

Fractals and Personal Esthetic Preferences – Indicators of Personality Traits

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Abstract

Introduction: *Fractals are geometric shapes, usually generated with the help of the computer. The output consists of self-repetitive, auto-similar, complex and abstract representations of the natural world. This means that similar shapes can be found everywhere around, especially in the natural environment and in the human body.*

Objectives: *The study shown here aims at underlining, presenting and making several suggestions about the way these shapes can be used as a form of Ambient Therapy in a health practitioner's offices and how the aesthetic of fractals can predict certain personality traits when used in the context of the Fractal Technique.*

Methods: *To achieve our objectives, we will present a critical review of works and studies pertaining to sciences like architecture, medicine, biology, and psychology. The findings are correlated with our personal research regarding the ability of fractals to reduce stress and predict personality traits.*

Results: *After 5 years of gathering and disseminating information about fractals during workshops, public conferences, student courses, and personal development groups, we observed that these shapes can reduce stress, activate alpha waves, induce fascination just by means of their presence and they can give important pieces of information about the viewer. Also, with the aid of some special guidance, fractals can be used as diagnosis and intervention tools within the frame of Unification Experiential Therapy.*

Conclusions: *Fractals can be an efficient tool in Ambient Therapy due to their capacity to reduce stress, and have a healing restorative effect as well, due to their similarity not only to parts of the human body but also to the evolution of the human behavior itself. It is well known that a visit to the doctor's office is usually stressful and full of anxiety, possibly because one might expect to receive a bad diagnosis or to expose his/her personal body and mind to a stranger. This is why it is important to provide a healing place for the client quite from the beginning. Also, when it comes to psychological offices, fractals can be a good tool to relieve stress, to reduce anxiety and sustain introspection, especially in the case of those clients who are not in contact with their inner world.*

Keywords: *fractals, Ambient Therapy, healing spaces, stress-free, sick buildings*

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I. Introduction

To give an exact definition of life is a utopia. There are so many variables to take into consideration. Of course, being alive means having a certain set of functions and characteristics. The same can be said about fractals.

Mandelbrot, the parent of what is often called today nature geometry, avoided putting his discoveries in a rigid box even though he had to adhere to the scientific standards. Inspired by the Latin word, "fractus", he chose the well-known term of fractals to describe all the shapes that can be broken into an infinite number of parts, no matter the size, and still be auto-similar to the whole. In other words, the whole reflects the part and the part reflects the whole.

Today, this is a name we can surely use to describe the shape and even the evolution of beings, organs, and patterns found all around us and even inside us. Trees, ferns, clouds, blood vessels, human tissues, heart beats have a fractal dimension, different than unidimensional (not a point), neither bi-dimensional and neither tridimensional because it doesn't fit the whole box (Butot, A, 1997).

For science, this was an important point and soon fractals became an interdisciplinary subject with a lot of practical applicability in domains like physics, art, architecture, medicine, sociology, biology and psychology. Nowadays, Fractal Theory is widely used to explain the evolution of non-linear systems (all system where the output is different than the input) like the fluctuation of prices, weather changes, city developments, synchronicity, Chaos Theory and other components of life.

Artists also became interested in these shapes, therefore today many clothes and indoor designers use them without even knowing what they are. How is that possible, you might ask? Well, fractals were present in people's life long before Mandelbrot discovered it.

Similar shapes are found in different cultures around the world since the beginning of humankind. People used to decorate their walls, clothes and they even made buildings using fractal geometry. But the most impressive proof comes from their presence in art. Every work of art is an expression of the psyche. This suggests that fractals might emerge from the psyche and work as a symbolic archetypal image similar to mandalas.

It is believed that humans have a certain set of predefined attributes, like an inner unconscious program that guides them through life, and it is called an archetype. Anima (feminine attributes) and Animus

(masculine attributes), Persona and Shadow (rejected parts of self) can be expressed in symbols during expressive creations and sleep. It is believed that objects like sun, air, mountains are symbols of masculinity, while rivers, earth, water are symbols of femininity.

Mandala is believed to be an archetypal image of the self. When these natural circles occur spontaneously during artwork or dreams, these suggest a struggle of the Self to unify and heal itself. Fractals are similar to mandalas because they iterate a starting point (similar genesis) and respect the rule of similarity at all levels (Simion, R., 2016).

We believe that when fractals emerge spontaneously from the psyche, that shape is an archetype of life's secret structure and inter-human invisible connection (collective consciousness and unconsciousness).

For some, life is described as the period from birth to death and for others (those who are more spiritual and who believe in life after death) it is described as a specific amount of time of existence on earth. For those more skeptical, life is the synthesis of all biological, physical, chemical and mechanical processes that make and keep something alive (the macro and micro world).

What happens with the person between the conception point and the end of life is what concerns health specialists the most. Psychologists struggle to discover more and more methods to predict someone's behaviors and to build questionnaires and tests that can realistically measure the probability to exceed certain personality traits in different life situations.

Some people already adopted the Fractal Theory to explain the formation of self, the patterns of making decisions and transgenerational anniversary syndrome. Starting from the idea that the part reflects the whole and the whole reflects the part, it is believed that the functioning of society in its leading institutions reflects the dynamics of the families and small communities. Also, the adult pattern of taking decisions reflects the way that adults used to respect rules and to make decisions during childhood plays and vice versa.

The Self consists of the image of the intrauterine psyche, the child psyche, the adolescent psyche and the present psyche. They are built one on another (in successive layers) thus, the whole contains the part, but the part also reflects the whole or at least contains the structure to generate that specific whole (Marks-Tarrow, 2008, 2010).

If physical life seems limited, the psyche is infinite. During a lifetime, one can experience infinite

situations and expand knowledge in a limitless way, exactly like fractals, the only shape that has a finite surface, but an infinite length. So if we adhere to fractals theory to describe life, we could say that life is the period of time where existence can experience an infinite number of variations, similar to the rest, but always unique, even though it is built on the same structure for every being on earth. This is why fractals might be the archetype or the symbol of life structure itself.

II. Objectives

We believe that there is a strong connection between personal preferences and fractals due to their likeness to natural objects. People tend to respond more positively to familiar situations and to be attracted by structures that are like their inner self.

Our main objective was to make a literature review of the existing studies and researches in order to identify a possible connection between the dimension of fractals and our preferences. Another objective was to find out if personality traits play any role in assessing fractals as beautiful or not. In this manner, we hope to attain this article's main purpose: to offer a series of recommendations on fractals and on ambiental therapy.

A study revealed that eye movement during object recognition keeps the same fractal dimension (D) around D1.5 no matter the object scanned. People seem to like to spend time in nature. These landscapes are rich in fractal shapes. After exposure to nature, individuals confirm they feel much better and that they experience a lower level of stress. These effects can be obtained when pictures of nature are used (Hagerhall et al, 2008).

People tend to appreciate fractals because they are similar to the natural objects. Some specialists even believe that the positive effects of exposure to pictures of natural elements is owed to their fractal structure and dimension.

Starting from this probability and from Pollock's paintings' success, R.P. Taylor conducted a series of studies to observe which kind of fractals are perceived as most appealing, beautiful and attractive.

One of the earliest studies was focused on finding out whether fractals are more attractive than non-fractals, and they used the "Pollockiser" - a chaotic pendulum that uses the dripping painting technique. Using the forced choosing technique, Taylor and his crew discovered that from a total number of 120 participants, 113 preferred fractal patterns over others. These results confirm the instinctual attraction to

shapes that are similar to our inside shape (Taylor, R.P., 2011).

Following these findings, more studies were conducted by specialists to find out whether people tend to like fractals with higher or lower dimension.

For Pickover, it seems that the most preferred dimension is 1.8 (Pickover, C., 1995). However, another study using only digitally generated fractals showed that less complex fractals with D1.3 seem to be perceived as the most appealing (Aks & Sprott, 1996), while for Forsythe shapes ranging from D1.6 to D1.9 are seen as more beautiful than the others (Forsythe, 2011).

Taylor explained that this contrasting results might be obtained since there were only artificial fractals used, and that is why he used in his next researches all three types of fractals we mentioned which ranged between D0.5 and D2.

In a series of studies, conducted over a period of 10 years in collaboration with other specialists, they showed that fractals between D1.2 and D1.5 tend to be rated as beautiful, while those over and above this dimension as unappealing. He used simple fractals like trees, clouds on white backgrounds and more complex fractals like cities and natural landscapes skyline silhouettes. The research was applied to approximatively 500 participants (a personal calculation of the available data) who were represented by generic public and psychology and architecture students.

With these data, Taylor tried to confirm the hypothesis that mid-range fractals have a universal aesthetic. None the less, Taylor himself and other specialists as well are interested to see whether gender, culture, age and personality traits tend to interfere with these preferences (Taylor, R.P., 2011).

We also ask ourselves in which manner personal values and judgments influence these choices and how these choices are influenced when meditative guidance with specific exploration of the psyche is used. Also, we are interested to see if personality traits have a role in rejecting the rest of the fractals which range from 0 to 1.3 and 1.5 to 3.

In our personal practice, subjects were exposed to these fractals in an experiential manner through Fractal Technique, which involves a direct, profound and subjective connection with the fractal computer generated shapes (Simion, 2016).

They were guided to choose those images that reflected them, the ones they rejected, the ones that were similar to their family or just the ones they felt

more attracted to. Through experiential analysis specific to the Unification Experiential Psychotherapy, we were able to identify and explore themes like family fusion, dependency, fear of rejection and the need for approval. We noticed a strong projective power of fractals through symbols and archetypes revealed during guided meditation with imagistic support and their correlation with real life traumas and dysfunctional patterns.

Fractals are infinite images which the psyche tries to complete with personal life experience. When describing their choices, the subjects' dialogue was an externalization of their real inner world, thus working like a projective tool.

III. Methods

The idea that fractals are inside and outside the human body leads to natural questions such as what is the meaning of this and what happens when the human body and psyche meets this kind of objects.

Even before fractal geometry was found, people were interested in the connection between nature and humans, a connection that is represented in art, stories and praised all over the world.

To prove that there is a connection between our personality traits and the aesthetics of fractals, we made a literature review of the researches on the neurological effect of these shapes on the observer. Also, we conducted our personal research on 47 subjects who were exposed to fractals during a 10 week program. Their personality was measured with Neo-FFI, their level of stress was measured test-retest and during each session they were asked to pick the image they liked the most out of 27 fractals, grouped in 3 categories: 1D – simple, 2D – medium, 3D – complex.

In the methods part, we offer our findings after analyzing a series of over 50 researches on the subjects from architecture, medicine and psychology.

Wilson even talks about biophilia - unconsciousness attraction towards nature. The restorative effect of nature is well studied and documented especially when it comes to medicine and architecture. It was observed that some diseases respond in a positive way to nature and the recovery process is accelerated even when nature can be accessed only through a window or a painting (Wilson, 1984).

Today, biophilic design is well known in interior and exterior architecture. Hospitals, health practitioner's offices, and corporate buildings have adopted this design being more or less aware of the fractals behind it.

New findings in fractal geometry show that natural landscapes are rich in fractal shapes and that people tend to be universally attracted by these shapes, exactly the way they are attracted to nature. This analogy suggests that fractals might also have some similar effects on the human brain like exposure to nature.

Maybe this is why people tend to decorate their house with plants, repetitive patterns, corals, wood, and stones. Most of these shapes respect the proprieties and dimensions of fractals, for example mineral patterns D1.78, geothermal rocks D1.25-D1.55, woody plants and trees D1.28 – D1.90 (Boutot, 1997).

A series of studies were conducted to observe whether this attraction towards fractal objects that are closer to the fractal dimension of the eye-movement during recognition process is related to a change in the observer's mind.

The Fractal Technique is a form of meditation with fractals as imagistic support. Different instructions and guidance are used to access dysfunctional parts of the psyche, to facilitate inward attention and to expand consciousness. At the end of every session, we asked subjects to rate their level of relaxation from 1 to 10. The ranks given ranged between 8 and 10 which is a really high score. Also, the test-retest measurements showed an important decrease of stress after a 10-week intervention with Fractal Technique and Unification Experiential Therapy.

Our observations are consistent with other more rigorous research where techniques like skin conductance, EEG, f(MRI) and blood levels of cortisol show that fractals have a personal power and propriety to reduce stress, activate alpha waves, induce fascination and inward attention.

A study conducted at NASA Ames Research Center, applied on 20 subjects who were asked to perform stressful mental tasks, showed that the observer feels the lowest level of stress in the presence of the D1.4 fractals (Taylor, R.P. et al, 2005). However, D1.3 fractals seem to stimulate the highest activation of the alpha waves, known as responsible for relaxation, meditation, and inward attention. These findings suggest that fractals can be successfully used as a pretext for meditation, self-introspection (Taylor, R.P. et al, 2011).

Another interesting fact is that D1.3 fractals also seem to have the biggest activation of beta waves that generate outward attention, intense mental activity, problem-solving and thinking. These results might be explained by the fact that fractals are infinite images,

that the brain tries to complete, to finish, to resolve. Also, the high attention might be due to the fact that fractals represent parts unknown to the psyche (Hagerhall et al., 2008).

Throughout personal development group where the Fractal Technique was used, we observed that, during meditation, subjects accessed the content of unintegrated traumas and fears, and in some ways even made spontaneous restorative changes (Simion, 2015, 2016; Voicu, 2015).

Further studies with f(MRI) measurements suggests that mid-range fractals activate the ventrolateral cortex responsible for high-level visual processing. Also, the dorsolateral cortex which sustains the long-term spatial memory is stimulated. But what is more interesting is the dynamics of the Parahippocampus which regulates emotions in correlation with sad or happy music (Taylor, R.P. et al., 2011).

These findings might suggest that fractals can activate happy or sad memories, or at least stimulate inner attention and fascination which is an effortless natural form of attention and relaxation. The Unification Experiential Therapy holds as a core belief the fact that memories are encoded in emotional responses that work like a hidden agenda in relation to any persons. Dysfunctional patterns of emotional regulation are formed in early childhood or following traumas. These patterns can be changed only by accessing them and by giving them new signification to one's life plan. It is believed that every time a traumatic event is brought back into present memory, the emotional response behind it is weaker and can easily be changed. Fractals seem to be a good tool to support inward attention and to get access to unknown or rejected traumas in a non-invasive way, even in a relaxing mode.

IV. Projective power of fractals - qualitative results

In our personal research, fractals were used in various ways to establish diagnostics and trigger optimization.

We called this possibility of using fractals The Fractal Technique, which is specific to the experiential therapy paradigm and consists of four major uses of fractals, especially of artificial ones:

- a) As a pretext for guided creative meditation with imagistic support for accessing unconscious content.
- b) As a product of creative meditation and a pretext of symbolic experiential analyses and correlation with real life scenario.

- c) As a pretext for dramatherapy with different themes like polarities, social relationships, reactions to stress.
- d) As a form of relaxation through guided meditation starting from a detail of the picture or by drawing fractals with eyes closed.

Experiential Therapy focuses on bringing the past emotions into the present by reactivating and recreating the past through symbolic and projective actions. By exteriorizing what is inside in a non-invasive way, especially through projection, meditation, and dramatization, the person involved in the process has the opportunity to reorganize the past through his/her present adult perspective.

Fractals have a really impressive projective power because they are infinite, apparently non-organized images that induce introspection and fascination to the viewer (see the studies above). Using different instructions, Unification Experiential Therapy creates different provocative scenarios which aim at activating themes like polarities (Ego-Non-Ego, Shadow and Persona archetype, masculine and feminine attributes), fear of rejection, dependency, identity problems and social relationships.

We noticed in one of our scenarios, where subjects were asked to pick the images they liked the most and the ones they rejected, that when describing their experiences during meditation, they were talking in an archetypal manner about their present situation and about their resources. In some cases, even transformational and spontaneous restorative effects were obtained. Symbols of birth, death, need for guidance, feminine and masculine attributes appeared in meditation as images of dwarfs, sun, mountains (relationship with authority and masculine attributes), as caves, plains, rivers and waters (relationship with mother and feminine attributes) or as mirrors, houses, treasure chests, changing shapes objects, monsters (relationship with self and unknown parts of self).

In another scenario, the subjects were asked to imagine for the rest of the session that they are to be transformed into fractals and to identify themselves with a fractal image that could speak about them instead of the subjects speaking about themselves. After the choices were made, each person had to talk about him or herself as if they were the shapes from the image. The dialogue matched their life situations and their relation with their self-image. For example, those who had important self-trust issues and problems with trusting the others, chose pictures that were less complex and diffuse, while those who had

demonstrative behavior and were attention seekers tended to choose the fractals that were very bright, full, complex and obviously different from the rest.

Most of them associated the images that were less complex to a figure that doesn't stand out doesn't want to bother the rest, fragility, and fear of exposure, while the rest said that if the pictures were to describe themselves to the others, they would identify them with complexity, a lot of directions, need for stability, disorder, tumultuous existence.

Also, it seems that fractals can be a useful tool for stimulating projection about family relationships and a tool that makes the discussion much easier. In one of our applications of the Fractal Technique, after an introspective guided meditation to access the connection between family and transgenerational transmissions, participants were provoked to pick an image that represented the invisible lines that tie each member one to each other (mentioned in the meditation instructions). The complexity of the shapes and the association the participants made were relevant for their life situations and, with the help of dramatization, they assumed a more aware vision of the role played by them in the dynamics of the family. Those who chose fractals that were sparse felt a need of separation from their family due to dependent relationships, while those who chose fractals that were complex, with small spaces in between, associated the images with their fusional relationships, dependence on others, where everybody would work as a whole. Another category was represented by those who chose fractals with an evident central point and who associated the images with the need of attention, of approval, praise and acceptance from those around, who were perceived as intrusive or rejecting shapes. Either way, the central point was in conflict with the rest and was searching for integration and self-assumption.

These preliminary observational results confirm the projective power of fractals and we encourage experiential therapist to introduce fractals in their intervention as an aid for experiential diagnosis and exploration of the unconscious, blocking content.

V. Correlation between fractal esthetics and personality traits - results

The results presented in this article were obtained during a greater research where the overall effect of the Fractal Technique on stress and anxiety after a 10-week intervention was measured and compared with the natural evolution of stress and anxiety in subjects with similar life contexts, but without any psychological intervention (Simion, 2016).

Even though Taylor found in his studies that fractals with the dimension between D1.3 and D1.5 seem to be liked by everyone, working as a universal aesthetic factors, our personal research shows that when a certain instruction is added, people tend to pick images and interpret these images in such a manner that reflect their real inner world.

These leads to the idea that because of the fact that fractals are artificial images, they don't have any significance or meaning. The meaning is given by the interaction with the observers and the reactions experienced while exposed to this kind of images. Also, we wonder why other images are rejected and if personality plays a role in this evaluation. We also believe that Taylor's results are limited by the fact that most of his results were gathered from psychology and architecture students who tend to have similar personality traits and behavioral tendencies.

Other studies are consistent with our hypothesis that the inner structure and personality of a person can be evaluated or at least suggested by the person's preferences towards fractals. In a studied done at Moscow University, 20 three-dimensional fractals with the dimension between D0.52 and D2.36, grouped into three types (1 - separate points and lines, 2 - laces, 3 - cushions), were evaluated by their attractiveness and complexity by a number of 140 subjects from the department of psychology. A series of tests like 16PF and Spielbergers's Test Anxiety Inventory were used to measure the level of anxiety, personality traits, and temperamental features - again, another possible bias in the target population.

The results showed that persons who tend to be self-blaming, insecure and with a tendency to worry, tend to like fractals of type 1. The same tendency was observed with people with a high need for approval. The results are consistent with our observation of the projective power of fractals.

On the other hand, people who were independent and tended to be aggressive, stubborn and competitive, appreciated type 1 fractals as the most unappealing. Instead, people who were emotionally stable and who tended to control their reactions perceived as attractive the type 1 fractals, while the opposite preferred the type 3 fractals. However, people who scored high at organization tended to perceive type 3 fractals as most beautiful and complex. An explanation given by the researcher about this result was that the subjects made intellectualized choices, respecting the instructions given, and suspended their emotional reactions. Those who had a moderate to high

openness and a moderate to high need to communicate, assessed fractals of type 1 as the most unattractive and preferred higher fractal dimensions (Mitina & Abraham, 2003).

Other studies have shown that highly creative people tend to like more complex art, while highly intelligent people tend to see beauty in simplicity. For example, on a self-administrated test about how creative they are, people who tended to perceive themselves as creative and original (but were not) were attracted by high fractals, while those who acted in an original way and were creative preferred lower fractals (Richards, 2001).

In our personal research, we analyzed the level of correlations between personality traits and perceived attractiveness with Person chi-square test. We analyzed people's preferences when asked to name the fractals they liked the most. Our preliminary results showed a significant statistical correlation and association between Neuroticism and the preferences of D3 type fractals (over 2), fractals that exceed the dimension of 1.3, believed to be the universal number of aesthetics. It seems that those who score high perceive D3 fractals as the most beautiful, while those with a low score the D1 fractals. These confirm one of our ideas that the rest of the fractals (others than 1.3-1.5) can be perceived both as beautiful and ugly function of personality traits and subjective evaluation. The preliminary research doesn't confirm any correlation between the rest of NEO-FFI scales.

Subjects who score high on neuroticism tend to be emotionally unstable, feel the need of approval, tend to have intense reactions, feel insecure and are unable to control their feelings. Our results are consistent with Medina findings, where people with similar personality traits and temperaments rated fractals over D1.5 as the most appealing.

VI. Conclusions and discussions

Even though preliminary and obtained on a small number of subjects, our results are consistent with other researchers' findings mentioned above, which makes us believe that there is a connection between certain personality traits and fractal preferences.

Although the results in our study are not statistically significant, we noticed similarities between our subjects' tendencies and the tendencies in the subjects pertaining to other studies presented in this article and we also noticed a strong correlation between neuroticism and preference for fractals that are very complex, abstract and intricate.

A psychological explanation might be the fact that the inner world of the neurotic is really complex, unstable and rich in dissipative emotional schemes and memories, masked under an apparently nice face. The D3 were usually associated with an explosion, nice chaos, madness. In experiential analyses, most of the metaphors used to describe the fractals helped to explore real emotional situations which were perceived by the viewer as explosive, intense and chaotic.

On other traits, the results were not statistically significant, but we observed that people who scored low on openness were attracted by lower fractals, while the rest of the people were attracted by higher ones. Openness is highly correlated with creativity and the acceptance of the new, of the unknown. We think that those with low scores rejected the D3 fractals because of their density and non-traditional appearance. We observed this reaction during their talks with other participants.

Experiential analyses and the symbolic experiences of our participants during personal development groups based on the Fractal Technique show that fractals have a strong projective power and can be a trustful tool in the diagnosis and the optimization of blocked experiences and dysfunctional patterns to stress and anxiety.

We think that a more accurate and larger research is needed to fully reject or accept the hypothesis that a minimal diagnosis can be made with the help of fractals if used in a projective manner, specific to Unification Experiential Therapy.

In the present, we expanded our research on a broader population, who didn't attend any intervention based on fractals. The data are gathered online with forced choices between three types of fractals. To induce a more personal choice of the pictures, we asked people to rate fractals from 1 (the most liked), 2 (unimportant) to 3 (disliked) and to imagine that they have to choose a picture that they would mostly like to represent them.

We hope that this way we can eliminate bias like intellectualized choices and unrepresentativeness of lots of subjects like psychology, architecture students or people with high neuroticism, moderate to high subclinical level of stress and anxiety (like in our present study).

References

- Aks, D. J., Sprott, J. C. (1996). Quantifying aesthetic preference for chaotic patterns. *Empirical Studies of the Arts*, 14, 1-16
- Boutot, A. (1997). *Inventing shapes. The morphological revolution – towards a neo-aristotelian mathematics*. Bucharest: Nemira.
- Forsythe, A.M., Nadal, Sheehy, N., Cela-Conde, C.J., Sawey, M. (2011). Predicting Beauty: Fractal Dimension and Visual Complexity, in *Art. British Journal of Psychology*, 102, 49–70.
- Hagerhall, C.M., Laike, T., Taylor, R.P., Küller, M., Küller, R., Martin, T.P. (2008). Investigation of EEG Response to Fractal Patterns. *Perception*, 37, 1488–1494
- Marks-Tarlow, T. (2008). *Psyche's veil: psychotherapy, fractals and complexity*. London: Routledge.
- Marks-Tarlow, T. (2010). The Fractal Self at Play. *American Journal of Play*, 3 (1), 31-62.
- Mitina, O.V., & Abraham, F.D. (2003). The Use of Fractals for the Study of the Psychology of Perception: Psychophysics and Personality Factors, a Brief Report. *International Journal of Modern Physics C*, 14(08), 1047-1060
- Pickover, C. (1995). *Keys to infinity*. New York: Wiley
- Richards, R. (2001). A New Aesthetic for Environmental Awareness, *Journal of Humanistic Psychology* 41, p. 59–95.
- Simion, R. M. (2015). The Fractal Technique - An Experiential Approach of Fractal Images in Reducing Perceived Stress Through Therapy of Unification. *Journal of Experiential Psychotherapy*, vol. 18 no. 2 (70), p. 40-47.
- Simion, R. M. (2016). The Fractal Technique - A Way to Acces the Unconscious and to Reduce Stress. *Journal of Experiential Psychotherapy*, vol. 19 no.2 (74), p. 14-22.
- Taylor, R.P., Spehar, B., Van Donkelaar, P., & Hagerhall, C.M. (2011). Perceptual and Physiological Responses to Jackson Pollock's Fractals. *Frontiers in Human Neuroscience*, 5, 60.
- Taylor, R.P., Spehar, B., Wise, J.A., Clifford, C.W.G., Newell, B.R., Hagerhall, C.M., Purcell, T. & Martin, T.P. (2005). Perceptual and Physiological Responses to the Visual Complexity of Fractal Patterns. *Journal of Nonlinear Dynamics, Psychology and Life Sciences*, 9 (1), 89-114.
- Voicu, M. (2015). The Imagogenogram and the Fractals. Interflows in the UT Paradigme. *Journal of Experiential Psychotherapy*, vol. 18 no. 1 (69), p. 44-52.
- Wilson, E.O. (1984). *Biophilia*. Cambridge: Harvard University Press.