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Review

Remark on Seven Applications of Neutrosophic Logic: in cultural psychology, economics theorizing, conflict resolution, philosophy of science, etc.

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Abstract: In this short communication, we review seven applications of NFL which we have explored in a number of papers.: 1) Background: The purpose of this study is to review on how Neutrosophic Logic can be found useful in a number of diverse areas of interest; 2) Methods: we use logical analysis based on NL; 3) Results: Some fields of study may be found elevated after analyzed by NL theory; and 4) Conclusions: We can expect NL theory can be applied in many areas of research too, both in applied mathematics, economics, and also physics. Hopefully the readers will find a continuing line of thoughts in our research in the last few years

Keywords: Neutrosophic Logic; cultural psychology, economics; conflict resolution; philosophy of science; cosmology.

1. Introduction

First, let us discuss a commonly asked question: What is Neutrosophic Logic? Here we offer a short answer:

Vern Poythress argues that sometimes we need a modification of basic philosophy of mathematics, in order to re-define the redeemed mathematics [6]. In this context, allow us to argue in favor of Neutrosophic logic as a starting point, in lieu of the Aristotle logic which creates so many problems in real world.

In Neutrosophy, we can connect an idea with its opposite idea and with its neutral idea and get common parts, i.e. <A> /\ <nonA> = nonempty set. The common part of the uncommon things! It is true/real... paradox. From neutrosophy, all started: neutrosophic logic, neutrosophic set, neutrosophic probability, neutrosophic statistics, neutrosophic measure, neutrosophic physics, neutrosophic algebraic structures etc.

It is true in restricted case, i.e. the Hegelian dialectics considers only the dynamics of opposites (<A> and <antiA>), but in our everyday life, not only the opposites interact, but the neutrals <neutA> between them too. For example: you fight with a man (so you both are the opposites). But neutral people around both of you (especially the police) interfere to reconcile both of you. Neutrosophy considers the dynamics of opposites and their neutrals.

So, neutrosophy means that: <A>, <antiA> (the opposite of <A>), and <neutA> (the neutrals between <A> and <antiA>) interact among themselves. A neutrosophic set is characterized by a truth-membership function (T), an indeterminacy-membership function (I), and a falsity-membership function (F), where T, I, F are subsets of the unit interval [0, 1].
As particular cases we have: single-valued neutrosophic set {when T, I, F are crisp numbers in [0, 1]}, and interval-valued neutrosophic set {when T, I, F are intervals included in [0, 1]}.
From a different perspective, we can also say: Neutrosophic Logic is (Or "Smarandache logic") A generalisation of fuzzy logic based on Neutrosophy.[1] A proposition is t true, i indeterminate, and f false, where t, i, and f are real values from the ranges T, I, F, with no restriction on T, I, F, or the sum n=t+i+f. Neutrosophic logic thus generalises:

- intuitionistic logic, which supports incomplete theories (for 0<n<100 and i=0, 0<=t,i,f<=100);

- fuzzy logic (for n=100 and i=0, and 0<=t,i,f<=100);

- Boolean logic (for n=100 and i=0, with t,f either 0 or 100);

- multi-valued logic (for 0<=t,i,f<=100);

- paraconsistent logic (for n>100 and i=0, with both t,f<100);

- dialetheism, which says that some contradictions are true (for t=f=100 and i=0; some paradoxes can be denoted this way).

Compared with all other logics, Neutrosophic Logic introduces a percentage of "indeterminacy" - due to unexpected parameters hidden in some propositions. It also allows each component t,i,f to "boil over" 100 or "freeze" under 0. For example, in some tautologies t>100, called "overtrue."
Neutrosophic Set is a powerful structure in expressing indeterminate, vague, incomplete *and* inconsistent information.
In this short review article, we will review 5 applications of NL theory in diverse fields of science.

2. Seven applications of Neutrosophic Logic in diverse fields of science

a. Cultural psychology

Culture is a shared meaning system, found among those who speak a particular language dialect, during a specific historic period, and in a definable geographic region. **Collectivism** is a **cultural** pattern found in most traditionall societies, especially in Asia, Latin America, and Africa. It contrasts with **individualism**, which is a **cultural** pattern found mostly in America and Europe.

This theme was expored by Prof. Harry Triandis.[2] Triandis was born in Greece in 1926. During the Second World War, he learned four foreign languages and developed his curiosity about the differences that exist between cultures. His time getting to know people across various European nations inspired him to research cultural disparities in the way

[1] http://fs.unm.edu/NeutLog.txt

[2] https://www.researchgate.net/profile/Harry_Triandis

79 people think.This issue can be reconciled by the help of NL theory, which may be
80 appropriate for socio-economics theorizing, as we will discuss in next subsection..
81
82 b. economics theorizing [3]
83 In a series of papers, we outlined a more general approach to reconcile classical tensions
84 between individualism-collectivism, between cooperation or competition. In our opinion,
85 our tendency to cooperate or compete is partly influenced by the culture that we inherit
86 from our ancestors. One of us (VC) once lived for a while in Russia, and he found that
87 many people there are rather cold and distant (of course *not all* of them, some are warm and
88 friendly). He learned that such a trait may be found as quite common in many countries in
89 Europe. They tend to be individual and keep a distance to each other. In physics term, they
90 are like *fermions*.[3]
91 There is a developmental psychology hypothesis suggesting that perhaps such a trait co-
92 relates to the fact that many children in Europe lack nurtures and human touch from their
93 parents in their childhood, which possibly make them rather cold and individual. Of
94 course, whether this is true correlation, it should be verified.
95 On the contrary, most people in Asia are *gregariously groupie* (except perhaps in big
96 metropolitans). They tend to spend much time with family and friends, just like many
97 Italians. They attend religious rituals regularly or watch music festival together, and so on.
98 In physics term, they are *bosons*. Of course, such a sweeping generalization may be
99 oversimplifying.[4]

[3] While our proposed simplifying analogy of human behaviour, i.e. individualism and collectivism sound not so common. Indeed such cultural psychology research has been reported since Harry C. Triandis et al. See for example: (a) The Self and Social Behavior in Differing Cultural Contexts, Psychological Review, vol. 96 no. 3; (b) Harry C. Triandis and Eunkook M. Suh, CULTURAL INFLUENCES ON PERSONALITY, Annu. Rev. Psychol. 2002. 53:133–60; (c) J. Allik & A. Realo, Individualism-collectivism and social capital, JOURNAL OF CROSS-CULTURAL PSYCHOLOGY, Vol. 35 No. 1, January 2004, 29-49. This last mentioned paper includes a quote from Emile Durkheim: "The question that has been the starting point for our study has been that of the connection between the individual personality and social solidarity. How does it come about that the individual, whilst becoming more autonomous, depends ever more closely upon society? How can he become at the same time more of an individual and yet more linked to society?"

[4] After writing up this article, we found that Sergey Rashkovskiy also wrote a quite similar theme, albeit with a statistical mechanics in mind. The title of his recent paper is: "'Bosons' and 'fermions' in social and economic systems." Here is abstract from his paper: "We analyze social and economic systems with a hierarchical structure and show that for such systems, it is possible to construct thermostatistics, based on the intermediate Gentile statistics. We show that in social and economic hierarchical systems there are elements that obey the Fermi-Dirac statistics and can be called fermions, as well as elements that are approximately subject to Bose-Einstein statistics and can be called bosons. We derive the first and second laws of thermodynamics for the considered economic system and show that such concepts as temperature, pressure and financial potential (which is an analogue of the chemical potential in thermodynamics) that characterize the state of the economic system as a whole, can be introduced for economic systems." Url: https://arxiv.org/ftp/arxiv/papers/1805/1805.05327.pdf

Therefore, it seems quite natural to us, why Adam Smith wrote a philosophy book suggesting that individual achievement is a key to national welfare (because he was a British which emphasized individualism).[5]

It took more than hundred years until mathematicians like John F. Nash, Jr. figured it out that individual pursuit toward their own goals will not lead them to achieve a common goal as society.[6]

At this point, some readers may ask: which is better, *to be like fermions or bosons*? Our opinion is: just like in particle physics, both fermions and bosons are required. In the same way, fermion behavior and boson behavior are both needed to advance the quality of life. Fermion people tend to strive toward human progress, while boson people are those who make us alive.

This issue again can be reconciled by the help of NL theory, i.e. such a human tension is always there, but they don't have to be conflicts. Similarly, from such a fermion-boson perspective (which we propose a new term: *ferson*), a classic tension between capitalism (emphasizing individual achievements) and socialism can be reconciled, for example by considering a range of possibilities, including a new term (possibly): *capicialism*. (It may remind us to a term introduced by Alvin Toffler in 70s, where he predicts culture shock, to describe the combined behavior of consumerism and producers: *prosumer*.)

c. conflict resolution [5]

Binary choices are another source of problems. As a one-liner joke says:

> *There are two kinds of people in the world: Those who think there are two kinds of people in the world and those who don't. (Plus some others who aren't sure.)* [7]

A funnier joke on binary logic:

> *There are 10 kinds of people in the world: Those who understand binary and those who don't*.[8]

As Phillipe Schweizer remarked:

> "These two possibilities, these alternatives, are the basis of cognition, and allow choice and therefore action through the fact that a preference becomes possible: either I prefer there is X, or I prefer there is no X. Then autonomy appears. And indeed the valuation or affect too: "I like" or "I don't like", and it goes with it

[5] If only Adam Smith was born in Bangkok or Manila, probably he wrote his book in a different way.

[6] Imagine 10 players of a football team go simultaneously to make a goal to their opposite team, will they succeed? Of course no, they should arrange according to their coach's instruction: 1-4-4-2, or other type of arrangement.

[7] http://philippe.ameline.free.fr/humor/TwoKindOfPeople.htm

[8] http://philippe.ameline.free.fr/humor/TwoKindOfPeople.htm

> together. The stages described here are not as distinct as those of Piaget, they overlap, include and extend. The "there is no" is opposed to the "there is" forming the opposite. Thus the binary appears and the logic of the same name also: either "there is", or "there is not": X or non-X, one and the other being mutually exclusive. …There is this and that and that again: a perception of the environment, a representation of a situation as a collection of objects. Our other most frequent and fundamental conception is opposition: there is or there is not. What also gives one thing and its opposite: day and night, hot and cold, big and small ... The importance of this simplifying binary conception of two situations sliced diametrically away in opposite is the most prominent form of mental life. It is the emblematic *form of a choice."*[9]

In this regards, One of us (FS) recently published a new book, with title: *Neutropsychic personality*.[13] In this book, FS described possible extension of Freudian mental model: *id-ego-superego*, using his Neutrosophic Logic theory. His definition of Neutropsychic is as follows:

> "Neutropsyche is the psychological theory that studies the soul or spirit using the neutrosophy and neutrosohic theories. It is based on triadic neutrosophic psychological concepts, procedures, ideas, and theories of the form (<A>, <neutA>, <antiA>), such as (positive, neutral, negative), (good behavior, ignorant behavior, bad behavior), (taking the decision to act, pending, taking the decision not to act), (sensitive, moderate, insensitive), (under-reacting, normally reacting, over-reacting), (under-thinking, normal thinking, over-thinking), and so on, and their refinements as (<Aj>, <neutAj>, <antiAj>)." [13, p.29]

Perhaps it would be necessary to develop an improved model of neutropsychic basis of decision making process.

Another possible way of resolution of this fundamental problem of human societies, is to accept the otherness, without being absorbed that otherness. In other words, we should try to find common trust, where people can do dialogue and do peaceful co-existence. While this notion of peaceful co-existence belong to social psychology, we can also think of this problem from a mathematical perspective of Kolmogorov's principle of contradiction, as we will discuss in next subsection.

[9] Quote from Phillipe Schweizer. *Thinking on Thinking: The Elementary forms of Mental Life Neutrosophical representation as enabling cognitive heuristics*. Submitted for review

d. philosophy of science

In a forthcoming book that we have just completed with a number of contributors, there is special chapter where two authors argued on empiricism vs. logicism.[9] While that was a quite intense debate, after Publisher's request for abstract to that particular chapter, one of us (VC) put these wordings to abstract of chapter 11:

> In this chapter, two authors from different backgrounds engage in an intense dialogue over empiricism and logic in developing physical theories. At one side, Neil Boyd argues that observation and direct experience are very essential to find the truth, probably because of his interpretation of Godel's incompleteness theorem. On the other side, Akira Kanda argues among other things: "Typical experimental physicists does not want to discuss anything out of empiricism. They do not know the way how empiricism was developed. For them, empiricism became an absolute religion not to be questioned. As I pointed out the biggest founder of empiricism, Hume, admitted that empiricism is not just induction upon empirical data, it is standing upon some fundamentally important non-empirical truth such as mathematics." In essence, this is an old problem in theoretical physics, which is most significant: to meditate and observe, or to derive theory based on a few axioms? Perhaps the answer is not so easy to grasp, but both approaches are complementary. Such an intensity of this dialogue can be viewed as reflecting the message of this book: there are serious old problems which call for attention by modern physicists and mathematicians alike.

This can be viewed as another case which calls for implementation of NL theory: whenever there are two opposite sides, there is always a choice to find a neutral side, in order to reconcile those two opposite sides. We can also think of them starting from *principle of contradiction*, proposed by Kolmogorov. To summarize, he argues that there is fundamental problem in developing complex arguments, they always lead to contradiction. This is proven later by Gödel.

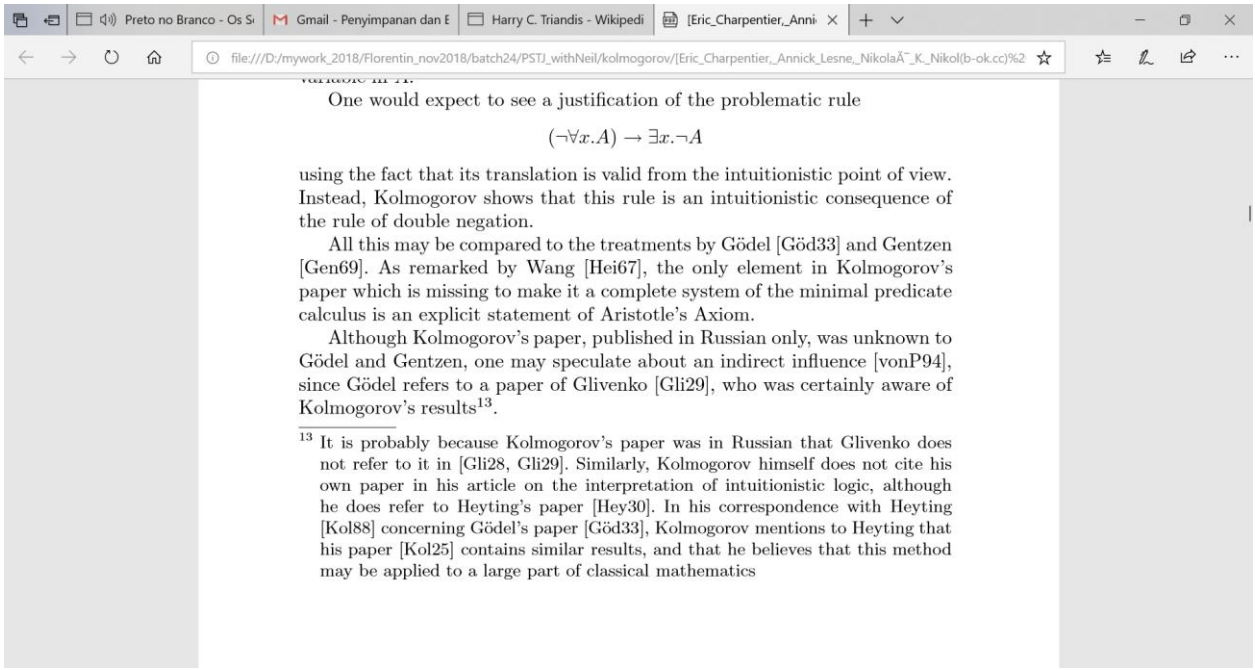

Figure 1. Screenshot from ref. [2].

What can we conclude from Kolmogorov's principle of contradiction? It is quite simple, i.e. developing a complicated theory from a number of postulates will very likely lead to messy contradictions, which often called "paradoxes." Just like the twin paradox in general relativity, or cat paradox in quantum wave function. See also [8].

To put this problem succinctly, we can paraphrase Arthur C. Clarke's famous saying: "Any sufficiently advanced technology is indistinguishable from magic,"[10] to become "**Any sufficiently complicated theory will result in a number of contradictions and paradoxes.**"

Such a logical analysis derived from Kolmogorov's principle of contradiction eventually remind us:

(a) to keep humble mind before Nature (God's creation), and perhaps we should not rely too much on our logic system and mathematical prowess,

(b) in developing a theory one should keep the complication and abstraction as minimal as possible,

(c) to build theory in a nearest correspondence to real facts; the best is if each parameter can be mapped to measurable quantity.

We hope the above three criteria can be a useful set of practical guidelines in building mathematical models in theoretical physics.

[10] Arthur C. Clarke, "Profiles of The Future", 1961 (Clarke's third law). url: http://www.quotationspage.com/quote/776.html

e. Cosmology [7]

Questions regarding the formation of the Universe and what was there before the existence of Early Universe have been great interest to mankind of all times. In recent decades, the Big Bang as described by the Lambda CDM-Standard Model Cosmology has become widely accepted by majority of physics and cosmology communities. Among other things, we can cite A.A. Grib & Pavlov who pointed possible heavy particles creation out of vacuum and also other proposal such as *Creatio Ex-Nihilo theory* (CET).

But the philosophical problems remain, as Vaas pointed out: Did the universe have a beginning or does it exist forever, i.e. is it eternal at least in relation to the past? This fundamental question was a main topic in ancient philosophy of nature and the Middle Ages. Philosophically it was more or less banished then by Immanuel Kant's *Critique of Pure Reason*. But it used to have and still has its revival in modern physical cosmology both in the controversy between the big bang and steady state models some decades ago and in the contemporary attempts to explain the big bang within a quantum cosmological framework. Interestingly, Vaas also noted that Immanuel Kant, in his *Critique of Pure Reason* (1781/1787), argued that it is possible to prove both that the world has a beginning and that it is eternal (first antinomy of pure reason, A426f/B454f). As Kant believed he could overcome this „self-contradiction of reason" („*Widerspruch der Vernunft mit ihr selbst*", A740) by what he called „*transcendental idealism*", the question whether the cosmos exists forever or not has almost vanished in philosophical discussions.

In a paper accepted recently by Asia Mathematika J., we take a closer look at Genesis 1:2 to see whether the widely-accepted notion of *creatio ex-nihilo* is supported by Hebrew Bible or not.[7]

It turns out that Neutrosophic Logic is in agreement with Kant and Vaas's position, it offers a resolution to the long standing disputes between beginning and eternity of the Universe. In other words, in this respect we agree with Vaas: "how a conceptual and perhaps physical solution of the temporal aspect of Immanuel Kant's „*first antinomy of pure reason*" is possible, i.e. how our universe in some respect could have both a beginning and an eternal existence. Therefore, paradoxically, *there might have been a time before time or a beginning of time in time*."

To summarize, Neutrosophic Logic study the dynamics of neutralities. And from this viewpoint, we can understand that it is indeed a real possibility that the Universe has both initial start (creation) but with eternal background. This is exactly the picture we got after our closer look at Gen. 1:1-2.

f. American Football game

(This section is after discussion with Robert Neil Boyd.)

Let's look at a situation in a football game (American style football).

The offense and the defense are lined up. The offense is in range to try a field goal kick to score 3 points. When the ball is passed from the center to the holder, so that the kicker may try to kick it through the upright poles which are the goal posts, many different things may happen. This is not a simple situation of the ball went between the uprights or not. The

263 defense may be able to get a man in position to block the kick.
264 If the kick is blocked, according to the rules, the defense may pick up the ball and carry it
265 towards their side of the field. If the man who picked up the ball and ran with it, is not
266 taken to the ground before he crosses the goal line, the play results in a touchdown, a 6
267 point score for the defending players.
268 Or the man who picked up the ball after the kick attempt was blocked runs several yards
269 towards his goal line, where he is tackled by one of the members of the kicking team, which
270 causes him to lose the ball he was carrying. The kicking team recovers the fumble. And the
271 play is over.
272
273 Or the holder may miss being able to catch the pass to him from the center, or the holder
274 may drop the pass from center and either pick it up and run with it, or he may be brought
275 to the ground by the defenders before he can do anything, or the pass may sail over the
276 head of everyone (whereupon, many things are possible), or the holder may fail to place the
277 ball properly for the kicker, resulting in a missed try.
278 Or the defense may commit one of several possible rule infractions before, or during the
279 kick, so that the result of the play is a penalty against the defending team. If the penalty is
280 large enough, it can result in a new set of downs for the kicking team, so the place-kicker
281 leaves the field so that the normal offense men can take 4 more tries to gain 10 yards.
282 Or there can be a penalty against the kicking team which may result in the kicking team
283 being forced out of range to try the kick. So the kicker leaves the field with no attempt to
284 kick a field goal.
285 Or the offensive team, who has the ball lines up their men for a field goal try. When the ball
286 is passed to the holder, it is a fake kick and the holder runs for a first down or a touch down
287 or passes the ball to an offensive player for a first down or passes the ball and it is not
288 caught, which means the defense obtains the ball at the spot where the ball was placed
289 before the kick attempt.
290 Or the kicker attempts to kick the ball through the uprights and succeeds, scoring 3 points
291 for his team.
292 The kicker can get the snap directly from the center and try to make a pass completion, or
293 he can run while carrying the ball. Which can result in interception or fumble or
294 touchdown or first down, or the kicker being tackled before he reaches the line to gain. Or
295 he completes a pass and the receiver makes a first down or a touch down or get brought to
296 the ground before the line to gain, or the receiver fumbles the ball as he is tackled, leading
297 to a potential touchdown for the other team.
298 Many additional possibilities exist, but most of them are very rare.
299 During any play in a football game, it is possible for any player on either team to score a
300 touchdown for a 6 points gain for their team. This is possible because human beings are
301 interacting in a game played with goals and goal lines and an oddly shaped biconvex bi-
302 conical ball inflated with high pressure air which is surrounded by a rubber sack which is
303 surrounded by a leather case which is held in place with stitches and laces. The shape of the
304 ball causes it to bounce in unpredictable ways when it is dropped or kicked or thrown. In
305 addition, hot temperatures make the ball softer and cold temperatures make the ball

harder. Both of the factors cause the ball to behave in different ways. When the ball is harder, it is like kicking a rock. When the ball is harder, it becomes more slippery so it it harder to throw and harder to catch. And harder if it hits you when it is flying through the air.

So a field goal try does not merely involve 2 possibilities, but an almost infinite variety of events may happen, before the try, during the try, or after the try.

Neutrosophic Logic may be expanded to more than 3 possible states, since in an infinite universe, an infinite number of things may happen. I understand the tri-state basis of it as being valuable in many circumstances. There should be ways to extend the logic into larger numbers of choices, so that there is a range of Yes, to 1000 kinds of maybes or almosts, or something elses, or something unexpected which was outside the starting point of the data set, and so on, to the No of the equation. The null-A of non-Aristotelian logic, which is what Neutrosophic logic is, can involve much more than just the simplistic null set.

Question: How to extend the center, null-A state, to provide for abnormalities or exigencies?

Right now, the easiest thing to do seems to be to widen the null state to include all the possibilities that are additional to, or contingent on one or more rules, internal to the null state. So now the null state becomes much broader. And able to handle much more complicated situations, such as a field goal try during an American football game.

It seems, the "expanded middle" would be a good option for problem structure in Neutrosophy.

g. Gravitation

Despite majority of physical theories of gravitation assuming it is a pull force, a number of researchers began to work out a push gravity, which is known as Le Sage/Laplace gravitation theory.

An interesting remark on impetus to Le Sage gravitation theory can be found in article by the late Prof. Halton Arp on his work with Narlikar:

> "Nevertheless the ball had started rolling down hill so to speak and in 1991, with Narlikar's help, I outlined in Apeiron the way in which particle masses growing with time would account for the array of accumulated extragalactic paradoxes. Later Narlikar and Arp (1993) published in the Astrophysical Journal Narlikar's original, 1977 solution of the basic dynamical equations along with the Apeiron applications to the quasar/galaxy observations.
>
> …
>
> The first insight came when I realized that the Friedmann solution of 1922 was based on the assumption that the masses of elementary particles were always and forever constant, m = const. He had made an approximation in a differential equation and then solved it. This is an error in mathematical procedure. What Narlikar had done was solve the equations for m = f(x,t). This a more general solution, what Tom Phipps calls a covering theory.
>
> …
>
> But Narlikar had overwhelmed me with the beauty of the variable mass solution by showing how the local dynamics could be recovered by the simple conformal transformation from t time (universal) to what we called τ time (our galaxy) time. The advertisement here was that our solution inherited all the physics triumphs much heralded

353 in general relativity but also accounted for the non-local phenomena like quasar and
354 extragalactic redshifts."[10]

355 Therefore, there are many reasons to support Le Sage gravity, despite majority of
356 physicists prefer Einsteinian view. Summarizing, there should be a hidden dynamical
357 matter creation process, suggesting that Newton third law was actually not just F=ma, but
358 F=d[mv]/dt = m[dv/dt]+v[dm/dt], therefore there is mass creation part. All physics of
359 Earth etc. assuming the Earth is static, but actually it is increasing in size and mass. This
360 approach has been explored by both of us and also Robert Neil Boyd in a number of
361 papers under preparation.

362 Moreover, from a NL perspective, we can find a reconciliation between "push" and
363 "pull" type of gravitation, by considering both forces are in place. To speak more plainly,
364 pull force takes place at astronomical scale, while push force takes place at geological
365 scale, and this effect can be found for instance: a. receding Moon from Earth (around 1
366 inch/yr), b. expanding earth caused by dissipative geodynamics process, c. Pangea
367 hypothesis. We will present our result in a paper to be presented in forthcoming 5th
368 *EuroSciCon* 2019.

369 Allow us to introduce another new term in order to reconcile push and pull gravitational
370 force, i.e. *pullsh* force. Such an idea is presently under investigation.

371 **3. Results**

372 Some fields of science can be found elevated after analyzed by NL theory; and therefore we can
373 expect NL theory can be applied in many areas of research too, both in applied mathematics,
374 economics, and also physics. For example, in the next section we will also explore on how NL theory
375 may be used to reconcile the "push" and "pull" gravitation theories. This is still a preliminary
376 exploration, so we include this topic in discussion section.

377 **4. Discussion**

378 We have discussed among other things, a few applications of NL theory in a number of fields, such
379 as cultural psychology, economics theorizing etc. The essence of our discussion is that NL allows
380 studying the dynamics of neutrality.

381 Moreover, from a NL perspective, we can find a reconciliation between "push" and "pull" type of
382 gravitation, by considering both forces are in place. To speak more plainly, pull force takes place at
383 astronomical scale, while push force takes place at geological scale, and this effect can be found for
384 instance: a. receding Moon from Earth (around 1 inch/yr), b. expanding earth caused by dissipative
385 geodynamics process, c. Pangea hypothesis. We will present our result in a paper to be presented in
386 forthcoming 5th EuroSciCon 2019. Such an idea will be investigated later on.

387 We hope these discussions will be found useful in other areas as well; for instance in international
388 relations and peace keeping efforts.

389

390 **5. Conclusions**

391 In this short article, we review seven applications of NFL which we have explored in a number of
392 papers. Hopefully the readers will find a continuing line of thoughts in our research in the last few
393 years, emphasizing our better understanding of various branches of human knowledge. All of these
394 branches were enhanced and elevated to a higher level through applications of NL theory.

395

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