Existential Graphs: A development for a Triadic Logic

Abstract: Existential Graph (EG) probably is the area where Peirce creativity shines so bright that until now, we're just understanding his ideas and comparing them with other modern notations. Here we introduce a sketch of a triadic logic using EG in order to follow the Peirce Program for this system. To do that task new symbols and operators are introduced. The power of the analytical aspects of the Existential Graph in logical research is emphasized and how it uses open new frontiers of questions. A case for fake news and post-truth study is introduced.

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Aristotle's logic had a deep impact in all the researchers that came after him. But the old master didn't close the doors of his own framework. We can find at "De Interpretatione" an outstanding analysis for the propositions related to contingent futures and how free will paradigm could leads us to a trivalent or triadic logic[1,2]. Charles Sanders Peirce also must be considered a father of this field. By 1909 Peirce wrote new ideas for the development of a triadic logic and also Truth Tables for several of its operators. In fact, he anticipated Lukasiewicz, Browne, Kleene, and Post among other logicians by many years although them didn't know the existence of this treasure hidden in the manuscripts that compound the Logic Notebook[3,4].

As triadic logic was incorporated inside multivalent logic research another topic Existential Graphs remains confined between Peirce scholars. Existential Graph (EG) probably is the area where Peirce creativity shines so bright that until now, we're just understanding his ideas and comparing them with other modern notations. If Peirce were lived today, we could think he feels confuse. For one side he would feel proud that other researchers discover value in his work. But he would also feel angry that no one seems to follow the program that Existential Graphs was created for: i.e. the most powerful tool for the analytical research of logic[5]. The topological ideas such as his continuum theory of synechism that he builds as a framework must be considered seriously[6]. In fact, we can mention that the mind is more likely analogical (i.e. continue) than digital (i.e discrete)

So, following Peirce's Project to use EG as a tool for analytical research we decided to develop a Triadic Logic using Existential Graphs. But an easy task could be just replacing Peirce own algebraic notation or the ones after him such as Lukasiewicz. Instead of that we try to use the graphs and follow the ideas that they provide to us. This paper is just an exercise of the Existential Graph use for what intentionally supposed to do.

First, we found that we need to extend the system. EG has three systems but they were designed for a bivalent logic. Alpha and Betha systems are already studied by scholars and compared to propositional and first order logic. The third one -gamma system- deals with modal logic and provides us ideas we can take for this new context.

Our first problem is just how to write the proposition P when is neither True nor False. We must remember that the idea behind EG is that a blank page or sheet of assertion is just like an empty mind so write P is True is easy: Just write P. P is False is a solid circle with P inside: the idea is that P is excluded of this mind. This seems a very simple approach but has some profound implications compared to the algebraic logic. EG are trying to simulate what actually happens in the mind instead of algebraic logic that just try to shift this process as a calculus. One is a pragmatic approach the other one is an abstraction.

P is True

P is False

But for the third situation we must find a solution. If the sheet of assertion presupposes bivalence P must be written in this mind in some no deterministic way to extend its possibilities. We could think that is not P what is in the mind but is the shadow of P. This shadow represents that P itself is truth in another state (another blank page) of the mind. Also, the shadow suggests us a 3D space for develop a more complete EGs instead of 2D that we use with the blank page.

So we propose to write for this case:

This is also familiar in a way with EG because this dash lines were used by Peirce as a circle surrounding P for: "P is possible". The semantic interpretation when P is neither true or false in a triadic system is already studied by scholars but we can mention one path as P is a doubt in the context of Peirce's The fixation of belief[6]. Anyway, just writing this graph give us an implicit semantic that is not clear in the algebraic approach. We just see something about P although not exactly P. This idea is also very similar to the representamen's definition as one of the components of a triadic relations of the sign (i.e representamen-object-interpretant).

Now we must think about negation as an operator. There could be a lot of possibilities if we take account algebraic notations, Peirce himself described four operators as a different type of negations. But we just follow the graphs and discover that we can use two symbols which are topologically irreducible:

If we think of them from a semantic perspective, there is one that is solid and the other is dashed. We could think as a “NO” or “no” negations. One -the solid one- is emphatic and changes the truth value to False and the other one is weak so it provides only some doubts and changes the truth value little. We can summarize these strong and weak negations at this table:

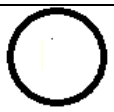
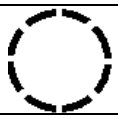
		
P	Ø	
	Ø	Ø

Table 1

The symbol Ø means False as opposite to the blank page that means true.

Now we have a new problem: The iteration of these negations. One of the possibilities is already solve by EG Alpha System. That is a double solid negation of P is just P. But for other combinations we must do a choice. In our case we choose an outside inside order as we can find examples in natural language that the first impression decreased the other.

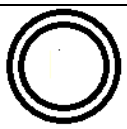
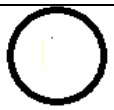
	
	
	
	

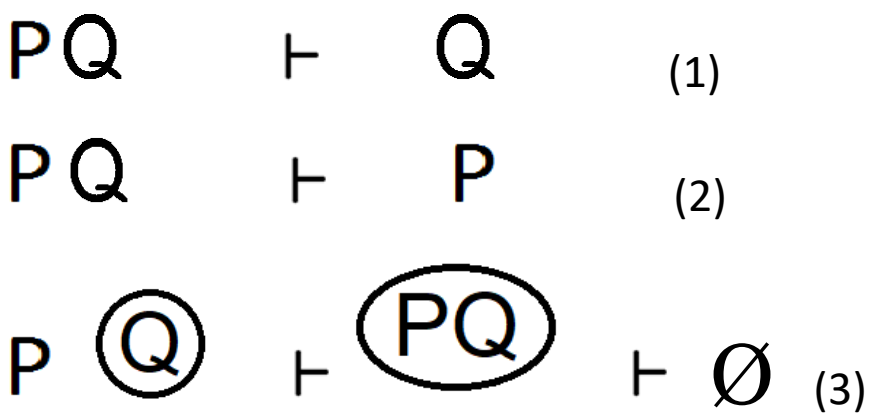
Table 2

As an example, for Table 1 and 2 we can show how these graphs work:

This approach uses only two monadic operators (negations) instead of the four defined by Peirce for his algebraic triadic logic system. But we note that two of its operators are not totally a negation as they preserve some true status (The operator "-" change True to False, False to True, but for the "i" state (or indeterminate true state) remains "i". The other two operators change all the true status but are not semantic as friendly as we propose. For example " ~ " operator change "I" state to True which is weird as a negation is supposed to less the true state. We think working with graphs is more meaningful by nature from the semantic perspective. It's curious that with the graph we naturally defined these two operators that were not defined by Peirce at its Logic Notebook (MS 339) where he outlined and creates a triadic algebraic logic a truly amazing advance for logic research.

Now we have some toys to play with this logic but go ahead with other important issue: the conjunction. Peirce did an extremely easy solution to this: just write the two propositions in the blank page: for a conjunction you just no need to invent a specific symbol. Existential Graphs Alpha system has 6 rules about the transformation of these graphs and was demonstrated that they are equivalent to classical propositional calculus (for example see Pierre Thibaut book at the references).

Peirce defines a rule that if two symbols are together you can just erase one of them (1) (2). We don't review all the transformation rules we just mention that they are consistent with propositional calculus. For example, to hold the false situation in the case P is true and Q is false you can apply two Alpha rules, one that allow you to add P inside the circle (you can add a given graph if it has an impair number of cuts i.e circles) and the other one that allow you to erase the P that is outside of the circle as is it repeated at the graph (i.e you can erase graphs that are repeated) (3):



But in a triadic logic the situation is more complex. We can analyze this case with one proposition P instead of the more general P and Q. Let us define it as this table:

PP	P
P	P

Table 3

We can understand how this work by an example. Suppose you're in a community and this proposition "Peter is Good" reach your mind. So, this proposition named P is in your mind so by EG definition is Truth. But suppose you later go to another community and Peter is Good reached your mind as a shadow. So probably you discover that Peter did some good things and also did some bad things, you're not sure if at the end Peter classifies as "Good" for the information gathered in the new community. If you mix your two experiences, you have this conjunction:

P

The final result is a matter of definition and ultimately must be based on your confidence in these two communities or also a new context inside the same community. At Table 3 we chose and optimistic approach. Of course, in formal logic "Peter is good" is considered as a vagueness sentence as they suffered the Sorites Paradox and was not properly hold until fuzzy logic and other approaches tries to give a new formal framework for this kind of assertions.

At this point we find the power analytic force of the EG for triadic logic. EG show us something no so clear in the algebraic approach. P is asserted in the mind over time and this could change the normal situation. P could be in some features different from P. A proposition is a result that came from a previous chain of sign and its history could make a difference. We can think more about this idea if we consider the triple conjunction as these two cases:

PPP	P
PP	P
P	

Table 4

PPP	
PP	P
P	P
	P

Table 5

Table 4 shows a more optimistic view: to change true status for P we need at least two doubts. On the contrary situation Table 5 shows us a pessimistic view that if for example the proposition “Big Mac is good” came from different communities such as advertisers, friends and colleagues so instead of reinforce its validity you start to doubt and finally you think that just the repetition is a reason to consider the proposition false. Here we have a concept of time and its consequence in the validation of True. Actually, if we try to totally stick to the idea that P is a proposition written in the mind, we just can´t write P exactly the same: the second time we write it we can note some little differences. This situation was a matter of recent research around ancient diagrams of Greeks mathematicians. These diagrams were copied by generations of copyists and they were changed to the point that they lost it mathematical significance.

The general case “P and Q” here means P different from Q. As these are two different objects inscribed in the mind is not clear if they reinforce their true state as the first case we defined before.

	Q	Q
P	PQ	P ¿?
P	¿?Q	¿?

Table 6

More interesting we can find out some similarities between propositions so if one is true and the other is neither true or false this affinity holds both are true when they appear together. To clarify this idea, we need to define if two propositions has these similarities or not. If it is the case we use a letter but if its nature are different we write one of them with a letter and the other one with a number.

	Q	Q	1	1
P	PQ	PQ	P1	P1
P	PQ	PQ	P1	P1

Table 7

Abduction could be linked with this idea of propositions with similarities. As an example, if it is true that the street is wet and is not true or false last night was raining (because we don't know) we must conclude last night was raining. Hence, as Table 7

$$PQ \vdash PQ \vdash Q$$

Of course, also could happened that just someone drop water on the street. This is an abduction and this notation also defined the set of propositions related to abduction inferences. We also can see this idea with a totally graphical example:

At this example we started with we see at a reality level: the street is wet. Then we have another proposition i.e. last night was raining. We don´t know what actually happened but this new one proposition is related with the previous one at the semiotic level. The wet street is an index of the previous rain. So, we can define that propositions that are related to each other as an index, icon or symbol of each other may have some similarities, i.e at the semantic level they could be related.

On the other hand, if the two proposition aren`t related at all the inference change. As an example, if it is true that the street is wet and is not true or false a planet has life, we only conclude that the street is wet and the doubt about extraterrestrial life also hold no abduction apply to this case. At the end the street is wet is true we don't gather any new information. We are using here rules already defined by Peirce in the alpha system that we can erase one of the symbols when they are together without any negation.

$$P1 \vdash P$$

$$P1 \vdash 1$$

If we continue with this inquiry a new idea emerges. We've propositions that are related in such a way that they reinforce its true state, we also have propositions that aren't related but we must consider relations in which the propositions weakness their true state. These could be related with the destructions of believes.

Therefore, in order to write a proposition and its class of relations we need three types of symbols such as letter (reinforced true state, numbers no reinforced true state and symbols change true state).

These “destruction of believes” relations works changing the status quo paradigm. It’s means that just a doubt of one of the propositions has a so close relation to the other one that if them appears together the first one is just not sure is true anymore.

	Q	Q	1	1	π	π
P	PQ	PQ	P1	P1	π	P π
P	PQ	PQ	P1	P1	π	π

Table 8

Here we move out from the classical algebraic approach. Peirce defined 6 binary conjunctions that they combine the true status of each one of the propositions. For example, for one operator Phi: P true, Q true concludes with P and Q True (actually, P Phi Q True); P true and Q undetermined concludes P Phi Q undetermined. Therefore, these binary conjunctions explore different possibilities, but proposition are just variables, and all are the same. Here me move the complexity from the operators to the nature of the propositions as we are more focus on the semantic perspective rather than a combinatorial calculus.

As an example, we can see the recent virilization of propositions around post-truth and fake news A lot of the post-truth works around the idea to install a proposition that is not verified by facts. But they don’t need the facts. This is why binary logic does not work so well here. They just need to say something that is not true or false just to make a general statement or a vague proposition that could be true but at least it produces some reasonable doubt to the target person. For a binary logician this is just a fake and no more words we can spent around that. But post-truth actually works and works as an argument some people follow. So, understand this faking machine that can change a presidential election is a target that we can understand deeper with triadic logic. Here a real one example:

Hilary Clinton is the best candidate

Hilary Clinton approved weapon sales to ISIS

⊢ Hilary Clinton is the best candidate

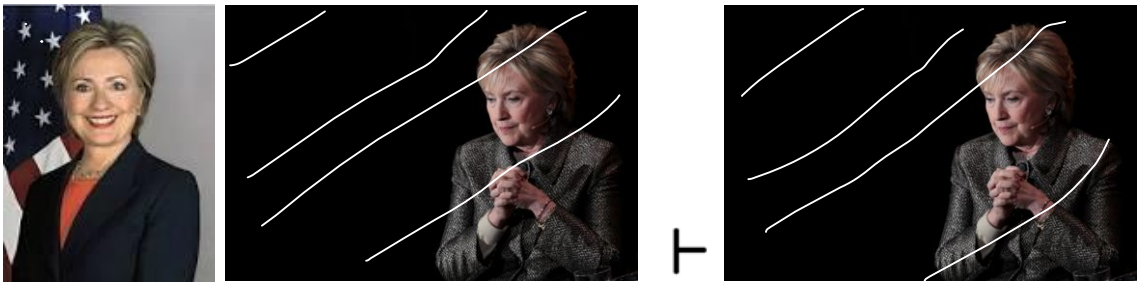
Here we see the power of the EGs for a Triadic logic. We just see what happens. Just a sentence not necessarily true but with the property to be closely related to the other could change the true status of the former. As Table 8 also show at the last column if now we make a conjunction between “Hilary is the best candidate” with a vague sentence we conclude with “Hilary Clinton is the best candidate” started to be a doubt. Post-truth mechanism requires no one instead of multiple vagueness sentences to achieves better results. It’s a process in which you need to make a machine to build more sentences, but these new sentences must remain with the Table 8 framework.

Let’s do it again with another “destruction of believes” proposition:

Hilary Clinton is the best candidate

Hilary Clinton in in very poor health due to serious illness

⊢ Hilary Clinton in in very poor health due to serious illness



The above example actually happened, and scholars who measures it find it has a significant impact on the last US presidential election[8]. We can note that these two propositions also have similarities as they are icons of the same object. Also, we must note that the above notation leads us to think in this way although we don’t know anything about logic. This is part of the power of the EGs than we can learn logic but simulation of what happens in the mind.

Discussion

As we said this triadic logic development is just an exercise to show the power of the EG as an analytical tool. We don´t try to build a complete system. A work to extend alpha rules to include this system will be an interesting task to do. We just outline a semantic approach around a Triadic Existential Graphs and show some of the ideas and possible path we can choose. Working with EGs empower our inquiry to do more research in logic and that was our primary focus.

For example, working with EGs we find out that we can reconsider what a proposition actually is as we noted that may be is interesting to write a proposition using 3 types of alphabets instead of just one. This triadic nature of the proposition is a new path that deserve more research. As Sandra Visokolskis and Gonzalo Carrión point out the notion of similarities between propositions plays a crucial rule to understand abduction as an inferential process[9]. We though -but more work must be done- that the semiotic category of the propositions (i.e study the semiotic relation as we shown it in our wet street and Hilary Clinton examples) may be helpful to define these similarities.

Table 4 and Table 5 makes one point of the analytical side: we must understand that the first axiom (the blank page) of the EG needs also rules. So, a blank page could be just a state of the mind with its well-defined packet of semiosis that defines the rules (i.e Table 4 or table 5). So, this is not just a logical path instead a more general semiotic one[10]. Also this kind of graph as Ahti-Veikko Pietarinen says “has not only Truth but supreme beauty”[11]

As easy and beauty EG are as a notation we can see also their power to follow the Peirce program: Just get a blank page insert your graphs and discover what happens in the mind.

Conclusions

EGs are an extraordinary tool for the analytical research of logic. Just using Existential Graphs flashlight some key concept of logic that could be analyzed and redefined or considered with new perspectives.

Triadic logic is a rich field for the generation of new ideas that are empowered by EGs.

Abduction could be related as the type of the alphabet use in this system. Propositions could be arranged as abduction classes. We defined three classes of propositions in terms of the relation that they hold together to reinforce or not its truth state. More work must be done to establish similarities conditions between propositions.

The emerging field of post-truth and fake news and its semiotic nature could be research with EGs and triadic logic.

A blank page has its well-defined packet of semiosis but as times flows new blank pages emerged and the habits involved could be different. A concept of Time and its consequences could be added to this type of approach. If we want to build a world when everybody has a chance to understand everybody else, try to know these pages arranged in a book with the help of logic and semiotic is the main challenge to solve in our XXI century.

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