Systems Approach to Knowledge Theory: Creative Space and Creative Environments

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- **1. The impact of systems science and multicriteria analysis on current change of understanding the world**
- **2. New approaches to the problem of knowledge and technology creation**
- **3. The Rational Theory of Intuition**
- **4. The concept of Creative Space**
- **5. New spirals for creative processes**
- **6. Further dimensions of Creative Space**
- **7. Conclusions**

1. The impact of systems science and multicriteria analysis on current change of understanding the world

- ***Systems science,*** in particular ***nonlinear dynamic systems analysis*** and also ***computational science*** have lead to ***theory of chaos and complexity,*** thus motivated the change of understanding the world – together with the emergence of ***critical and soft systems science***

- Multiple criteria decision analysis has drawn attention to ***interactive decision making*** and ***unconscious aspects of human behavior,*** thus contributed to the revolutionary situation in epistemology we observe today

1. The impact of systems science and multicriteria analysis on current change of understanding the world, 2

- Diverse ways of periodization of civilization eras
- Classical of ***third wave*** type (e.g. preindustrial-industrial-postindustrial), shallow
- Deeper: based on historical periodization approaches. Best F. Braudel (1979: *Civilisation matérielle, économie et capitalisme, XV-XVIII siècle*), the concept of ***long duration historical structure,*** 1440-1760 Europe. Hence:
  - Banking and travel civilization: 1440-1760
  - Industrial civilization: 1760-1980
  - Informational and knowledge civilization: 1980-2100?
- each characterized by an unique ***perspective of perceiving the world***

1. The impact of systems science and multicriteria analysis on current change of understanding the world, 3

- Two basic concepts: ***chaos*** and ***complexity:***
- Basic principle of a ***strange attractor*** or another ***chaotic generator*** (e.g. ***pseudo-random generator*** in computers): take a dynamic system with strong nonlinearity and include in it a sufficiently strong negative feedback to bring it close to instability
- Basic conclusion of ***deterministic theory of chaos:*** the possibility of ***order emerging out of chaos***
- Other aspects of ***catastrophe theory*** (Thom) and ***stochastic theory of chaos*** (Prigogine) - complex, unstable dynamic systems create new modes of behaviour
- ***Computational complexity****:* nonlinear dependence of computational effort on problem dimension

1. The impact of systems science and multicriteria analysis on current change of understanding the world, 4

- ***A new way of understanding the world, systemic and chaotic,*** such that the world:
  - **will not be seen** as a ***giant clock, machine;***
  - **but will be seen** as a ***complex dynamic system*** (***a tornado, an avalanche***);
  - with possibly ***chaotic behaviour,*** resulting from nonlinear dynamics with strong feedback;
  - with ***order emerging out of chaos***
  - with ***butterfly effect*** instead of ***inevitability;***
- ***A new way of understanding and utilising knowledge***;
- ***A new foundations of epistemology: the principle of emergence*** (of qualitatively new properties of a complex system) instead of ***principle of reduction*** (of properties of a system to the properties of its components).

1. The impact of systems science and multicriteria analysis on current change of understanding the world, 5

- Since about 1980: ***interactive approaches*** to multiple criteria decision support, including ***reference point approaches*** (Wierzbicki; Sawaragi and Nakayama)
- Interactive approaches stress the ***sovereign role of the human user of the system,*** thus his ***intuitive, unconscious, tacit, a-rational "metaphysical"*** abilities
- Such abilities are stressed in the ancient and modern Far East philosophy; this influenced, for example, psychoanalysis via Nietzsche, Bergson, Freud, Jung
- This lead – a century later - Sawaragi and Nakamori to ***Shinayakana Systems Approach,*** Wierzbicki to ***Rational Theory of Intuition***

1. The impact of systems science and multicriteria analysis on current change of understanding the world, 6

- The epistemology of 20th century was dominated (consciously in the first half of 20th century, unconsciously in the second half) by Wittgenstein's ***wovon man nicht sprechen kann, darüber muss man schweigen*** (***if we cannot speak about it, we must remain silent***)
- The multicriteria analysis, later management science helped to show that Wittgenstein's opinion was not correct: ***we must speak today about "metaphysical"*** *subjects such as* ***intuition, unconscious, tacit knowledge*** *in order to* ***understand knowledge creation***

2. New approaches to the problem of knowledge and technology creation

- **Two schools of thinking how knowledge is created:**
  - creative abilities are irrational, intuitive, instinctive, subconscious – thus distinguishing ***the context of discovery*** from ***the context of verification;***
  - science is a result of induction and creative acts are not irrational.
- However, the concepts of ***tacit knowledge,*** of ***intuition*** and of ***group collaboration*** resulted since the last decade of 20th century in ***many quite new approaches to knowledge creation,*** all directly or indirectly related to Japanese origin (and many to JAIST).

2. New approaches to the problem of knowledge and technology creation, 2

- ***Shinayakana Systems Approach*** **of Sawaragi and Nakamori (1992)**
- ***SECI Spiral*** **of Nonaka and Takeuchi, *The Knowledge Creating Company* (1995)**
- ***Rational Theory of Intuition*** **by Wierzbicki (1997)**
- ***Process of Regress*** **by Motycka (1998), using *Collective Unconscious* of Jung (1953)**
- ***I^5 System*** **by Nakamori (2000)**
- ***The Management of Distributed Organizational Knowledge*** **by Gasson (2004), several others**

2. New approaches to the problem of knowledge and technology creation, 3

- Since the beginning of the last decade of 20th century, many approaches were developed stressing and rationalizing the need of using irrational abilities of human mind in creative processes
- It is, actually, ***a scientific revolution,*** because 20th century was dominated by the principles of logical empiricism that refused to speak about such metaphysical aspects
- We interpret this revolution also as one of the signs of the beginning of a new era of informational and knowledge civilization

3. The Rational Theory of Intuition

- ***The need of better understanding tacit knowledge***
- The concept of intuition: Nietzsche, Freud, Bergson ... - as ***an essential but irrational phenomenon***
- Old methodological dispute: ***hard models - soft thinking, soft models - hard thinking***
- Earlier, in humanities: ***hermeneutics*** (e.g. H. Gadamer)
- ***General systems theory*** of Bertalanffy: ***holistic or Gestalt perception***
- English school of ***deliberative, soft decision making*** (P.Checkland and others)
- H. i S. Dreyfuses (from Berkeley): ***Mind over Machine*** - with an essential experiment: ***experts of master class make decisions in a deliberative way***
- Wierzbicki (1997): ***a Rational Theory of Intuition***

3. The Rational Theory of Intuition, 2

- Rational theory of intuition is based on two premises:
- ***Primo,*** on contemporary knowledge about relative complexity of processing speech (audio signals) and vision (pictures, television): the ratio of bandwidth 1:100, ***the ratio of processing complexity at least 1:10 000,*** **a picture is worth** (at least) **ten thousand words**
- ***Secundo,*** we use the following ***thought experiment:*** Imagine the period in human evolution when we discovered speech. ***How did we process signals from our environment just before this discovery?***
- The discovery of speech was a tremendous ***evolutionary shortcut:*** we could process signals 10^4 times faster. This made possible the intergenerational transfer of knowledge and thus ***started entire evolution of human civilization***

3. The Rational Theory of Intuition, 3

- The discovery of speech slowed down biological evolution, accelerated intellectual evolution of humans. As with each simplification, it had also drawbacks. E.g., binary logic was practically discovered as a tool of ideology: "***This must be true or false, there is no third way!***"
- But what happened to our old abilities of ***pre-verbal*** processing of information? The discovery of speech suppressed these abilities, pushed them down to ***subconscious or quasi-conscious*** behaviour. Our consciousness, especially its logical and analytical part, became strictly related to speech and verbal articulation.
- However, ***we still possess our old pre-verbal abilities of information processing that are about 10^4 times stronger than verbal;*** for the lack of a better word, we call them ***intuition.***

3. The Rational Theory of Intuition, 4

- ***Definition:*** **Intuition is quasi-conscious and subconscious, pre-verbal and holistic (parallel, distributed) information processing, utilizing aggregated experience, training and imagination and performed by a specialized part of human mind**
- Under ***rationality*** we understand here ***the rationality of scientific theories*** following W. Quine and K. Popper, not other concepts of rationality
- We adopt thus a **rational evolutionary definition of intuition** that allows falsifiable (testable experimentally) practical conclusions
- For example, a conclusion is that ***in order to stimulate intuition we must suppress consciousness*** (as in Zen meditation or in athletic concentration)

3. The Rational Theory of Intuition, 5

- Entire **Rational Theory of Intuition** was developed, with appropriate concepts, definitions, structure of intuitive decision processes, relations to cognitive sciences ***(right brain - left brain),*** etc. An essential distinction:
  - repetitive, ***operational intuitive decisions***
  - unique (non-repetitive) ***strategic intuitive decision processes,*** including ***creative decisions***
- Further: practical conclusions, experimental tests, etc.
- ***There are two parts of tacit knowledge:***
  - **intuition,** ***our intuitive ability of utilising life-long experience and imagination***
  - **emotions,** ***which actually include also part of explicit knowledge***
- An essential element of intuitive creative processes is the phenomenon of ***aha, illumination, heureka,*** **enlightenment**

4. The concept of Creative Space

- This concept resulted as a way of ***integrating known theories of knowledge creation***
- The basic assumptions are:

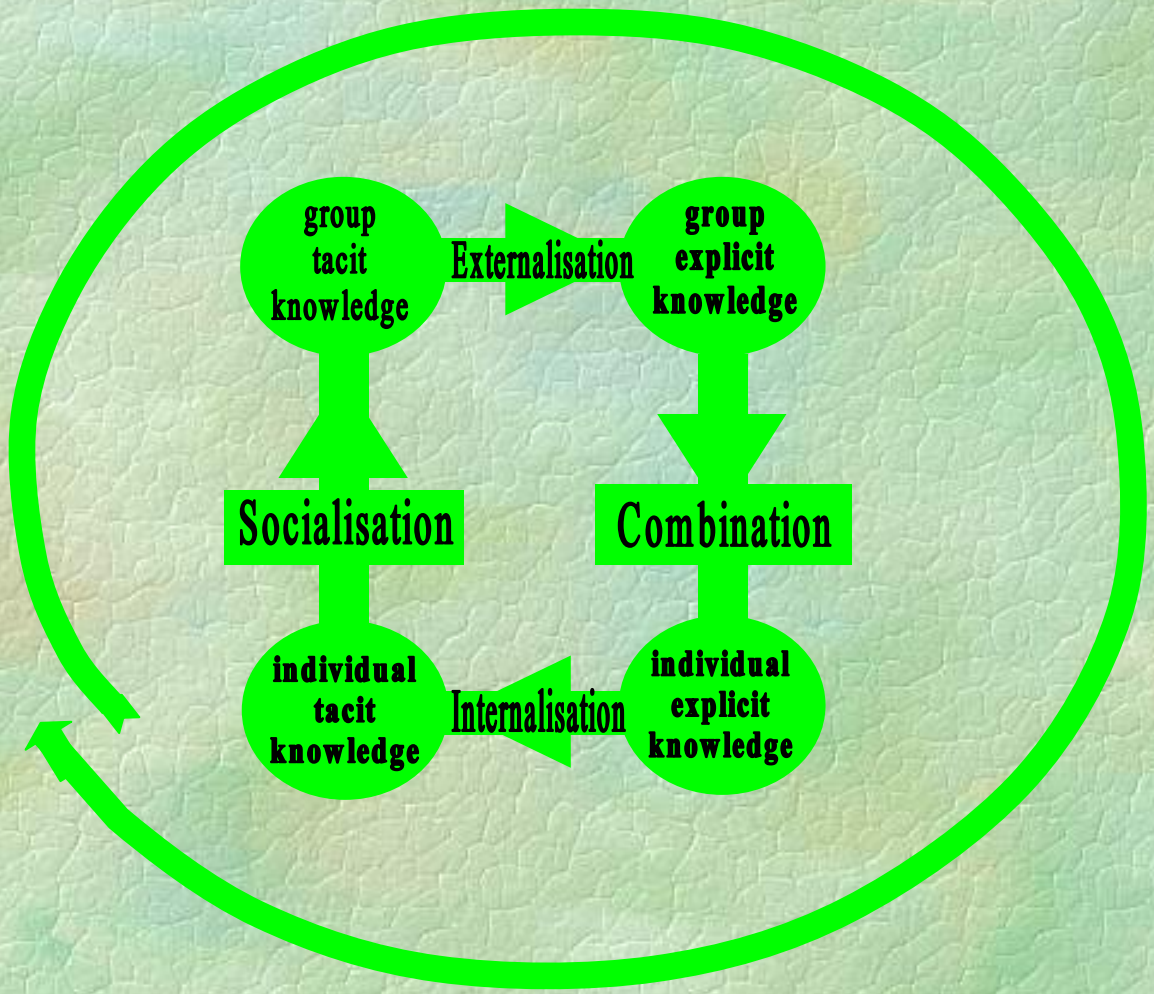
➢ Use at least three-valued logic (three levels of ontological elements)

➢ Use the epistemological and the social (*so-called ontological*) dimensions of ***SECI Spiral*** as basic, but add also other dimensions (as in ***I^5 System***);

➢ Carefully define the ***nodes*** (ontological elements) of Creative Space and study possible ***transitions*** (not *knowledge conversions*) between the nodes.

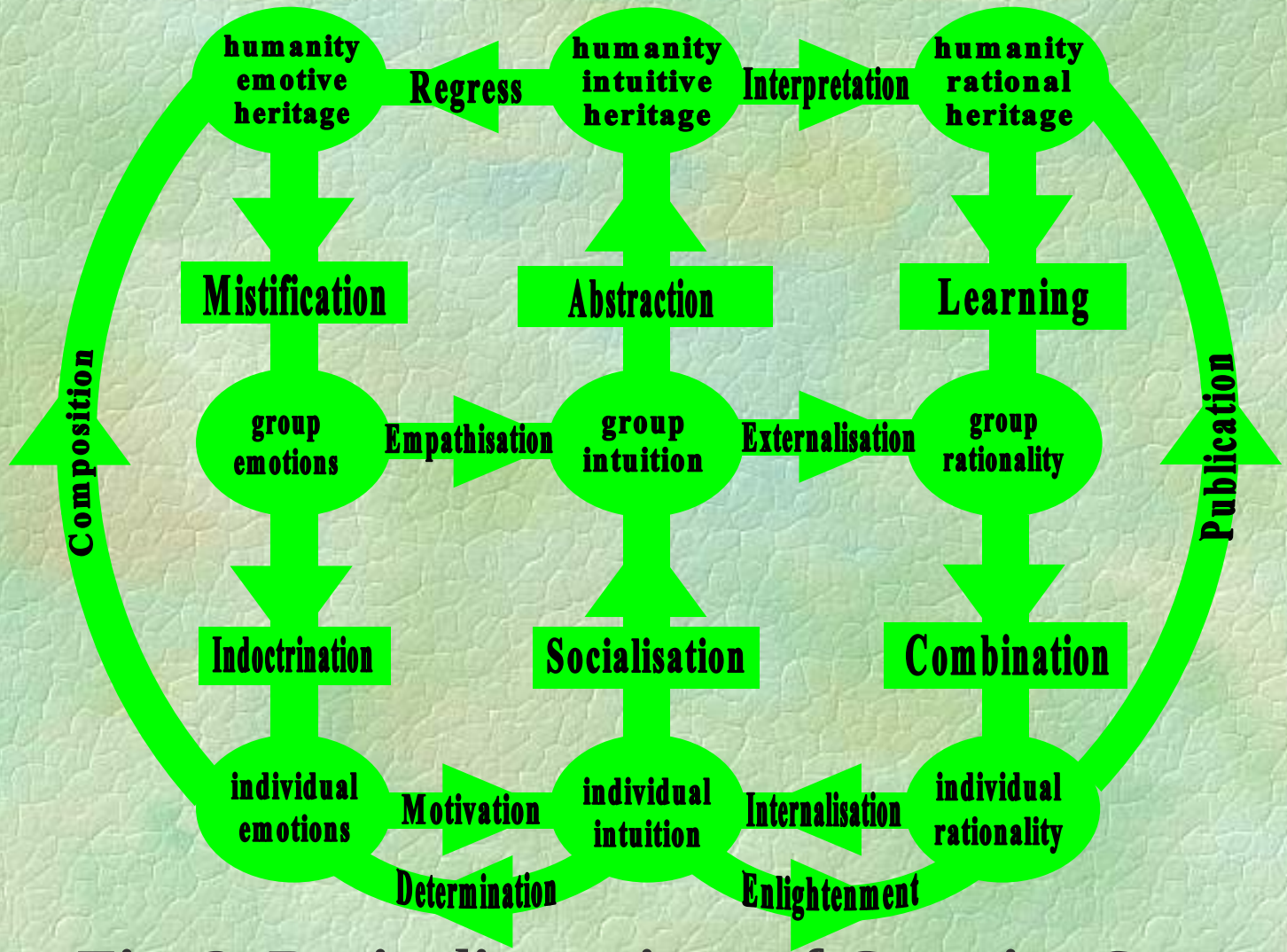
➢ Thus, create a ***network-like general model of creative processes***

4. The concept of Creative Space, 2



- **Fig. 1. The SECI spiral**

4. The concept of Creative Space, 3



- Fig. 2. Basic dimensions of Creative Space

4. The concept of Creative Space, 4

- The ***ontology of Creative Space:*** discussion of nodes and transitions
- Example: the ***emotive heritage of humanity*** contains not only tacit knowledge elements, also explicit knowledge:
  - Music, movies, other art forms – all influence our creativity
  - However, their influence is indirect, through emotions, even if we know them explicitly
  - For example, you might have seen a movie thus you know it explicitly; but its impact on your creative behavior is indirect, emotional
- Thus the distinction ***emotive – intuitive – rational*** is more precise, than ***tacit – explicit***
- ***Emotive heritage*** contains also an important tacit element – the ***collective unconscious*** of Jung

4. The concept of Creative Space, 5

- Another example: the ***intuitive heritage of humanity*** <=> the Kantian ***a priori synthetic judgements***
- Plato, later Kant have shown that ***there are true ideas that we have in our mind and they appear obvious to us*** (ideas of space, time, logic)
- However, the concepts of non-Euclidean space, relative time, multivalued logic have shown that ***these ideas are not obvious and not necessarily true***
- The Rational Theory of Intuition suggests that they are our ***intuitive heritage of humanity –*** extremely valuable for civilization evolution, but ***mesocosmic,*** hence not necessarily true

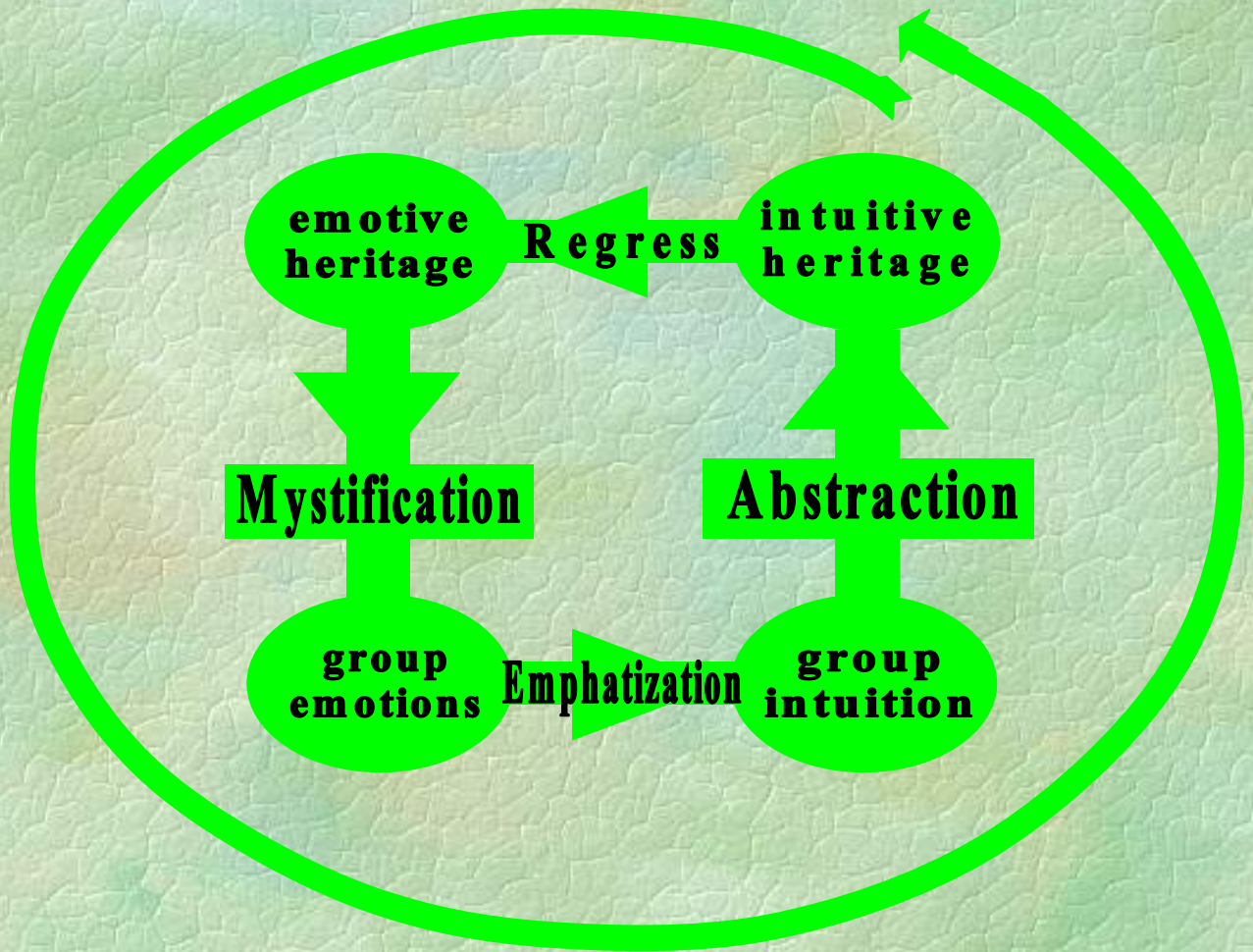
5. New spirals for creative processes

- Even within the basic dimensions of Creative Space, two new spirals can be discerned:
  - Motycka ***Regress Theory*** implies ***ARME Spiral*** in the upper left-hand corner of Fig. 2, ***describing knowledge creation in times of a crisis of a scientific discipline;***
  - Wierzbicki ***Rational Theory of Intuition*** implies ***EDIS Spiral*** in the lower right-hand corner of Fig. 2, like SECI Spiral, but different direction and transitions, ***describing normal processes of knowledge creation as they usually happen in academia – universities and research institutions;***
  - Other conclusions are possible – e.g. ***practical:*** how to improve conditions and efficiency of normal processes of knowledge creation.

5. New spirals for creative processes, 2

- Motycka ***Regress Theory:***
  - In a time of crisis of a scientific discipline (e.g. physics before quantum theory) a group of scientists comes intuitively to conclusion that they must find new concepts;
  - They seek such concepts in mathematical intuition, but cannot find them. Thus, they turn to ***collective unconscious*** of Jung in a process Motycka calls ***regress***
  - ***Archetypes in collective unconscious*** provide them with sources of new ideas which they discuss on emotional level until by empathy they become part of their intuition;
  - If this is sufficient, ***mathematical intuition helps them to formalize their ideas.*** If not, the process of regress is repeated.

5. New spirals for creative processes, 3

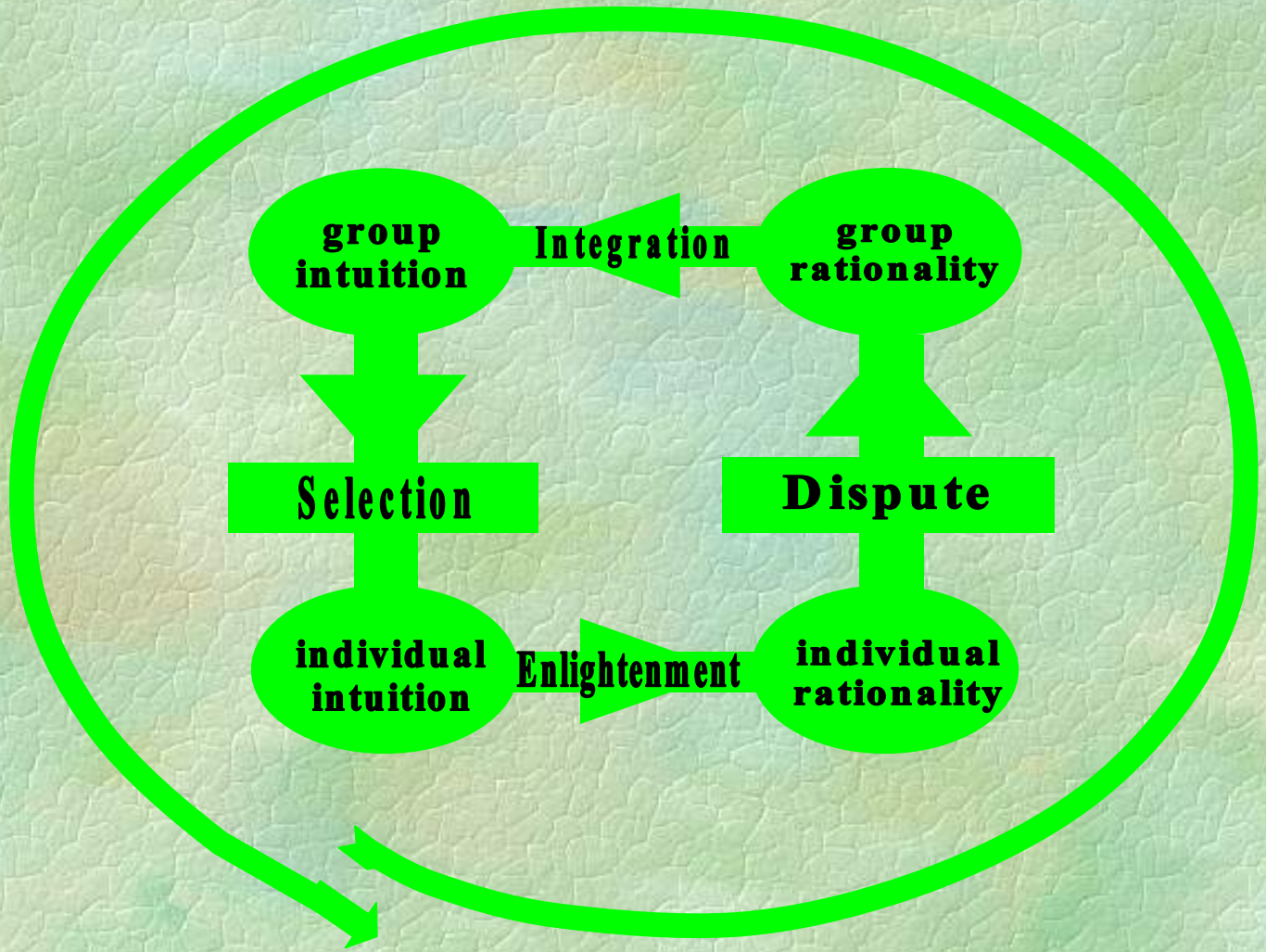


- ARME Spiral (Motycka)

5. New spirals for creative processes, 4

- Thus the historical phenomenon of creating new scientific theories in times of a scientific revolution, described by Motycka independently from Nonaka and Takeuchi SECI spiral, ***can be represented as another spiral in the Creative Space***
- Kuhn argued that scientific revolutions are divided by long phases of ***normal science development***
- ***SECI Spiral, for all its revolutionary and organizational value, does not describe the process of normal science or technology creation in academia*** (at universities, in research institutes)
- Can we find a spiral in Creative Space that ***describes the old process of normal science and technology creation?***

5. New spirals for creative processes, 5



- EDIS Spiral (Wierzbicki)

5. New spirals for old creative processes, 6

- ***What is the purpose*** of describing old creative processes with spirals?
- ***Better understanding, practical conclusions:***

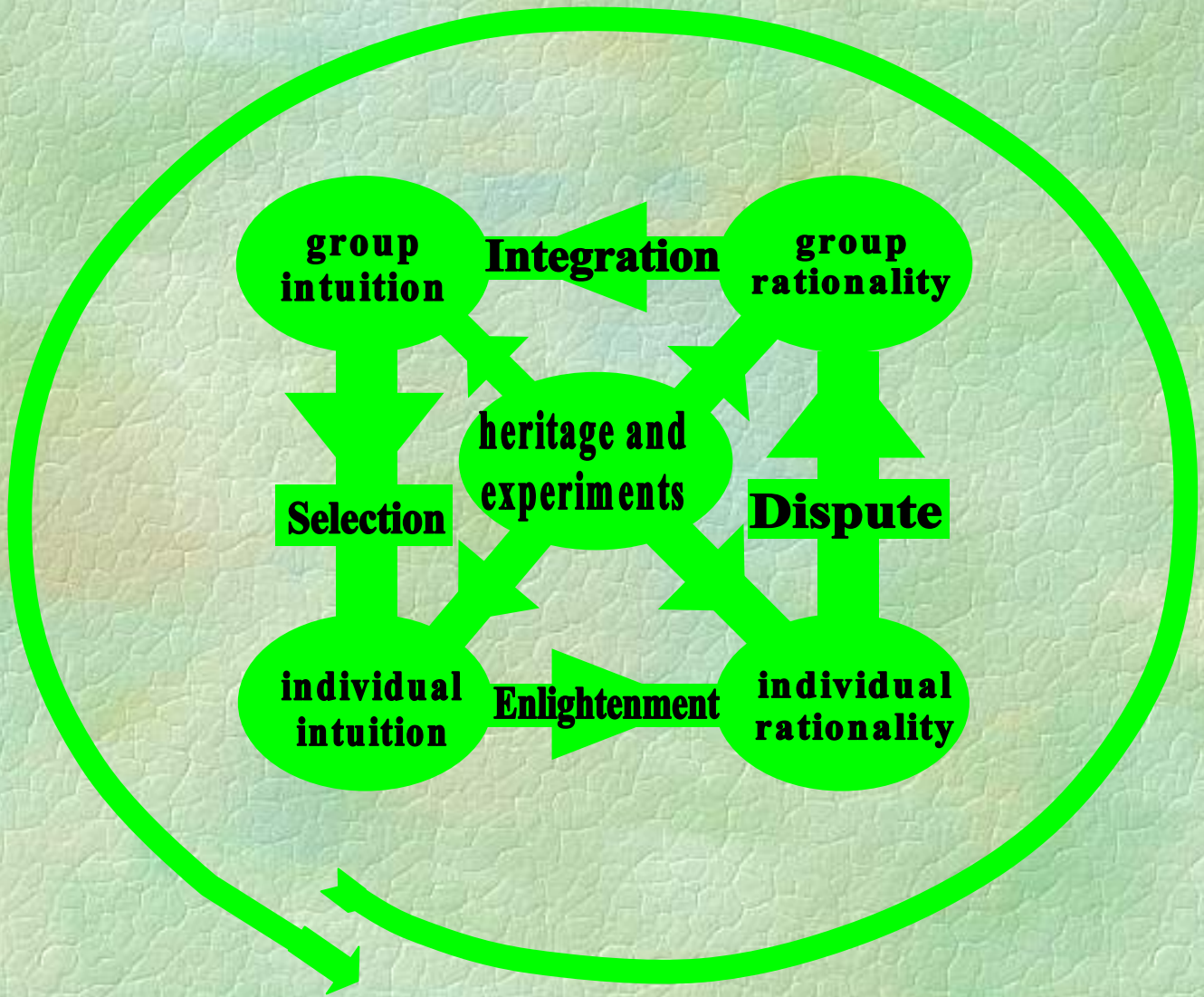
➢ We know how to enhance ***Enlightenment*** (see ***Rational Theory of Intuition***);

➢ We notice that Far Eastern societies are better than Western at ***Socialization*** and ***achieving consensus*** (used in SECI Spiral) but (perhaps therefore) worse in ***Dispute***

➢ We notice that ***Integration is intuitive,*** hence Far Eastern societies might be good in it, but also ***based on critical dispute,*** hence both Far Eastern and Western might require ***reciprocal help in achieving good Integration***

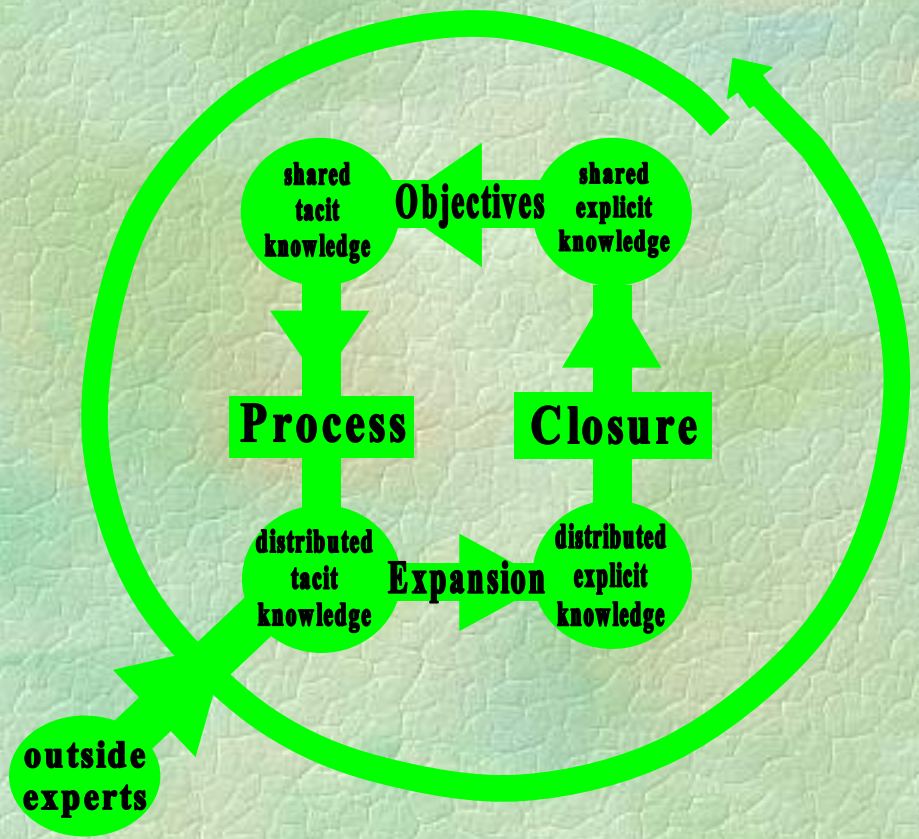
➢ ***Is EDIS Spiral complete?***

5. New spirals for creative processes, 7: EDIS Spiral augmented

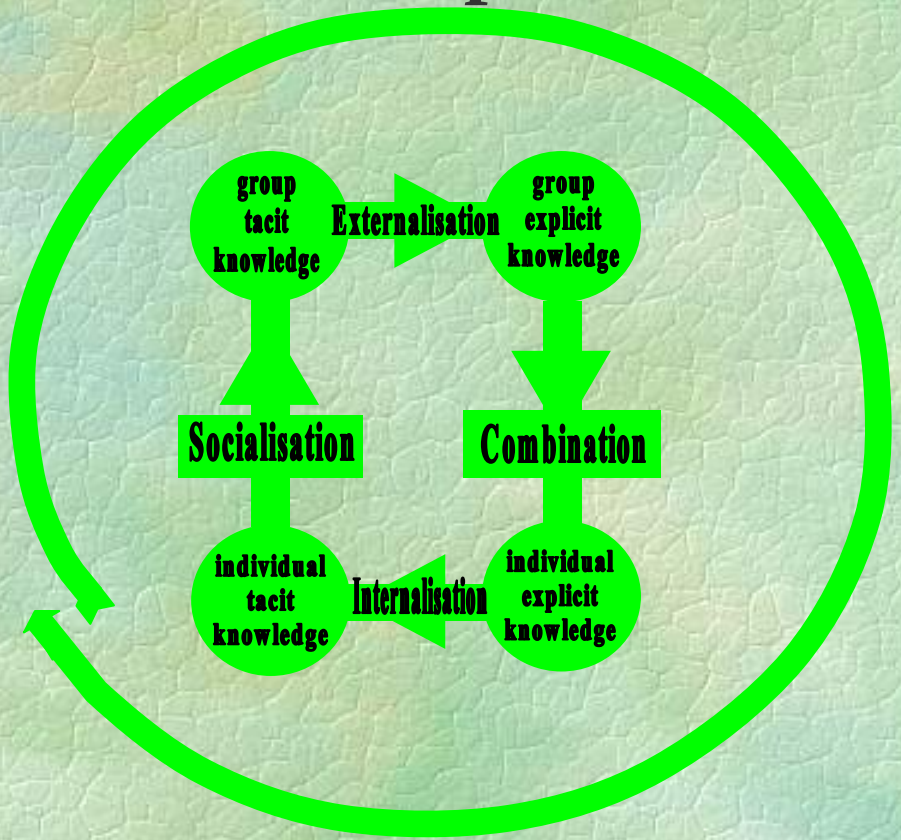


5. New spirals for creative processes, 7: Gasson *OPEC Spiral* versus *SECI Spiral*

Gasson ***OPEC Spiral***



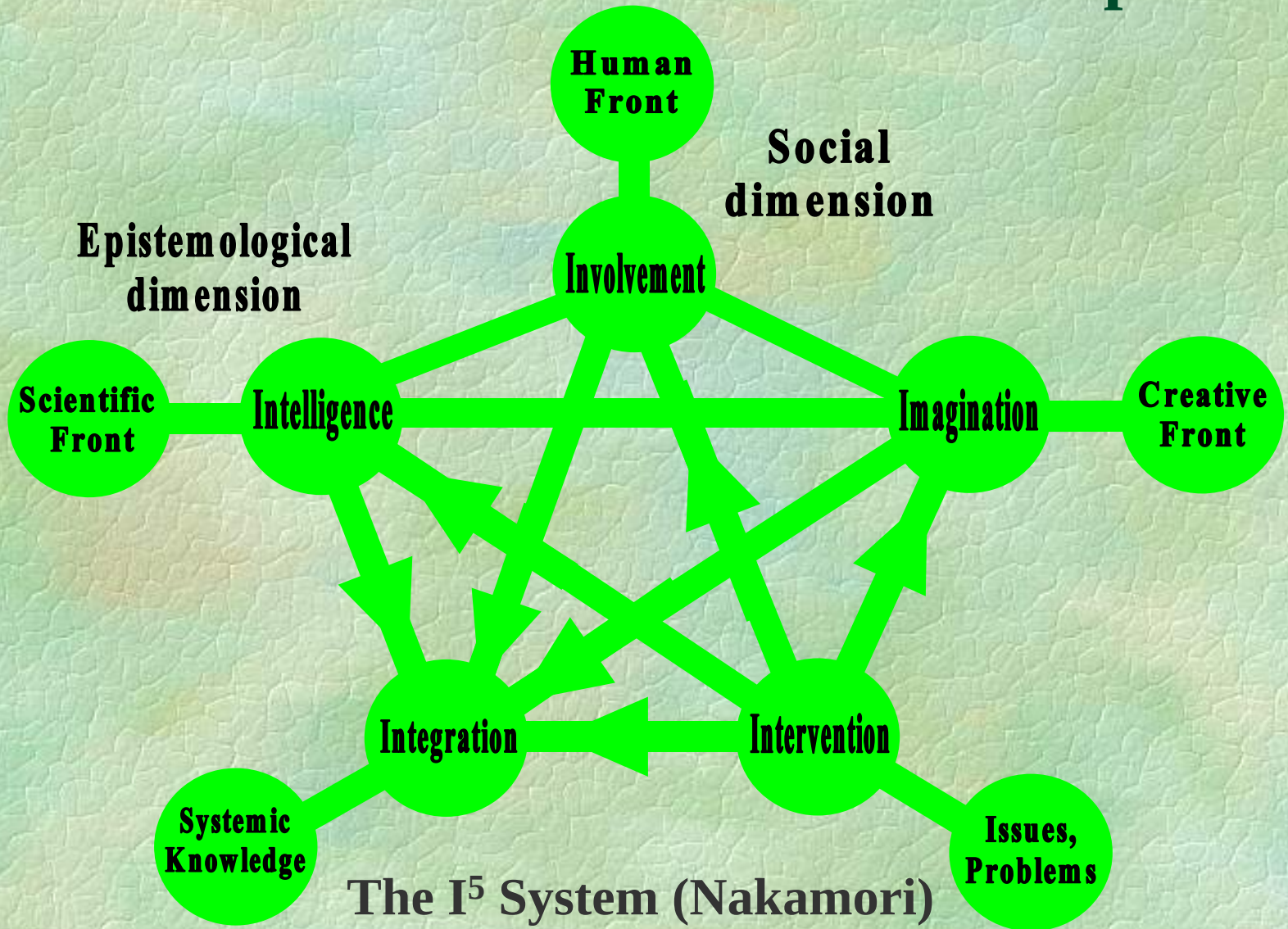
SECI Spiral



5. New spirals for creative processes, 8: Gasson *OPEC Spiral* versus *SECI Spiral*

- Although Gasson might be right that in Western companies the opposite direction of knowledge-processing ***OPEC spiral*** dominates,
- She subconsciously (perhaps influenced by the cultural trend created by Wittgenstein) does not accept the concept of ***Knowledge Creating Company*** and assumes that the company will hire outside experts, if more knowledge is needed,
- Thus, ***SECI Spiral*** truly reflects possible advantages of Far-Eastern type companies in organizational knowledge creation;
- However, in academia we have different purposes (e.g. promoting individual advancement of young researchers) than in a business-oriented company, thus we have a different ***EDIS spiral,*** different problems.

6. Further dimensions of Creative Space



The I^5 System (Nakamori)

6. Further dimensions of Creative Space, 2

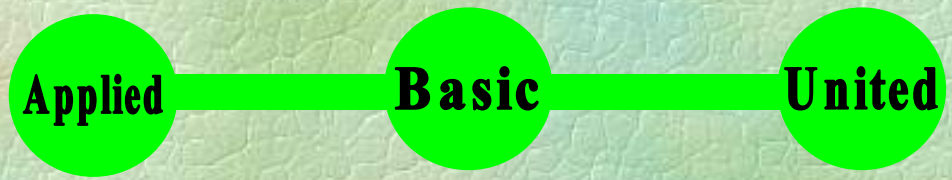
- **Dimension *Imagination*** (necessary but not sufficient for creativity)

- **Dimension *Intervention*** (strong in Western culture: Kant, Western individualism)

6. Further dimensions of Creative Space, 3

- **Dimension *Integration*** (interdisciplinary, requires systemic knowledge)

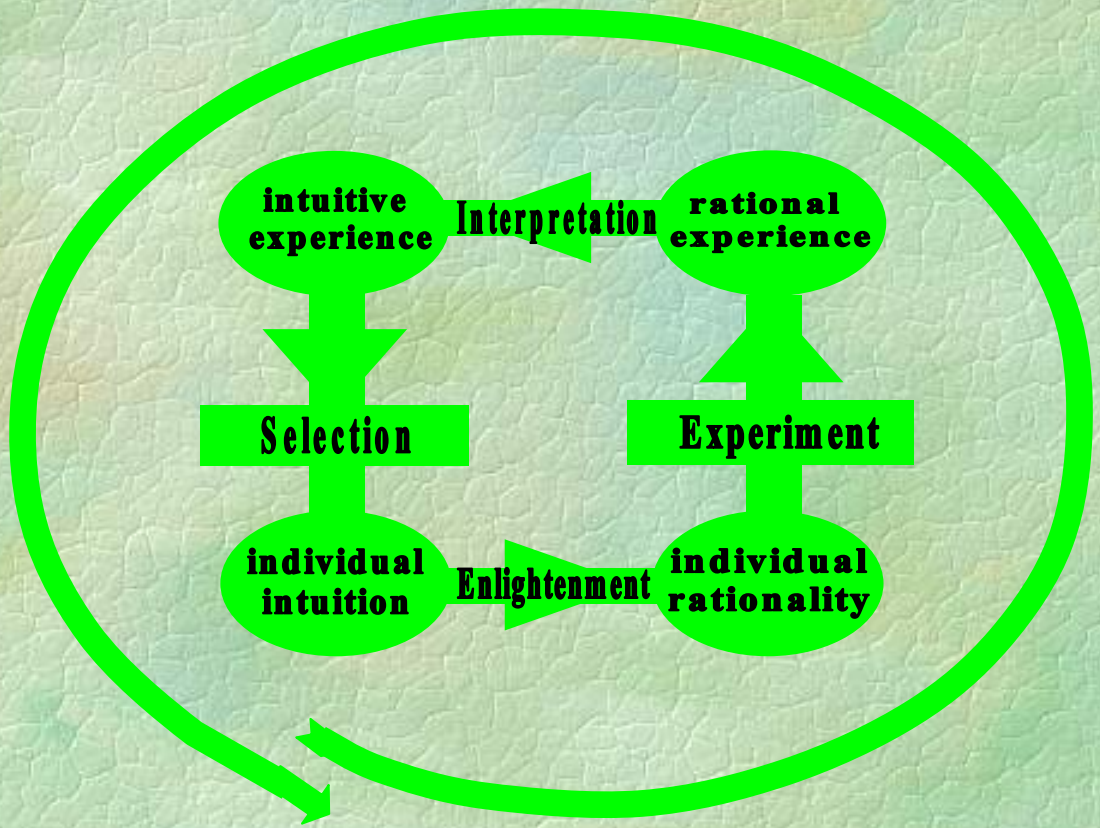
- **Dimension *Abstraction*** (the value of intersubjective or experimental verification)



- **Dimension *Objectivity*** (truth is necessary not as an absolute, but as a condition of human evolutionary cooperation)

6. Further dimensions of Creative Space, 4

- **Example: *EEIS (EDIS') Spiral* using other dimensions:**



7. Conclusions: practical advice

- Diverse; example – the conditions for scientific dispute:
  - cultural and psychological;
  - organizational;
  - theoretical;
  - practical;
  - technical.
- Further example – theoretical aspects of dispute:
  - Plato ***Dialogs:*** example of Socrates
  - ***eristics***
  - ***dialectics: thesis – antithesis – synthesis***
  - ***methods*** of formulating ***antithesis: questioning assumptions,*** in particular ***unstated,*** in particular ***hidden***
  - ***methods*** of formulating ***synthesis – like integration, it is an intuitive process***

7. Conclusions: general

- **The concept of *Creative Space* is a good tool for the integration of diverse knowledge creation theories**
- **Using this concept, we can:**

➢ **Clarify the ontology of knowledge creation theories;**

➢ **Obtain new interpretations of existing theories;**

➢ **Obtain new variants of theories;**

➢ **Obtain new insights and practical conclusions.**