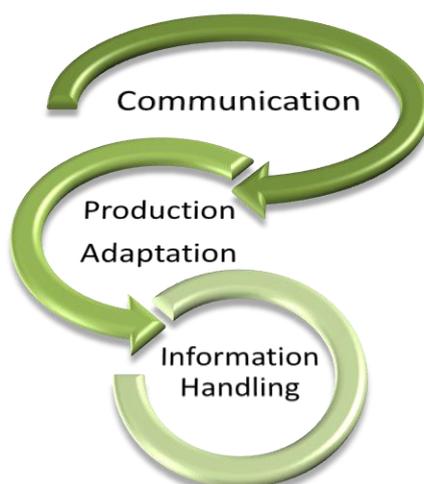

Figure 9: Abstract presentation of Brainstorming phases

The production of a *bridging idea* falls within **Activity [3]**, occurring during its initial cycles.

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[69] Wegerif R., *Mind expanding: Teaching for thinking and creativity in primary education*, Maidenhead: Open University Press, 2010.

(**Side-note:** It is of course perfectly possible to further specify the exact nature of the Brainstorming activities to be used at this stage. See Section [2.2] and [2.3])

[iv] In Activity [5] the Educator/Group Leader evaluates the solution and decides whether the whole process is to be repeated. He/she can then choose to restart the process with the same conditions i.e. begin anew with Activity [3], or provide a new **random stimulus** (possibly taking advantage of the scaling options) i.e. begin anew with Activity [2].

Example

A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this.

We get [**poetry**] as a random word. This is the initial stimulus. The bridging idea could be that **a poem has structure**. The notion of **structure** can then lead us down different paths, which we may later combine to advance our research:

[1] We may view the natural event as **a structured occurrence**, and thus one that may be studied methodically. We then begin by examining the patterns inherent in it, in the hopes of finding useful data that will help us predict future snowstorms and more effectively deal with their consequences.

[2] Another way to go is to view the village itself as a poem. There are often **sub-structures** in poems, such as riming, which create bonds between verses. We may then get the idea of exploiting the existing sub-structures or creating new ones within the village, in order to deal with the damages caused by the snowstorm. So if we take riming as our model, we may think of linking two houses or two sub-groups of houses by making one responsible to provide help and care for the other, in case of another emergency.

[3] By combining the above we come to see the inherent properties of the problem i.e. that it concerns **a structured event, calling for a structured and possibly structural solution**; a concise view of the matter that we can then transfer onto other catastrophic natural phenomena such as earthquakes, floods etc.

Variations of Basic Structure

Variation [A]

The Educator/Group Leader presents two (or more) *random stimuli*. The group is then divided and each subgroup explores one of the stimuli. The forking thus happens at Activity [2]. Activity [3a] and [3b] can either lead to different results [*Figure 10*] or re-converge into an overarching Activity [3!] with the aim of combining the two (or more) approaches into one comprehensive solution/idea [*Figure 11*].
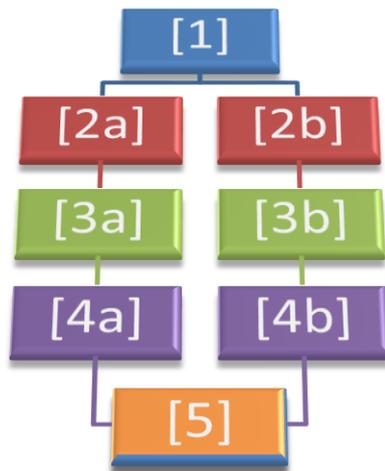
Figure 10: Possible structure of Variation [A]
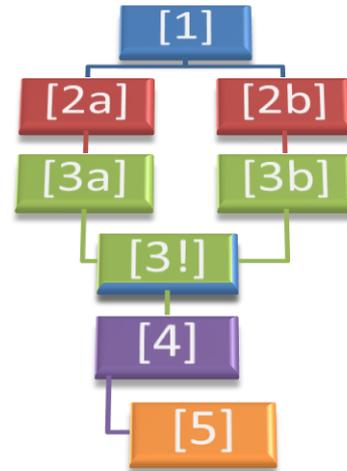
Figure 11: Possible structure of Variation [A]

Variation [B]

The Educator/Group Leader presents one random stimulus, but divides the group into subgroups each one exploring a different ***bridging idea***. The forking thus happens after the initial cycles of Activity [3], i.e. after the production of the initial ***bridging ideas***. **Activity [3a]** and **[3b]** can either lead to different results [*Figure 12*] or re-converge into an overarching **Activity [3!]** with the aim of combining the two (or more) approaches into one comprehensive solution/idea [*Figure 13*].
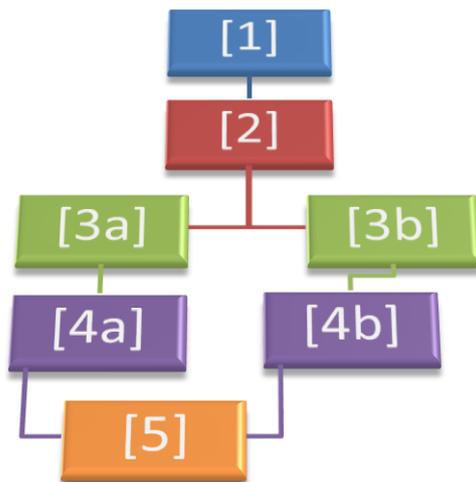

**Figure 12: Possible structure of Variation [B]**
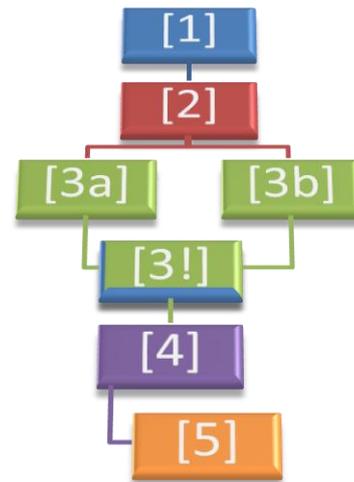
Figure 13: Possible structure of Variation [B]

Variation [C]

The Educator/Group Leader presents two random stimuli. The first will be used as a sort of ***meta-stimulus***, guiding the use of the second stimulus. The second ***ground-stimulus*** will be used in the production of a solution/idea. The use of different types of stimuli (e.g. a random rule as the ***meta-stimulus***, and a word as the ***ground-stimulus***) plays well with this variation. After the introduction of the two stimuli in **Activity [2$]** and **[2@]**, there follows a brief **Activity [3]** type of process, here

referred to as **Activity [3$]** [*Figure 14*], in order to decide/understand how the ***meta-stimulus*** is to be exploited in the use of the ***ground-stimulus*** (which occurs in **Activity [3@]**).

Figure 14: Possible structure of Variation [C]

Variation [D]

The Educator/Group Leader presents a ***random stimulus***. Then a brief **Activity [3]** type of process follows. Then another ***random stimulus*** is introduced, followed again by a brief **Activity [3]** type of process. This procedure is repeated as many times as the Educator/Group Leader deems necessary. The results of all the **Activity [3]** type processes are collected and discussed, in an overarching **Activity [3!]**, and a solution/idea produced [*Figure 15*].

Figure 15: Possible structure of Variation [D]

Endnotes:

[i] All the structures can be integrated/combined with other techniques and new hybrid forms produced.

[ii] The structures can also be integrated/combined with each other in order to produce more complex ones.

[iii] The variations assume that a group is performing the exercises. In the case of an individual, a sub-group is understood to represent one line of reasoning or viewpoint that the individual can pursue.

[iv] The main difference between **Variation A** and **Variation D** is that in the latter the whole group is working together in brief **Activity [3]** types of processes. The emphasis is on the quantity of *random stimuli* that may possibly be integrated.

3.1.2 RE-CONCEPTUALIZATION

Core Principles

Re-Conceptualization is a SLT technique. It involves the use of *already established solutions and ideas* in *new environments*, the purpose being to exploit the potential of *familiarity*[70] in the production of novel ideas. The familiar features of the established solution/idea will re-inscribe themselves on the unfamiliar environment, or conversely these same familiar features will appear in a new light.

Basic Model

After the introduction of the problem, a *pre-established solution/idea* is provided (this may involve a *search* beforehand, see Note [ii]). This solution/idea is taken from a field/issue whose relation to the problem/task at hand is up to the educator's discretion (see Note [ii]). The *core element* of the solution (see Note [iv]) is then subjected to a process of *conceptual transformations* and *exploration of possible extensions*,[71] the aim being to create *links* to the problem/task at hand. These links will then lead to the production of a solution/idea.


- [1] • Presentation of Problem/Task
- [2i] • Search for the Pre-established Solution/Idea
- [2ii] • Introduction of Pre-established Solution/Idea
- [3] • Discussion/Brainstorming for New Solution
- [4] • Presentation of New Solution
- [5] • Evaluation of New Solution
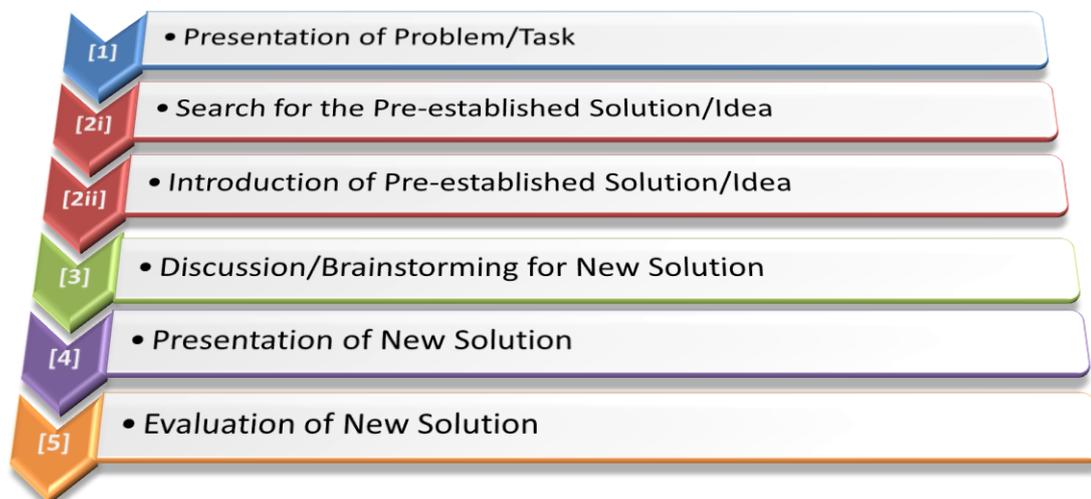
Figure 16: The basic structure of Re-Conceptualization

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[70] Bailin S., *Achieving Extraordinary Ends: An Essay on Creativity*, Norwood: Ablex, 1994.

[71] This is in many ways the model upon which the DLT techniques are based. (see Section [3.2]). A diagram is created with a particular aim in view. Understanding the mapping process which establishes the connections between diagram and what is represented, is similar to understanding the structure of a particular solution/idea, in connection to the problem it addresses. The process of conceptual transformations also has its equivalence in DLT. It is important here to stress though, that the pictorial elements add a new level of engagement to the semantic *Po*. One is asked to think *through* the diagram, letting the pictorial elements guide one to new spaces of possibility.

Table 3: Analysis of Re-Conceptualization

Activity	Type	Mode	Role	Interaction
[1]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2i]	Information Handling	Gathering Classifying Analyzing Assessing	Individual Learner or Group Participant	Individual or Group Based
[2ii]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2ii]	Assimilation	Reading Viewing Listening	Individual Learner or Group Participant	Individual or Group Based
[3]	Communication	Discussing Debating Critiquing	Individual Learner or Group Participant	Individual or Group Based
[3]	Production Adaptation	Creating Writing Drawing	Individual Learner or Group Participant	Individual or Group Based
[3]	Information Handling	Gathering Classifying Analyzing Assessing	Individual Learner or Group Participant	Individual or Group Based
[4]	Presentation	Live Text Video Audio	Individual Learner or Group Participant	Individual or Group Based
[5]	Information Handling	Gathering Classifying Analyzing Assessing	Educator or Group Leader	One to One or One to Many

Table 3: Analysis of Re-Conceptualization

Notes:

[i] In **Activity [1]** the Educator/Group Leader presents the problem or task at hand, in person within the classroom, or via text or a video/audio recording.

(For the possibility of Peer-to-Peer assignment of problems/tasks see Note [i] in the *Random Stimulus* section.)

[ii] The activities collectively referred to as **Activity [2i]**, constitute a search for the pre-established solution/idea. The search can be conducted on the spot or it may have already been assigned by the Educator/Group Leader on some previous occasion. This is an *optional step*. Pools (or the capability of producing such pools) can be provided containing possible candidates along with a classification of their relevance to the problem/task at hand. The Educator/Group Leader may scale the exercise/task either by guiding/directing the search-phase, or by choosing the pools of pre-established solutions/ideas to be presented to the group, based on their relevance to the problem/task at hand. (The Individual Learner takes these decisions on his/her own.)

[iii] The activities collectively referred to as **Activity [2ii]**, constitute the introduction of the pre-established solution/idea. The Educator/Group Leader presents the solution/idea to be used in person within the classroom, or via text or a video/audio recording. The Learners then familiarize themselves with the pre-established solution/idea. (The individual Learner performs both these stages on his/her own.)

[iv] There different options as to how the *core element* of the pre-established solution/idea is extracted: [a] The **core element** is provided to the Educator/Group Leader or Individual Learner along with the pools containing the solutions. [b] The Educator/Group Leader or Individual Learner decides what the **core element** is. In both [a] and [b] this takes place within **Activity [2]**. [c] The deliberation and decision concerning the **core element** becomes part of **Activity [3]** and is taken within its initial cycles.

[v] The activities collectively referred to as **Activity [3]**, constitute the main *Brainstorming activities* (see Note [iii] in the *Random Stimulus* section).

The process of *conceptual transformation*s and *exploration of extensions* for the production of *links* fall within **Activity [3]**.

[vi] In **Activity [5]** the Educator/Group Leader evaluates the solution and decides whether the whole process is to be repeated. He/she can then choose to restart the process with the same conditions i.e. begin anew with **Activity [3]**, or provide a new *pre-established solution/idea* (possibly taking advantage of the scaling options) i.e. begin anew with **Activity [2i]** or **[2ii]**.

[vii] It is of course possible to use the pre-established solution/idea as a foreign element, i.e. use it as a candidate for the *Random Stimulus* type of technique. The difference would be that *Re-Contextualisation* seeks to exploit the familiar features of an element, whereas *Random Stimulus* is more about imposition from without. Actively making the Group search for the initial candidate reinforces that familiarity.

Example

A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this.

In searching for an established solution we come across the idea of **a greenhouse**. What is constitutive of a greenhouse as a solution is the idea of regulating the environmental conditions within it, thus making the sustenance/cultivation of plants possible in environs otherwise unfavourable. Our task now is to create sufficient links that will turn this idea into a crisis-solver and possibly beyond:

[1] The first idea might be to somehow **enclose the whole village within some sort of protective frame**, thus in effect treating it as a plant within a greenhouse. Of course the logistical and practical difficulties/impossibilities of such an endeavour will almost immediately become evident.

[2] The general idea of a protective frame, though, should not be as easily discarded. We cannot protect the whole village in this way, but we may be able to protect all of the villagers. What if we built some sort of structure within the village or in any case somewhere easily accessible by all the villagers that can serve as **a shelter**? We concentrate the whole village in one space and focus on that.

[3] But the greenhouse has more to offer. The sun and water make a greenhouse into **a self-sustained micro-ecosystem**. The same should hold for our shelter. It must be equipped with everything needed for sustenance. Important here is also power. The greenhouse regulates sunlight. Why not use sunlight as a source to power up generators (as well as back-up ones for in a snowstorm sunlight is not an option)? This may lead to even further developments such as using the same **eco-friendly technology** in other areas of the village, as well as possibly turning it into a source of income for the community by selling the power thus acquired.

[4] What else can we do with our investment? Apart from the direct advantages to crisis management and economic benefits, how deeply can the community profit from this? The notion of **cultivation** plays a crucial role here. Greenhouses are an excellent way to import foreign, exotic life forms and experiment with local ones. Seen this way, it becomes easy to reconceptualise the greenhouse as **a cultural centre**. Why only shelter the villagers' lives in a time of crisis and not shelter the village's spiritual and cultural life in constant crisis in our day and age? And of course why not introduce new and exotic elements to the life of their spirit that will serve as sources of inspiration and provocation, much needed stimuli if a culture is to evolve and avoid staleness.

Variations of Basic Structure

Variation [A]

The Educator/Group Leader presents two (or more) *pre-established solutions/ideas*. The group is then divided and each subgroup explores one of them. The forking thus happens at **Activity [2]**. **Activity [3a]** and **[3b]** can either lead to different results [*Figure 17*] or re-converge into an overarching **Activity [3!]** with the aim of combining the two or more approaches into one comprehensive solution [*Figure 18*].
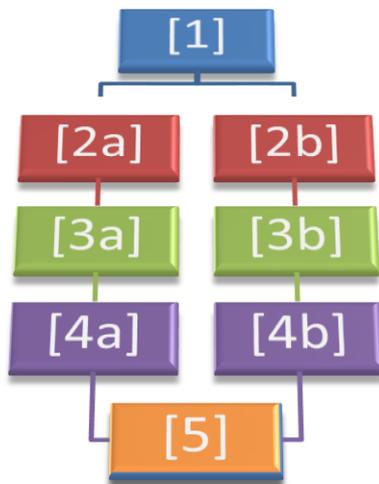
Figure 17: Possible structure of Variation [A]
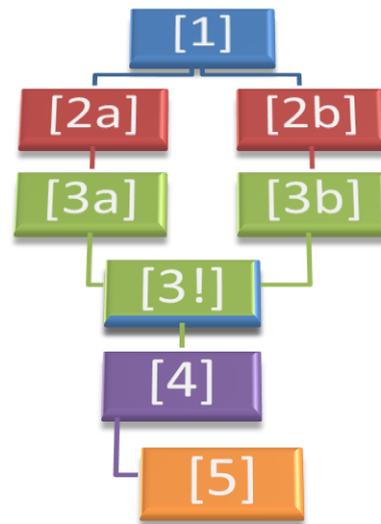
Figure 18: Possible structure of Variation [A]

Variation [B]

The Educator/Group Leader presents one pre-established solution, but divides the group into subgroups each one exploring a different *link* (the result of initial conceptual transformations and extensions). The forking thus happens after the initial cycles of **Activity [3]**, i.e. after the production of the initial *links*. **Activity [3a]** and **[3b]** can either lead to different results [*Figure 19*] or re-converge into an overarching **Activity [3!]** with the aim of combining the two (or more) approaches into one comprehensive solution [*Figure 20*].
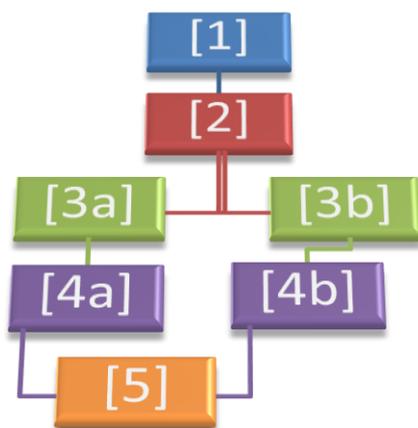

Figure 19: Possible structure of Variation [B]
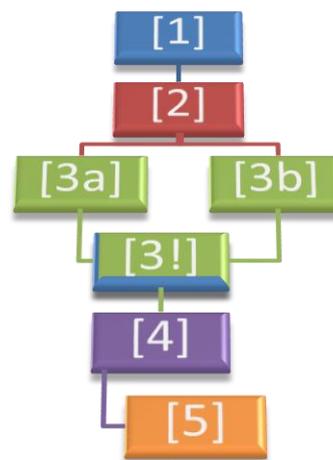
**Figure 20: Possible structure of Variation [B]**

Variation [C]

The Educator/Group Leader presents one pre-established solution/idea, but divides the group into subgroups each one exploring a different *core element*. The forking can thus happens either at **Activity [2]** [*Figure 21*] or in the initial cycles of **Activity [3]** [*Figure 22*], depending on how the *core element* is extracted.
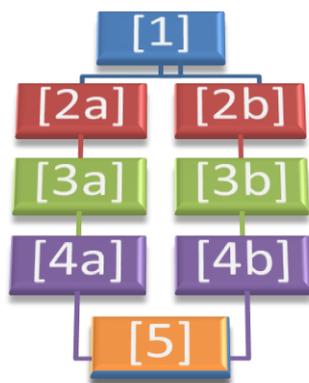
Figure 21: Possible structure of Variation [C]   **Figure 22: Possible structure of Variation [C]**
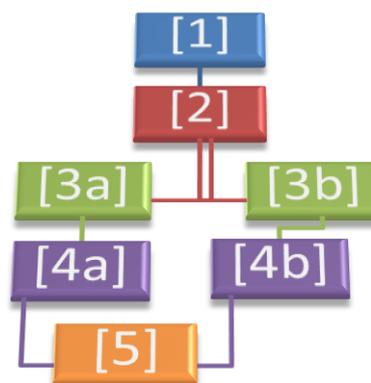
Endnotes:

[i] All the structures can be integrated/combined with other techniques and new hybrid forms produced.

[ii] The structures can also be integrated/combined with each other in order to produce more complex ones.

[iii] **Activities [2i]** and **[2ii]** have been merged into **Activity [2]** throughout the examples for the purpose of simplification. If the option of **[2i]** is taken then in **Variation [A]** two (or more) searches will be conducted.

[iv] The variations assume that a group is performing the exercises. In the case of an individual, a sub-group is understood to represent one line of reasoning or viewpoint that the individual can pursue.

3.1.3   ESCAPISM

Core Principles

Escapism is a SLT technique. It is a general term for the use of *[what if] counterfactuals*,[72] in the production of new solutions/ideas. The main principle is that *temporary emancipation from the given* (in a variety of forms) will not only facilitate the production of new and unusual ideas[73], but will also *localize and bring more into focus the conditions* within which the problem is situated.

Basic Model

After the introduction of the problem the player is asked to imagine *some element of the world* (see Note [ii]), within which the problem/task is situated, as being completely/significantly different or

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[72] The distinction between [what if] and [as if] counterfactuals, originates in the work of the OU team, and is part of the theory of "Possibility Thinking". E.g. see Craft, A., "Teaching for Possibility Thinking: what is it, and how do we do it?", *Learning Matters*, Melbourne, Catholic Education Office, 15(5), 2010 and Craft, A., "Possibility Thinking and Fostering Creativity with Wisdom: opportunities and constraints in an English context", in Bhegetto R. & Kaufman J. (Eds), *Nurturing Creativity in the Classroom*, Cambridge: Cambridge University Press, 2010.

[73] Gaut B., "Creativity and Imagination", *The Creation of Art: New Essays in Philosophical Aesthetics*, Gaut B. & Livingston P. (Eds), Cambridge: Cambridge UP, 2003.

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unrestrained in nature. A ***provisional idea*** is constructed which will serve as a model or basis for further processing, that will eventually lead to the final solution/idea.
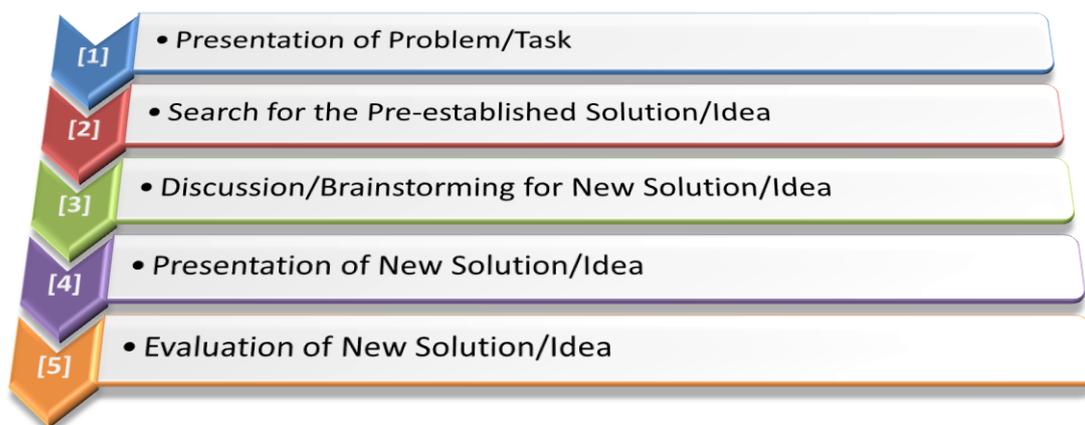

Figure 23: The basic structure of Escapism

Table 4: Analysis of Escapism

Activity	Type	Mode	Role	Interaction
[1]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2]	Presentation	Live Text Video Audio	Educator or Group Leader	One to One or One to Many
[2]	Assimilation	Reading Viewing Listening	Individual Learner or Group Participant	Individual or Group Based
[3]	Communication	Discussing Debating Critiquing	Individual Learner or Group Participant	Individual or Group Based
[3]	Production Adaptation	Creating Writing Drawing	Individual Learner or Group Participant	Individual or Group Based
[3]	Information Handling	Gathering Classifying Analyzing Assessing	Individual Learner or Group Participant	Individual or Group Based
[4]	Presentation	Live Text Video Audio	Individual Learner or Group Participant	Individual or Group Based
[5]	Information Handling	Gathering Classifying Analyzing Assessing	Educator or Group Leader	One to One or One to Many

Notes:

[i] In **Activity [1]** the Educator/Group Leader presents the problem or task at hand, in person within the classroom, or via text or a video/audio recording.

(For the possibility of Peer-to-Peer assignment of problems/tasks see Note [i] in the *Random Stimulus* section.)

[ii] The activities collectively referred to as **Activity [2]**, constitute the introduction of a *[what if] counterfactual*. The Educator/Group Leader presents the counterfactual to be used in person within the classroom, or via text or a video/audio recording. The elements of the world (*the given*) to be imaginatively reconstructed, abolished, ignored or just tweaked can range from *simple facts* (e.g. historical counterfactuals situations or fictional ones) up to *fundamental natural principles and laws* (e.g. no death and decay or no gravitational force) or *basic ethical and social norms* (e.g. What if it is ethically commendable to murder your kids? or What if it were socially acceptable to use violence rather than argument in debates?). Another possible variant of the same basic type of technique is to *take a certain outcome or condition as fixed* and then reason/develop ideas on its basis, e.g. What if everything that could turn up well did so? (or the opposite). Here the counterfactual is used to restrain reality in some way. The Educator/Group Leader may scale the exercise/task by a careful selection of the type and token of the counterfactual he/she will introduce. An alternative simple fact may be easier to understand than an alteration in some fundamental law of physics, for example. Also one fact altered may be easier to manage than an alteration in another fact. (The Individual Learner takes these decisions on his/her own.) Pools (or the capability of producing such pools) can be provided containing possible candidates along with a possible classification of their conceptual difficulty.

[iii] The activities collectively referred to as **Activity [3]**, constitute the main *Brainstorming activities* (see Note [iii] in the *Random Stimulus* section).

The production of a *provisional idea* falls within **Activity [3]**, occurring during its initial cycles.

[iv] In **Activity [5]** the Educator/Group Leader evaluates the solution and decides whether the whole process is to be repeated. He/she can then choose to restart the process with the same conditions i.e. begin anew with **Activity [3]**, or provide a new *[what if] counterfactual* (possibly taking advantage of the scaling options) i.e. begin anew with **Activity [2]**.

Example

A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this.

We begin by posing an escapist type of counterfactual, for example: **What if we could control the weather?** Well then the solution seems clear: Control over the weather means control over the phenomenon (snowstorms in this case), which means the crisis can be easily dealt with. But how are we to use this?

[1] The first idea might be to **take it literally**, and attempts have and are being made to do just that, i.e. find means to control the weather. They are still of course at the level of hypotheses and research programs (unless certain conspiracy theories are to be believed) and in any case even if they eventually are successful it will take years by which time our little mountainous village will be completely ruined.

[2] Let us take another look at our original idea: Controlling the weather (through the use of some sort of magical powers or super-technology) seems quite straight-forward and definitive as a solution. But is it? The climate forms an extremely delicate system. Micro changes in one area can have major consequences in another. Arbitrarily changing the weather patterns over our village can have unknown (and possibly) disastrous effects in other parts of the world (even if just at the level of the wider community surrounding the village). Well then, what if we could create a loop-hole, a sort of spatiotemporal bubble around the village and thus any changes in the climate will only affect this village? So now we have these two new insights into our problem: [a] **the local natural phenomenon is just a part of an interconnected whole** and thus [b] **we need to isolate the village in order not to accidentally affect anyone else**.

[3] A new path is now emerging. The new holistic conception of the snowstorm in condition [a], mirrored in the need for isolation in [b], reveals a subtle yet important underlying aspect of our way of thinking up till now: We tend to think of the natural phenomenon and of our village as something isolated. Why not try and involve the wider community surrounding the village (consisting of other settlements in the area etc.), into forming **a united holistic approach towards a solution**? The interconnectedness of the phenomenon, points towards the need for interconnectedness in the wider community, and thus in the solution to be taken.

[4] Let us take another look at our first idea: Control over the climate means control over the phenomenon. But a phenomenon has many dimensions. **We can then reapproach the notion of control as well as that of a phenomenon**. Control does not just mean magically ordering the clouds to stop doing whatever it is they are doing. Our understanding of a snowstorm as a disastrous event primarily consists of our understanding of its consequences. So control may very well mean controlling the consequences, by for example creating the necessary infrastructure to deal with them. And the notion of a phenomenon can extend to include its reception by the public. In this case control may mean to try and influence the public's perception/reception of it. If we combine this approach with the findings in section [3] we may decide on a mass media/internet campaign to raise awareness of the problem our village is facing, which can lead to the accumulation of help in the form of funds, expertise etc. coming from all over the world.

Variations of Basic Structure

Variation [A]

The Educator/Group Leader presents two (or more) *[what if] counterfactuals*. The group is then divided and each subgroup explores one of them. The forking thus happens at Activity [2]. Activity [3a] and [3b] can either lead to different results [*Figure 24*] or re-converge into an overarching Activity [3!] with the aim of combining the two or more approaches into one comprehensive solution [*Figure 25*].
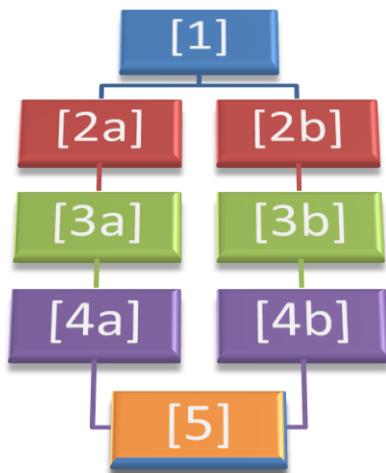
Figure 24: Possible structure of Variation [A]
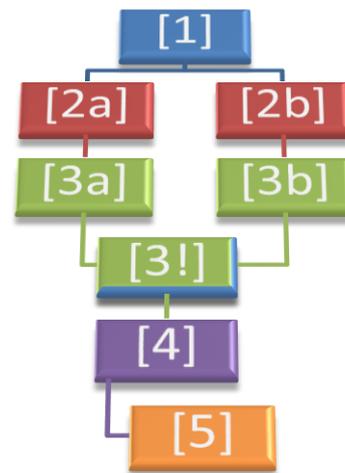
Figure 25: Possible structure of Variation [A]

(See Endnote [iv] for a sub-variation of this variation.)

Variation [B]

The Educator/Group Leader presents one [what if] counterfactual, but divides the group into subgroups each one exploring a different *provisional idea*. The forking thus happens after the initial cycles of **Activity [3]**, i.e. after the production of the initial *provisional idea*. **Activity [3a]** and **[3b]** can either lead to different results [*Figure 26*] or re-converge into an overarching **Activity [3!]** with the aim of combining the two (or more) approaches into one comprehensive solution [*Figure 27*].
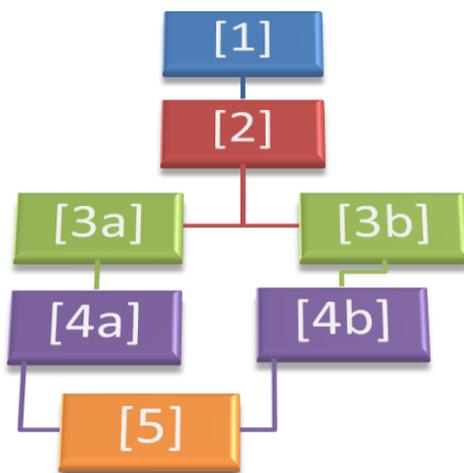

**Figure 26: Possible structure of Variation [A]**
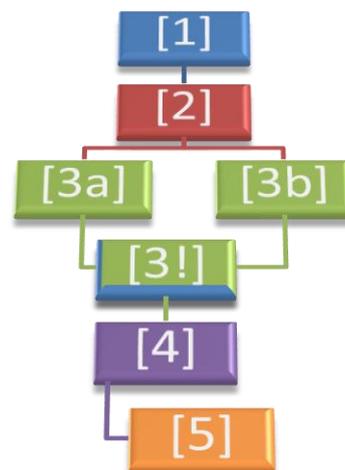
Figure 27: Possible structure of Variation [A]

Variation [C]

The Educator/Group Leader presents two *[what if] counterfactuals*. The first will be used as a sort of *meta-counterfactual*, guiding the use of the second counterfactual. The second *ground-counterfactual* will be used in the production of a solution/idea. The use of different types of counterfactuals (e.g. a fixed condition as the *meta-counterfactual*, and a simple fact as the *ground-counterfactual*) plays well with this variation. After the introduction of the two counterfactuals in Activity [2$] and [2@], there follows a brief Activity [3] type of process, here referred to as **Activity [3$]** [*Figure 28*], in order to decide/understand how the *meta-counterfactual* is to be exploited in the use of the *ground-counterfactual* (which occurs in Activity [3@]).

Figure 28: Possible structure of Variation [C]

Endnotes:

[i] All the structures can be integrated/combined with other techniques and new hybrid forms produced.

[ii] The structures can also be integrated/combined with each other in order to produce more complex ones.

[iii] The variations assume that a group is performing the exercises. In the case of an individual, a sub-group is understood to represent one line of reasoning or viewpoint that the individual can pursue.

[iv] The use of *[what if] counterfactuals*, provides us with the opportunity to create a limiting case, a sub-variation for **Variation [A]**. Counterfactuals can come in opposite or at least opposing pairs. For example: **[What if x were the case?]** or **[What if y were the case?]**, where *x* and *y* both emancipate us from what is given, yet do so in opposing, mutually exclusive or antithetical ways. In that case we have the opportunity of introducing a further step Activity [X] after Activities [4a] and [4b] in which the two subgroups *debate* as to which solution is the better one [*Figure 29*]. The idea here is that the final solution/idea is not a product of integration, but one of opposition. Alternatively this process can be introduced as part of Activity [3] [*Figure 30*].
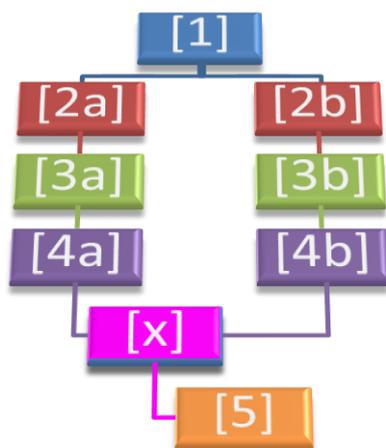

**Figure 29: Possible structure of Variation [A]**   **Figure 30: Possible structure of Variation [A]**
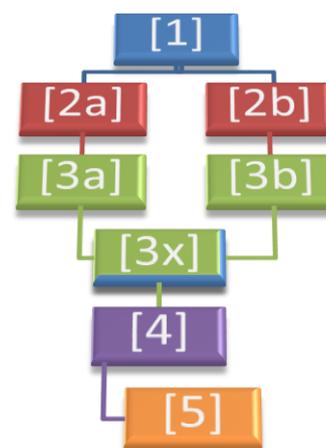
3.1.4 ROLE PLAY

Core Principles

Role Play is a SLT technique. It is a general term for the use of *[as if] counterfactuals*,[74] in the production of new solutions/ideas. The technique builds upon the everyday experience/intuition of a perspective. A *change of perspective* is meant to reorient us within a given problem revealing new paths to be explored, but also to *make us aware of unobservable limitations* in our habitual way of seeing.[75]

Notes:

[i] The term *role* has been left vague on purpose. There are many different dimensions in which to understand the concept of a role. We can follow the standard route and conceive of a role as a person/profession/occupation e.g. a fireman, a dwarf wizard or we can be more abstract in our conceptualization e.g. play the part of the victim, play someone who has is scared of heights etc. We can even understand a role as some principle/virtue/vice e.g. justice, benevolence, greed etc. or basic attitude/approach such as optimism, pessimism, neutrality etc. There really is no limit as to what can constitute a role, as essentially *a role is a tool to effect a change of perspective*. One can even create a sort of meta-role in which each player is asked to reason according to one of the types of conceptual lateral techniques expounded in this document. The type of technique is then treated as a role.

[ii] It is interesting to note a particular connection that exists between this technique and *Escapism*. We can re-conceptualize *Escapism* as a *Role-Play* technique in which the player is asked to play God. Instead of the world, it is now the **agent** that embodies counterfactuality.

Example

A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this.

Let us take as our roles those of **the believer**, **the secularist** and **the environmentalist** and see some possible expositions of each one's approach to the problem:

[1] The believer will view the catastrophe as an act of God (a mandate of Heaven, the dictates of Fate, the necessity of pain in the veil of illusion that is life etc.). Man abides by the will of God by examining himself and accepting his environment, within a world of divine provenance. The religious community is vital in such proceedings. So the believer **will focus on strengthening the cohesion of the local community**, through for example the creation of support groups and public events, centred on some sort of inspirational doctrine that **will lead to emotional and spiritual healing**.

[2] The secularist will view the catastrophe as a natural event (no deeper meaning other than one you yourself give, if there is any kind of governance it belongs to the laws of physics and probabilities etc.). Man makes his own fate by adapting himself and controlling the environment, within a world of chance and change. The scientific community (the community of experts and problem solvers) will play a crucial role here. The secularist **will focus on amassing and implementing the relevant**

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[74] See note [72].

[75] Carruthers P., *The Architecture of the Mind: Massive Modularity and the Flexibility of Thought*. Oxford: Clarendon Press, 2006.

information and technology, such as forecast models, snowmobiles for transport, innovations in the food supply system etc. that **will lead to the prediction and management of such crises**.

[3] The environmentalist will also view the catastrophe as a natural event but embedded within the holistic framework of an ecosystem (everything is interconnected, the environment is not an enemy but an ally etc.). Man makes his own fate by adapting himself and respecting/working with the environment, within of a world of interdependencies and fragile balances. The activist community will be the base of operations. The environmentalist will focus on **amassing, disseminating and implementing eco-relevant information and eco-friendly technologies,** such as new techniques for cultivation and alternative power supplies better suited to the local climate that **will lead to more long term solutions through a community more aware and embedded within its natural habitat**.

[4] Any of these perspectives may be followed, or a more comprehensive approach may be pursued, by examining and comparing the weaknesses and strengths of each perspective, which may in turn lead to a their **integration in an overarching scheme**.

3.2   DIAGRAMMATIC LATERAL THINKING (DLT)

"Words make Division, Pictures make Connection."[76]

We start by setting the stage on which LTC2's expansion to cover diagrams is set. To this end we will briefly discuss the notion of **Multimodality** (Section [3.2.1]). We then explore the literature on **Diagrammatic Reasoning** (**DR**) (Section [3.2.2]) in order to acquire some useful premises for the explication of the foundations of **Diagrammatic Lateral Thinking** (**DLT**) (Section [3.2.3]).

3.2.1   MULTIMODALITY

Multimodality, i.e. the use of more than one medium in communicating processes, one may argue is the default state of human communication. Gesture and sound are interlinked, image is older than text, and even in the most highly textualized modes of communication, image will inadvertently feature either implicitly or explicitly. Globalization, and the evolution of long distance communication throughout the 20th century, in particular, has introduced the use of image (and colour) as a standard practice in everyday dealings.[77] We nowadays trade in images. What is interesting is that embedding images in our textual communications offers new paths of meaning. Note for example the ever expanding use of emoticon symbols. They have been around longer than one expects, with examples dating from the 19th century, [*Figure 31*] but are currently blooming into almost essential communication constituents especially in online environments. They provide alternate sources for the enrichment of meaning, and endow asynchronous text-based communications with some of the features of face-to-face interaction.[78]
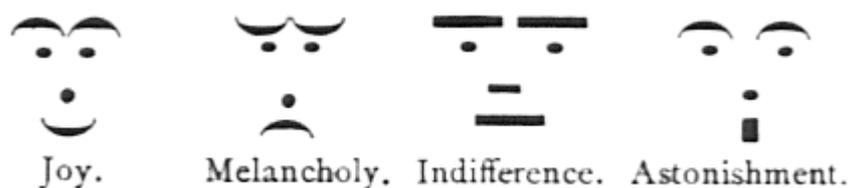

Figure 31: Emoticons printed in 1881 in the U.S. magazine *Puck*

The evolution and dissemination of computer technology, coupled with the explosive cultural impact of the internet has fundamentally changed our information acquisition habits and techniques in a multitude of ways. What interests us here is our new-found relationship with the bearer of information. Until recently the printed page was the principal information bearer. For a great majority of 21st century information handlers (and definitely the ones related to the *C²Learn* project), the computer (iPad, tablet) screen has, to a very large extent, taken the place of the printed page. Despite the obvious changes this signals, i.e. the inclusion of moving images (gifs, videos etc.) and sounds as standard practice of information dissemination, a more implicit change has taken place, namely the way one engages with the information itself. In western culture we take the layout of a book for granted, i.e. one entry point upper left-corner and one exit point on the lower right, but as in most (if not all) things human this too is a matter of convention. A typical web-site screen on the other hand

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[76] Neurath O., *International Picture Language*, Kegan Paul, Trench, Trubner & Co., London, 1936.

[77] Kress G., *Multimodality: A Social Semiotic Approach to Contemporary Communication,* Routledge, 2009.

[78] Gajadhar J. & Green J., "The Importance of Nonverbal Elements in Online Chat", *EDUCAUSE Quarterly* 24, 2005.

provides the user with multiple points of entry and exit.[79] [*Figure 32*] This is important as it changes the role of the author, or rather authoring becomes a joint activity. The user essentially is asked to co-design the page, by his/her selective use of entry and exit points. It is important here to note that a typical game interface partially shares the same characteristic, i.e. provides the user with a multitude of entry-points complementing the main screen.

Figure 32: Typical examples of a book and web-site page. The book-page has one entry/exit point, marked by the red arrows. In the web-page the red squares mark clusters of different entry/exit points.

3.2.2 DIAGRAMMATIC REASONING

[I] Defining DR

The simplest definition of ***Diagrammatic reasoning*** (DR) is: **reasoning through the use of visual representations**. These representations can include all forms of imagery, but particularly diagrams have received the most attention.

It is not as easy to define the graphic-linguistic boundary though. We easily forget that text, immediately classified as linguistic by most of us, is also an image.[80] Various attempts have been made to pinpoint the differences. For example it has been argued that graphical representations exhibit specificity, i.e. contrary to linguistic systems of representation, a graphical system has expressive limitations, which means it cannot present certain sets of information without exhibiting others.[81] A description of a particular mountain may leave a lot of things unspecified (the exact number of trees on its slope for example), whereas a picture of that mountain will inevitably go into every detail (depending of course on the precise nature of the image). Another way to differentiate between the two is the notion of "homomorphism", i.e. a graphical representation has some type of resemblance to what it depicts, as opposed to a linguistic representation that exhibits no such obvious resemblance.[82] It is not necessary for our purposes to go into this debate, let alone

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[79] Kress G.R., *Literacy in the new media age*, RoutledgeFalmer, London, 2003.

[80] Kress A. & van Leeuwen T, *Reading Images: The Grammar of Graphic Design*, Routlege, London, 1996.

[81] Stenning K. & Oberlander J., "A cognitive theory of graphical and linguistic reasoning: logic and implementation", COGNITIVE SCIENCE, 1995.

[82] Barwise J. & Etchemendy J., "Visual Information and Valid Reasoning", *Visualization in Mathematics*, Zimmerman W. ed., Mathematical Association of America, Washington DC, 1990.

adjudicate, but we should keep in mind that there is a more complex relationship between linguistic and graphical systems of representation than one may be inclined to think.[83]

[II] A Classification of Diagrams

There are many ways to classify diagrams, and of course there are sub-classifications for each group. The following is an easy-to-use classification, based on the relationship of the representation to what is being represented:

- **Analogue representations**: The emphasis here is on strong resemblance to the object(s) represented. Paradigmatic cases include photographs and detailed depictions of objects, mechanisms, organisms etc.
- **Schematic representations**: Less resemblance, the aim is to depict the essence of an object or phenomenon. Paradigmatic cases include maps and architectural plans.
- **Conceptual representations**: The aim is to depict interrelations of non-visual features (processes, ideas). Venn diagrams are paradigmatic in this case.

Most of the literature on DR focuses primarily on conceptual and (to a somewhat lesser degree) on schematic representations. It is important to note here that the use of the term *diagram* within the context of DLT takes into account and refers to all three kinds of diagrams. As *C²Learn* is to be used by students as young as 10 years of age, it is important that one is able to provide and request different types of graphical representations depending on the needs of the exercise/task and the competencies of the students.

[III] Premising DLT

The literature on DR revolves around a number of key issues, such as the nature of the representation in relation to what is represented, internalist/externalist debates regarding our understanding of diagrams, the pros and cons of using diagrams etc. The aim of this section is to gather the most important points relevant to our subject, and formulate a number of remarks as to the nature and efficacy of diagrams. These remarks, arranged as bullet-points provide background scaffolding, premising *C²Learn*'s DLT.

The progression of Euler diagrams, through Venn and Pierce's modifications (there are of course further developments but they are not as relevant to our purposes[84]), highlight most of the essential observations we can draw from the literature.

Euler[85] used closed circles to represent existential relations. It is an intuitive system as it relies on the premise that membership in a set is represented by inclusion within the circle representing that set. [*Figure 33*]

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[83] See Shimojima A., "The Graphic Linguistic Distinction", *Thinking in Diagrams*, Blackwell A.F. ed., Kluwer Academic Publishers, Dordrect, 2001 for an in depth discussion of this topic.

[84] See for example Shin S., *The Logical Status of Diagrams*. Cambridge: Cambridge University Press, 1994, or Shin S., *The Iconic Logic of Peirce's Graphs*, Cambridge: MIT Press (Bradford), 2003.

[85] Euler L., LETTRES À UNE PRINCESSE D'ALLEMAGNE. St. Petersburg; l'Academie Imperiale des Sciences, 1768 (English translation on Google Books).

All A are B.   **No A Is B.**   **Some A Is B.**   **Some A Is not B.**
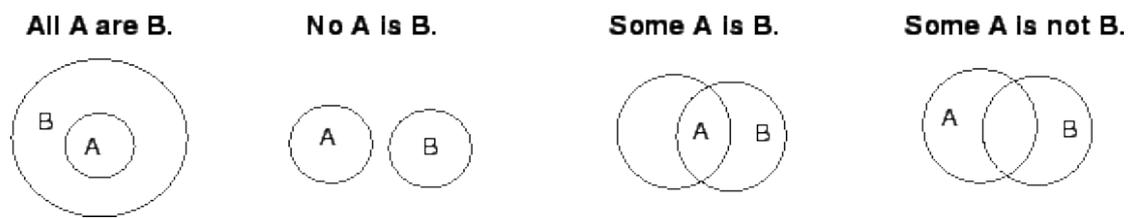

Figure 33: Examples of Euler diagrams

There are limitations though as more complex existential relationships are too hard to represent resulting in significant loss of clarity. Venn[86] tried to improve on Euler's work by introducing what he called primary diagrams, which represent all the possible set relations between sets. He used shading in order to represent set emptiness in universal statements. [*Figure 34*]

All A are B.   **No A is B.**
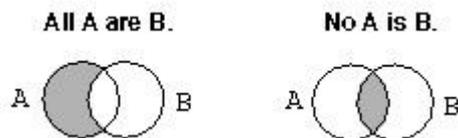
Figure 34: Examples of Venn diagrams

Still, though, ambiguities and difficulties persisted. Pierce[87] maintained that Venn diagrams fail to represent existential statements and more complex disjunctive statements. He introduced new syntactic elements to enhance expressive power ("o"=empty set, "x"=existential import and "-"=disjunction). [*Figure 35*]

All A are B or some A is B
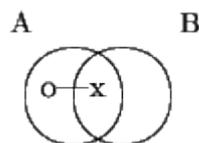
Figure 35: Examples of Pierce diagrams

The complexities revolving around the equivalence of diagrams to first-order propositional logic is not what interests us here. What we can gain from this very brief presentation of the syntactical progression exhibited above can be summed up in the following:

- Exploiting the two-dimensionality of diagrams one can express complex relationships without resorting to the complexities of sentential syntax, which are sequential in nature.[88]
- The use of colour (shading in the above case) can provide more syntactical resources and thus enhance clarity and expressive power. This may be termed as a *representational shift*. Systematic use of such devices (for example pairing concepts and colours together) can help solve problems.[89]

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[86] Venn J., SYMBOLIC LOGIC, London: Macmillan, 1881.

[87] Peirce C.S., COLLECTED PAPERS, Cambridge, MA: Harvard University Press, 1933.

[88] Stenning K. & Lemon O., "Aligning Logical and Psychological Perspectives on Diagrammatic Reasoning", *Thinking in Diagrams*, Blackwell A.F. ed., Kluwer Academic Publishers, Dordrect, 2001.

[89] Kaplan C. A. & Simon H. A.," In Search of Insight", *Cognitive Psychology* 22, 1990.

- The use of linguistic/algebraic marks can enhance the representation power of diagrams. Most diagrams will consist of a mixture of linguistic and graphical elements. This holds for schematic diagrams too[90], not just the conceptual ones examined above.

The last crucial observation can be drawn from the literature on the effectiveness of diagrams in CIP. CIP (Complex Information Processing) refers to human cognitive and reasoning procedures. These procedures essentially entail the processing (comprehension and transformation) of information, arranged in assemblies of symbols. In diagrams these symbols are visual features (shape, size, colour, spatial orientation etc.).[91] Much of the literature agrees that CIP is benefitted by the use of diagrams, due for example to the fact that the information in diagrams is indexed by spatial location, thus preserving explicitly the geometric and topological relations of the problem's elements[92]. It is important here to note though that such benefits are premised on the background knowledge of the relevant domain[93], as well as the specific nature of the diagram and its interconnections with the context within which one encounters it.

- Diagrams can indeed help cognitive processes but care must be taken that the users are acquainted with the domain of the information presented in the diagram. This is important when building any LT exercise. Care must be taken that the diagrams are group appropriate (age, level of education, other characteristics of the particular group etc.), and that everyone is comfortable and able to use whatever information is present.

3.2.3   DR GONE LATERAL

[I] Defining DLT

DLT begins with the *extended mind theory*.[94] Simply and briefly put, the idea driving the theory, as applied to diagrams, is that a diagram, through its use, serves as a vehicle of cognitive processes, embodying the various aspects of the problem. The agent's mind is extended onto the diagram and reasoning, proceeds through structural rather than semantic or syntactical entailment. One therefore thinks *through* the diagram rather than use it as a simple prop. Drawing from the literature on DR we can further qualify this central position with two additional claims:

- Diagrams are not merely signs communicating concepts, but socially constructed toolkits for the collaborative creation of knowledge, through mutual interactions. The process of constructing a diagram is more important that the final product.[95]

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[90] Herbert D. M., *Architectural Study Drawings*, New York, Van Nostrand Reinhold, 1993.

[91] Cheng P., Lowe R. & Scaife M., "Cognitive Science Approaches To Understanding Diagrammatic Representations", *Thinking with Diagrams*, Blackwell A.F. ed., Kluwer Academic Publishers, Dordrect, 2001.

[92] Larkin J.H. & Herbert H. A., "Why a Diagram is (Sometimes) Worth Ten Thousand Words", *Cognitive Science* 11, 1987.

[93] Cheng P., Lowe R. & Scaife M., "Cognitive Science Approaches To Understanding Diagrammatic Representations", *Thinking with Diagrams*, Blackwell A.F. ed., Kluwer Academic Publishers, Dordrect, 2001.

[94] Clark, A., *Being There: Putting Brain, Body and World Together Again*, MIT Press, Bradford Books, 1998.

[95] Vile A., Polovina S., "Thinking of or Thinking Through Diagrams? The Case of Conceptual Graphs", Thinking with Diagrams Conference, Aberystwyth, 1998.

- The possibilities one sees for transforming a given diagram, are part of one's comprehension of the diagram itself. The functions of the diagram both on the semantic and pragmatic level are determined in part by these possibilities.[96]

DLT abstracts from diagrammatic representations and constructs new analogical solution/ideas, to be used in the problem or task at hand.[97] Embedded within the larger framework of LDS (Section [2.3]), it is an inherently social procedure. The diagram is open to collaborative, public comprehension and manipulation. Interaction within the Group is essential. Both the processes of understanding and creating a diagram are understood as iterative consisting of more than one cycles.[98]

A diagram is treated/used as a *Po. Diagrammatic Po* opens lateral pathways through three main processes, which comprise the core of DLT:

[1] *Identification*: This process is crucial in that it will allow both the Educator/Group Leader and the Group to arrive at a shared understanding of the diagram they are to work with, by identifying the elements that are to be used as analogical building blocks. What is to count as an element is not fixed, and will emerge through the discussion. This process also helps the Educator/Group Leader to form a better understanding of any possible difficulties the Group may have in understanding the diagram.

[2] *Re-Mapping*: This does not refer to what is customarily understood as mapping though it does rely on that concept. Within the context of DLT, *re-mapping* means to abstract from a given diagram's elements, and re-apply them onto a problem or task, through the use of analogical reasoning. After the diagram's elements are identified, analogies are built based on these elements. These analogies are fuelled by an effort to map the elements on to the challenge at hand.

[3] *E-Transformation (Exploratory Transformation)*: Comprehension of a diagram entails an understanding of its inherent possibilities for change. In DLT the creation of analogical solutions takes this into account. The aim is to further sensitize the agent in exploring these possibilities. A diagram has potential, and thus more possibilities for analogy are inherent within it, than at first evident. The new forms of the diagram[99] (or in some cases in conjunction to the particular operations used in transforming it) are then used in *re-mapping*.

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[96] Sloman A., "Diagram in the Mind?", Thinking with Diagrams Conference, Aberystwyth, 1998.

[97] The idea that diagrams may be conduits of new ideas is already present in the bibliography. See for example Magnani, L., *Abduction, Reason, and Science: Processes of Discovery and Explanation*, Kluwer Academic/Plenum Publishers, New York, 2001 and Magnani, L., *Philosophy and Geometry. Theoretical and Historical Issues*. Kluwer Academic Publisher, Dordrecht, 2001, for an explication of the notion of *abductive reasoning* (or manipulative abduction), where *one thinks through doing*, seeking to create communicable accounts of new experiences, while integrating them into existing systems. For a very different understanding of a diagram's creative potential see Deleuze G. & Guattari F., A thousand Plateaus: Capitalism and Schizophrenia, University of Minnesota Press, 2003, where the diagram is viewed as a signification-producing machine.

[98] See for example Epstein S.L., Thinking through Diagrams: Discovery in Game Playing, *Spatial Cognition IV: Reasoning, Action, Interaction*, International Conference Spatial Cognition 2004, Frauenchiemsee, Germany, 2004 for a very interesting case study involving the construction of a conceptual diagram of the solution space, for traditional Chinese game *Pong hau k'i*.

[99] It is important here to note that as the users of **C²Learn** are of a younger age the transformations will not necessarily consist of with strict topological processes. A more open-ended, imaginative process is here envisioned. Whether the resulting form can still count as a variant of the original one or whether it has become a completely different entity, will be decided by the Group and Educator/Group Leader. It may be possible, though, that particular constraints be implemented by the computational tool itself. (This is an area that still needs further clarification and is part of the work still needed for DLT.)

[II] DLT Proto exercises/tasks

The three levels are represented by proto-exercises/tasks. As we are still in the initial stages of development, the examples provided below, primarily aim to elucidate the core principles of DLT. This means they are explications of basic processes/tools to be used when building an exercise/task. Level [i] will feature in every exercise. Level [iia] is based on the process of **re-mapping** and Level [iib] is an enhancement based on the process of **e-transformation**. Level [iii] is a combination of both [iia] and [iib]. The examples below have a mid to higher level of difficulty (more suitable for junior high school students and above). Scaling is of course possible and will largely depend on the exercise/task given and the difficulty of the diagrams provided.

Level [i]

The Group is presented with the following diagram [*Figure 36*]. It is a representation of society from a particular socio/economic viewpoint.

The Eduactor/Group Leader begins discussing with the Group the particular characterisitcs of the diagram.

Questions may include:

[1] Can you describe what you see?

[2] What is the main purpose of the image? How does it achieve this purpose?

[3] Can you describe the structure of the diagram? Is this structure significant? In what way?

[4] What are the elements of the diagram? Are colours used? What do you think is their function?

[5] What else does it remind you of?

[6] Can you think of ways to transform it?

Figure 36

This is the ground level upon which DLT exercises are built. The main function, of the questions the Educator/Group Leader addresses the Group with, is to completely familiarise the Group with the diagram they are presented, and guide them through the analogical reasoning procedures.

Level [iia]

The Group is presented with the following diagrams [*Figure 37*]. The task they are given is to describe a new form of society (or basic political/social structures) based on the diagrams. (The Group may of course be divided into sub-groups and each one assigned one of the diagrams.)
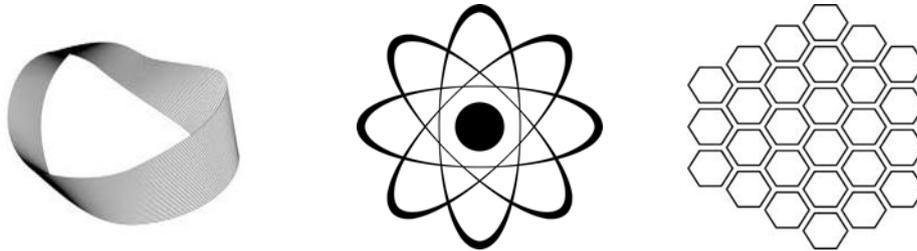

Figure 37

Possible solutions/ideas given by the players may include:

[1] The **moebius strip** seems like an ordinary strip with two sides but actually if we follow one of them we end up on its opposite; meaning that in reality it only has one side. This may lead us to question the notion of difference and hierarchy, by questioning whether seemingly oppositional or antithetical relationships actually are so.

[2] The image of the **atom** may lead us to question the classification into social groups and instead focus on one element of society, be that the individual or the family, as the nucleus around which everything does or should revolve.

[3] The picture of a **hive** may prompt us to review the notion of comprehensive and rigidly defined levels and instead view modern man as a unit occupying a cell within a vast network of relationships.

This proto-exercise/task is based on the process of *re-mapping* elaborated above. The analogical solutions/ideas here presented all stem from a remapping of the particular diagrams' elements onto the task presented at the beginning.

Level [iib]

The Group is presented with the following diagram [*Figure 38*]. The task they are given is to propose solutions to the problem of hunger in a particular country. They cannot use the diagram as it is, though, but must find ways to transform it.
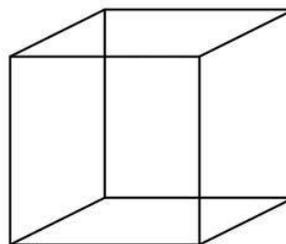

Figure 38

Possible solutions/ideas given by the players may include:

[1] We imagine the cube as a rubix-cube. The haphazard arrangement of squares represents the equally haphazard way the country's food resources are scattered. Mentally rearranging the cube (imagine it solved) we come to a more ordered arrangement, with every facet of the rubix-cube made of one colour.   [*Figure 39*]
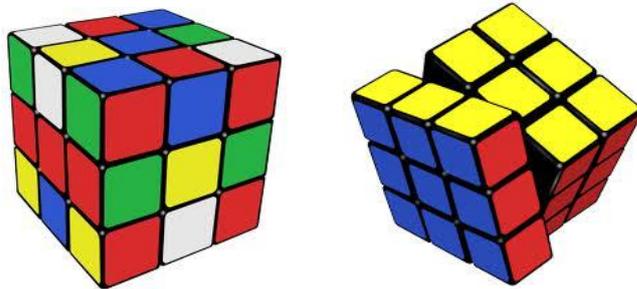
We hit upon the idea of proposing the scheme of separating the country into different areas and dedicating each area to a particular food resource depending on the soil, micro-climate conditions etc. The food then is distributed equally to the whole populace

Figure 39

[2] We imagine the cube opening up, and turn it into a box. [*Figure 40*]
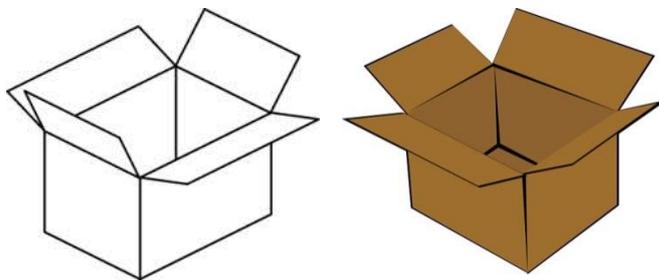
Figure 40

The box can then be understood as a kit containing everything one needs (guides, seeds, tools etc.) to be able to help out in the cultivation of the impoverished country's fields. A social program is envisaged, where students from more prosperous countries, donate their time through their school, by going over to the country in need for a period of time to work to help with the agricultural production, or some similar type of activity

This proto-exercise/task is based on the process of ***e-transformation*** elaborated above. The inherent possibilities of the diagram are first explored, and the analogical solutions are based upon the new-found forms.

Level [iii]

The Group is presented with the following exercise/task: Create a diagram representing a social institution/structure/process that addresses one of the following issues: [a] Social inequality, [b] Economic inequality, using any/all of the following shapes:
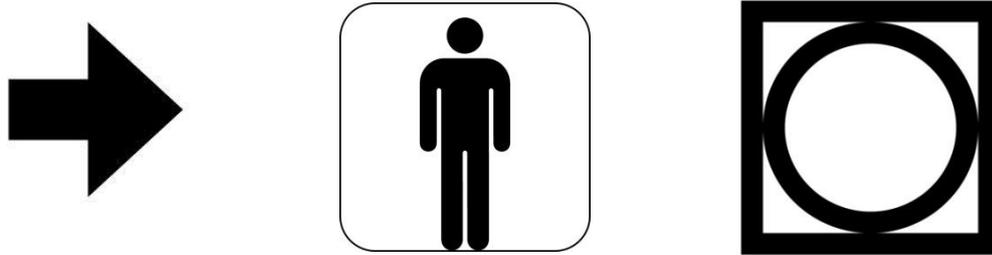
Figure 41

Possible solutions/ideas given by the players may include:

[1] Weekly meetings of the local community. Each week one member is chosen to narrate their everyday experience and how discrimination (gender/race/religion/age) is affecting their and their families' lives. [*Figure 42*]

Figure 42

[2] A form of investment available to companies and entrepreneurs, only on the basis that the company is legally bound to provide social work for the community it belongs to. A bottom-to-top approach trying to get small scale companies to care more for the economically underprivileged in their community. [*Figure 43*]

Figure 43

This proto-exercise/task reverses Level [iia] and combines it with [iib]. The Group has to create a new diagram by transforming and combining the diagrams given. The Group can then discuss the choices made concerning the structures and elements of the new diagram, and how they relate to the narrative associated with it.

The three shapes provided function as conduits for the creative process. It is important that the Group has direct access to them (either as physical or digital entities) and is free to manipulate rearrange them in different ways. They are tools to deconstruct the problem, and construct the new solution idea, yet remain flexible and interpretable in different ways.

In the first example the [circle] and [man-symbol] are chosen to represent a space of equal opportunity and exchange of experiences.[100] The use of one colour further manifests the idea of equality.

In the second the [arrow] is used to denote actions, the [man-symbol] to denote the community, and the [circle/square] as indexes. The colour is neutral.

Endnotes:

[i] In the exposition of the above proto-exercises/tasks it is assumed that they are carried out by a Group (including an Educator/Group Leader). In the case of an Individual Learner the examples of inquiries given in Level [1], represent possible trains of thought that he/she may take when engaging with the diagrams.

[ii] As has been note in the SLT section, synergies between kinds of LTC² are both possible and desirable. Diagrams may be introduced as alternative *Po* for all the main SLT techniques. Also we can envision more complex exercises/tasks where after an initial introduction of a *conceptual Po*, a *diagrammatic* one is also introduced along the way to further the creative process. *Conceptual Po* can also function as meta-tools, i.e. as rule giving stimuli for the *re-mapping* or *transformation* of the diagrams (see the *Random Stimulus* [Variation C] entry where *conceptual Po* are used in this fashion).

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[100] Of course, others might strongly disagree with the use of the stereotypical [man-symbol] to express equality and equal opportunity, as it depicts an abstract figure of a male human being. They might come up with antithetical representations where the [man-symbol] functions as a bearer of prejudice and discrimination.

3.3   EMOTIVE LATERAL THINKING (ELT)

"Reason is, and ought only to be the slave of the passions,

and can never pretend to any other office than to serve and obey them."[101]

We begin by premising Emotive Lateral Thinking (ELT) on the strong evidence existing today, supporting the primacy of emotions in cognitive processes (Section [3.3.1]). We then move on to examine the fundamental insight and processes out of which ELT is developing, with the help of examples [(Section 3.3.2]).

3.3.1   PREMISING ELT

In philosophy the idea that emotions are fundamental in the overall cognitive economy of an individual is as old as Plato's tripartite division of the soul[102] into 'reason', 'spirit' (the seat of emotive affects) and 'appetite'. The *primacy* of emotions, though, is an idea[103] that started gaining momentum in the 18th, and even more so the 19th century. Hume[104] subjugates reason to emotions and inductive necessity to mere custom, whereas later on we find Kierkegaard[105] discarding calculation in favour of the passionate decision, Schopenhauer[106] promoting the affective stirrings of our Will as the proper path towards understanding the metaphysical foundations of reality as a whole, and Nietzsche[107] using thoughts as the 'mere shadows of sensations'. In the 20th century the two dominant philosophical figures, Wittgenstein[108] and Heidegger[109], bring ratiocination to the level of animal instinct/training and ground our concepts in the pre-reflexive being-in-the-world respectively.

Today there is good evidence, from neuroscience and psychology/psychiatry that emotions function in both conscious and unconscious ways to affect judgment, reasoning process and overall cognitive behaviours. Emotions are understood as more primitive than concepts, and the most ancient, yet still

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[101] Hume D., *A Treatise of Human Nature*, Oxford: Clarendon Press, 1978, p. 415.

[102] Plato, *Plato: Republic*, Hackett Publishing Company, 1992.

[103] Or to be more precise a deep shift in method and foundational understanding.

[104] Hume D., *A Treatise of Human Nature*, Oxford: Clarendon Press, 1978, and Hume D., *Enquiries: Concerning Human Understanding and concerning the Principles of Morals*, Oxford: Clarendon Press, 1977

[105] See e.g. Kierkegaard S., *Either/Or: A Fragment of Lif*e, London: Penguin Books, 1992, and Kierkegaard S., A Literary Review, London: Penguin Books, 2006.

[106] Schopenhauer A., *The World as Will and Representation* (Vol. I-II), New York: Dover Publications Inc., 1966.

[107] See e.g. Nietzsche F., The Gay Science, Cambridge: Cambridge University Press, 2001.

[108] See e.g. Wittgenstein L., *Philosophical Investigations*, Oxford: Blackwell Publishers Ltd., 2001 and Wittgenstein L., *On Certainty*, Oxford: Blackwell Publishers Ltd., 1997. Though, due to the particular nature of Wittgenstein's method and insights, centred on philosophical therapy, a reconstruction of his remarks into theses is a delicate affair to be treated with much care.

[109] Heidegger M., *Being and Time* (Suny Series in Contemporary Continental Philosophy), New York: State University of New York Press, 2010.

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fully active, guides in decision making.[110] The limbic system of the brain, which is older in evolutionary terms, can guide action almost completely, before the higher cognitive centres of the brain, assume conscious control.[111]

Indirect evidence of the primacy of emotion can also be found in cases of emotional impairment, which can exert many kinds of pressures to decision making process. For example, making a decision involves accepting a certain degree of uncertainty, i.e. one is emotionally able to end the inquiry/search phase and proceed to action. Emotional impairment can inhibit this process by leading to an endless iteration of the search phase, and a constant sense of un-readiness to take action.[112] On the other hand positive emotional feedback can lead to performance enhancement, improved risk management and overall creativity boost.[113] This is premised on the fact that emotive conscious and unconscious processes help navigate and sort the an otherwise overwhelming amount of data and interrelations, one id faced with especially in complex situations demanding high performance decision making.[114]

3.3.2 [3.3.2] ELT FOUNDATIONS

[I] The Gordian Knot

Phrygia, 333 B.C. When Alexander the Great was faced with the most masterfully constructed knot in history, a knot that no man could untie, he did the most obvious thing in the world: He cut it. The revolutionary character of the act was its obviousness, or rather the difficulty of registering the obvious as a solution. It is important to note here, though, that some other man may have been severely penalized for such an action. Alexander was viewed as a victor, a conqueror, a type of super-man by the public, and continues to be viewed as such by many. Such an entity, which transcends the boundaries of a mere mortal, is not only allowed but expected and celebrated for the transgression of rules and barriers. Alexander himself *felt* as a solution to many, and it was these feelings of awe and infallibility that were transferred onto his action. His act *felt* as a solution. We *feel* he was right, that he solved the Gordian Knot. It opened new paths as to what "solving" is. Or to be more precise, it cut into a whole new space, *feeling* our way around for new possibilities of what a solution can be.

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[110] See e.g. Damasio A. R., *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*, New York: Harcourt, 1999, and Damasio A. R., *Looking for Spinoza: Joy, Sorrow and the Feeling Brain*, New York: Harcourt, 2003.

[111] LeDoux J., *The emotional brain*, New York: Touchstone/Simon & Schuster, 1996.

[112] Goleman D., *Emotional intelligence* at work, New York: Bantam, 1998.

[113] See e.g. Losada M. & Heaphy E., "The role of positivity and connectivity in the performance of business teams: A nonlinear dynamics model", *The American Behavioral Scientist* 47(6), 2004.

[114] See e.g. Goleman D., *Emotional intelligence* at work, New York: Bantam, 1998, and Damasio A. R., *Descartes' error: Emotion, reason, and the human brain*, New York: HarperCollins Publishers, 1994.

Figure 44: The Gordian Knot, the ancient world's paradigmatic lateral puzzle

[II] ELT Processes

An understanding that emotions play a role in LT is already present in the literature.[115] LTC² codifies this understanding, adding new layers to it. ***Emotive Lateral Thinking*** is an explication and expansion of the fundamental insight that one may approach the creative act and in particular the rarest kind, i.e. transformational creativity, through the notion of an emotive lateral judgment. An emotive lateral judgment is premised on a sensitization in ascribing *emotive value*. A transformational creator is in a sense a predictor, an evaluator of the public's emotive reaction to the disruption, caused by his/her creative act.

This idea is grounded by the kind of evidence surveyed above (Section [3.3.1]), and is further informed by work from Stenning.[116] Taking into account Wittgenstein's work on concepts, and concept formation, he elaborated a theory that grounds concept formation to emotions, to the emotive impact our environment has on us since birth. These affective foundations predate language, and are the basis upon which we classify and abstract the world in concepts. This has the implication that emotions are the underlying operators of basic activities such as comparison, similarity and analogy.

We have further elaborated, and refined the above approach to include less rare types of creativity resulting in a distinction between two types of emotive lateral judgments, which make up the two basic processes of ELT:

First Order Emotive Lateral Judgment (ELJ[1]): ELJ[1]s are premised on an awareness of one's emotive state(s) in connection to objects (understood to include items, people, and situations) in the world, an awareness of how the world impacts one emotively. That means one is able to ascribe ***emotive value*** to objects. The notion of *emotive value* is essential, as it allows one to explore analogical equivalences. It is important here to note that *emotive value* is understood here as interconnected with - grounding and is grounded by - ethico-cultural sensitivities.

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[115] See e.g. De Bono E., *Serious creativity: Using the power of lateral thinking to create new ideas*, New York: HarperCollins Publishers, 1992.

[116] Stenning K., *Seeing Reason: Image and Language in Learning to Think* (Oxford Cognitive Science Series), Oxford: OUP Oxford, 2002.

An ELJ[1]'s basic type of question is: "What has an equivalent *emotive value* to this object?"

The answer to this question comprises the *emotive Po* to be used in constructing a new solution/idea to a given problem/task. We sensitise the player to emotive value, by asking him/her to build analogical equivalences, based on it. The new object, carrying the equivalent *emotive value*, can then be used in different ways in the challenge. The object itself can become part of the solution, or associations connected with it can play that role. We thus create a lateral path that moves through the 'side-streets' of an emotive equivalence, by-passing any obstacles of non-similarity in form or logical structure, that may prevent us from reaching the alternative we need.

Second Order Emotive Lateral Judgment (**ELJ[2]**): This the second level at which ELT can work. It is here that we encounter transformational creativity. **ELJ[2]**s can depend upon **ELJ[1]**s, but this is not necessary. They do necessarily depend, though, on a sensitization in ascribing *emotive value*.

An **ELJ[2]**'s basic type of question is: "What can be emotively accepted as a solution by the public (others, the group etc.)?"

To reach the rare moments of transformational creativity, the rules governing a field of discourse or conceptual space must be changed. An **ELJ[2]** allows us to transcend the given rules formulating a given problem/task, by opening up a space of possible solutions/ideas maintained by the emotive reaction (understood to carry ethico-cultural interconnections) of the public. The lateral path in this case works essentially as a short-circuit letting us by-pass the resistance offered by the (implicit or explicit) rules themselves, in order to reach a creativity conducing space. Here we are not looking for an alternative through equivalence, but seek to temporarily bracket the rules, in order to bend or alter them, by successfully predicting the emotive acceptance of our act as a solution, by the public.

In terms of the above Gordian Knot scenario, Alexander was acutely aware of the emotive register (*emotive value*) of him by the public. The public were emotively prepared, even expected for this super-human, sword-wielding conqueror to bend the rules. In a sense, the space for cutting the Gordian Knot was already prepared. What Alexander needed was the right type of question to get him there. The answer consisted in one of the most famous **ELJ[2]** of all time.

[III] The Gordian Knot revisited

"The ancient world's greatest puzzle was there, a knot that couldn't be untied. Alexander cut it in two with his sword. Lateral thinking, you see. Centuries ahead of his time."[117]

In order to better understand the above, we will explore another illustrative example, this time stemming from popular culture, and specifically the field of comic books. The source is Alan Moore's (Author) and Dabe Gibbons' (Illustrator) seminal, award-winning comic book: *Watchmen*. It has been hailed as a paradigm of its kind, transcending the boundaries stereotypically dividing the comic book genre, from what is customarily perceived as 'serious literature'. It has been characterized as a deconstruction of the genre itself, particularly the superhero type of stories, due to the multiplicity of perspectives the story is narrated from, the adult themes it explores, and the morally ambiguous (one could instead say 'realistic') characters that populate it.

One of the central characters is Ozymandias. He used to belong to a team of superheroes (or 'costumed vigilantes') but is now working solo, primarily managing a multinational billion-dollars' worth company he created. Ozymandias is an admirer of Alexander the Great, and is faced with his

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[117] Moore A. (Author) & Gibbons D. (Illustrator), Watchmen, DC Comics, 1986/87. This quote is attributed to Ozymandias, one of the major characters in the story (see main text).

own Gordian Knot to unravel. As the comic book is set in a close alternate of the late '80s period, cold-war politics set the stage. American-Soviet rivalry has escalated, and the threat of nuclear war is imminent. Ozymandias, unbeknownst to his former teammates concocts a plan to bring about world-peace. This plan, though, involves a number of murders, dark plotting, and most importantly simulating an extra-terrestrial attack, in order to unite the world's superpowers in face of the common threat. The toll of the simulation is unbearably heavy, as millions of innocent people have to die in order for it to feel like an actual threat. Contrary to most comic books where the 'good guys' save the day, Ozymandias' plan succeeds, and the rest of the characters (as well as the readers) are left with the daunting task of trying to understand what just happened. Can such acts be accepted as a solution to the problem of world peace? Is this ingenious creativity or is it mad destruction?

We can use the concepts we have introduced to try and unravel this conceptual knot. In some ways, we can say that Ozymandias uses a form of ELT, one based on **ELJ**[1]. We can reconstruct a possible reasoning process as follows:

"What does a state of peace feel like?" Or: "What kinds of emotions prevail among men and women in a state of peace?" Or: "What are the emotional underpinnings of a state of peace?" (i.e. "What is its emotive value?")

The answers here will most probably include: "A sense of solidarity and unison." "Feelings of trust." "Benevolent feelings towards fellow humans and lack of enmity."

The customary path would involve actions that *directly* promote/establish such feelings. The *lateral* path involves the use of an *emotive Po*: "What other situation is characterized/underpinned by the same kinds of emotional states?"

The answer that Ozymandias gives is: "Unity in face of a greater threat."[118] He then takes the utilitarian approach, staging an alien-invasion and sacrificing millions, for what he perceives to be an even greater good.

Figure 45: The dark side of creativity.[119]

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[118] Historical examples of such situations of course abound. One of the more recent one being the United States and the Soviet Union, working together under the threat of Nazism.

[119] The image is a frame from the movie Watchmen, released in 2009, directed by Zack Snyder. Image reproduced from http://herocomplex.latimes.com/uncategorized/is-watchmen-the/.

If we view his actions from the **ELJ**^{2} standpoint, though, a different image emerges. The key here is that Ozymandias had to keep the mechanisms of his solution hidden. The reason is that for most people, his solution would have failed at the **ELJ**^{2} level. This is evident in three ways: [i] The readers instinctively identify Ozymandias as the villain, although his motives are not what customarily drive villains. He is not looking for more power, but a way to bring about world-peace. [ii] Most of the other protagonists rebel against his solution, each in way consistent with t his/her belief/custom framework. [iii] The only character that comprehends Ozymandias' solution is a being called Doctor Manhattan. He is the only character who actually has superhuman powers. He used to be a man but a laboratory accident[120] turned him into a god-like being, thus depriving him of his emotional connection to humanity. It is often thematized in the book, how human affairs no longer matter to him, as he cannot find any emotional foothold in them.

Ozymandias does not change the rules of the game, he hides his rules, and thus the public can have no perspicuous view of the mechanisms comprising his solution to the problem of world-peace. Alexander's solution was open to public scrutiny. The public accepted his cutting of the Gordian Knot as a solution, thus bestowing to his act the status of transformational creativity.

This approach tries to do justice to the common-sense view (Section [1.1]) that although there can be something creative in acts of brutality such as a terrorist attack, there remain many elements that are deeply problematic to them being characterized as creative, by examining the most insidious form of a terrorist attack, one that is actually bent on world peace. If all this seems too fantastical and extravagant, it's best to remember that in the world of gaming, global conspiracy plots, alien invasions and men and women running around wearing what-can-only-be-termed as weird looking pyjamas, sporting unnecessarily outlandish names, is an everyday occurrence. What this example highlights is the deep ethical and cultural interconnection that underpins a successful **ELJ**^{2}. Here we see quite clearly how crucial it is to embed LTC^2 in the ethically oriented and culturally sensitive framework of WHC. To fully engage in the transformational creativity possible at the **ELJ**^{2} level, ethical and cultural awareness are vital.

[IV] On the Construction of ELT Techniques

ELT is still early in development. We have identified the two main processes that comprise its core, and this will allow us to construct more detailed techniques serving the ***C^{2}Learn*** objectives. As ELT thematizes emotive value, it may prove to have close affinities to *Role Play*, and thus an amalgam of the two may be formed.

ELJ^{1}s can be incorporated within the Random Stimuli technique, as it might very well be the case that the stimulus be a word demoting some emotive value. In that case one could start by exploring emotive equivalents – i.e. objects, all connected to the specific emotive value denoted by the word – and then using one of them to take the sort of analogical steps we saw in the *Random Stimulus* example. Of course, **ELJ**^{1}s can most certainly also function as building blocks for stand-alone techniques.

ELJ^2 type of techniques may also work well together with the *Escapism* technique. They both aim at undermining the rules of the problem/task, by emancipating us from the unstated conditions of the challenge. Whereas *Escapism* disrupts through counterfactuality, **ELJ**^{2}s provide us with the emotive space to work on. One can support the other in achieving their goal.

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[120] It is infamous how often in comic books 'laboratory accidents' result in super powers rather than painful injuries and death.

As diagrams also carry emotive value,[121] it is highly likely that we may find ways to create hybrids of DLT and ELT techniques. The most readily available option would be for the emotive equivalents of ELʲ[1]'s to be expressed diagrammatically, and thus also acquire the characteristics of a *diagrammatic Po* too. Another might be to use an ELʲ[2] in order to push the boundaries of *e-transformation*, i.e. how far could one go in transforming a given diagram, and the transformation still be emotively registered as a transformed version of the original one (i.e. instead of just feeling like a completely new shape). At this point though, these options are still at the level of speculation.

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[121] We briefly indicated, for example, how the use of the stereotypical [man-symbol] can be very controversial and provoke strong emotive reactions by other players (note [100]).

4   Appendix

Plans for future work

Firstly we want to finish integrating our theoretical framework with that of the OU team. This process has already been underway and important milestones have been reached. Two of the major theoretical tools of OU, i.e. WHC and LDS have formed and organic unity with our perspective, and have been explicitly thematized in the relevant sections (Sections [1.3] and [2.3]). The counterfactual [what if/as if] distinction, which forms part of another theoretical tool by OU (Possibility Thinking), has also been incorporated (Sections [3.1.3] and [3.1.4])

The development of the game environment(s) will also help us in a multitude of ways to further our research, and tailor our theory:

[i] On the level of creativity assessment we will be able to specify metrics, as explications of our notion of a frame, that can help assess players' performances. This will involve close work with the NCSR-D, UoM and SGI teams (Section [1.2]).

[ii] We will be able to structure and evolve our brainstorming activities in order to better facilitate the *C²Learn* objectives (Section [2.2]). Our work here will also include close collaboration with OU, EA and BMUKK.

[iii] We will be able to further tailor the SLT techniques, especially the *Role-Play* one (Section [3.1.4]).

[iv] Further research is needed to evolve the DLT proto-techniques, and the ELT processes into comprehensive, complete techniques (Sections [3.2.3] and [3.3.2]). Our work with NCSR-D and UoM will be paramount in this respect (especially for DLT), as well as our collaboration with OU (especially for ELT). There is also still much to explore in the area of synergies between techniques and different kinds of LTC[2].

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