DRAFT OF A REFORMED SYNTHETIC APPROACH TO PHILOSOPHY, COGNITION AND BEYOND

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Abstract: A new epistemic approach is proposed. Recent trends in philosophy show that the analytic style is losing its verve; some reasons are: the emerging role of probabilistic/statistical approaches (in opposition to the logical ones) to the mind\brain (e.g. Bayesian approaches) and their central role in contemporary science, moreover the prevailing deterministic approach to the world of the analytic school, influenced by first order logic and classical physics, seems to be inadequate; for this reason, it will used an undeterministic modus operandi. Also psychology, intuitions and creativity will have an important role in this approach. The starting points of this hypothetical method are Henri Poincarè's synthetic way in philosophy (in opposition to Bertrand Russell's analytic way) and Max Born's indeterministic way in science (in opposition to Albert Einstein's deterministic way). A reform, in connection with actual trends in philosophy and science, will be applied to Poincarè's synthetic approach.

Keywords: post-analytic philosophy, reformed synthetic philosophy, philosophy of statistics, indeterminism, bayesian reasoning, probabilistic causality, psychodynamics, creativity, intuitions, conventionalism.

Introduction

More than a century ago, Bertrand Russell and Alfred North Whitehead published their '' Principia Mathematica'': they developed the ambitious project of demonstrating that all mathematics can be reduced to Symbolic Logic, giving a substantial contribute to the foundation of analytic philosophy. In ''Principia Mathematica''(1910), logic is described like the system of formal inferences depending purely on the logical form of the assertions considered. The differentiation betwixt "form" and "content" has therefore a central importance; Russell uses it for the recognition of the logical constants, by reference to which logical form is determined, therefore logic is a mere enumeration. If logicism is no more than a system of formal inference, as Russell stated, then Gödel's two incompleteness theorems represents the fundamental confutation of his plan of demonstrating that all mathematics can be reduced to symbolic logic[1]. Gödel was not the only critic of ''Principia Mathematica'': Henri Poincarè was probably one the sharp opponents of the logical-analytic approach. The German physicist Max Born, surprisingly, was another great adversary of logicism. Born: father of the probabilistic approach to quantum mechanics, was also the ''enemy'' of Albert Einstein because of his advocacy of indeterminism. Born stated that determinism of classical physics is ''an idol, not an ideal''(Born,1969:97), I think that this interpretation must be extended to logicism because, in my opinion, logicism and determinism are two faces of the same medal and I will try to show their connections using a well-known metaphor used by Russell and Wittgenstein: the analogy betwixt philosophy and science generated the "logical atomism," a concept developed in the first decades of last century. Both Wittgenstein and Russell stated that there must be indivisible, determinated elements at the basic grade of reality: logic must mirror this conception. Ironically, some years later, quantum mechanics introduced probability in classical physics and demonstrated the existence of subatomic particles. Gödel (1931) and Bergmann (1957) showed the fallacies within the logical system elaborated by Russell.

Despite these critical accounts, analytic philisoshy dominated the entire 20th century; what we can say around the final quarter of the last century philosophy is that the authentic theory of analysis and the majority of its assumptions were discarded by a relevant number of analytic philosophers. For example, the anti-psychological[2] approach of a relevant number of analytic thinkers and the denial of cognitive content of unconscious and emotional processes are rapidly declining.

The pubblication of *Post-Analytic Philosophy* (Rajchman et al.,1985) by Hilary Putnam, Richard Rorty, Thomas Nagel and other influential analytic thinkers is the manifestation of a certain dissatisfaction with the analytical heritage. This dissatisfaction is very complex, variable and, usually, not very deep.

Gone is the idea that concepts in philosophy are usually made of simpler and well determined notions: Quine's discussions against analiticity is just a particular case of the broader assumption that language and therefore thought are basically indeterminate.

Synthetic-Analytic: history of a conceptual dichotomy

In history of philosophy the concept of ''synthetic'' is connected to the ''analytic'' one. Although there are anticipations of these notions in Aristotle and Hume in their works, the

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[1] Godel stated that logicism seems to be empty, because it grounds its truth only on the formal structure of symbols; therefore rational operations are made '' in accordance with psychological and pragmatic viewpoints'' (Godel,1986:329). In accord with Godel, I think that this hypothetical philosophical approach must be strongly connected to psychology.

[2] As written by Russell in his introduction to Wittgenstein's ''Tractatus Logico-Philosophicus'':''The psychological part of meaning, however, does not concern the logician'' (Wittgenstein,1922:20).

exact concepts “analytic” and “synthetic” themselves were introduced by Kant (1998) at the beginning of his *Critique of Pure Reason*, where he wrote:

> In all judgments in which the relation of a subject to the predicate is thought (if I only consider affirmative judgments, since the application to negative ones is easy) this relation is possible in two different ways. Either the predicate *B* belongs to the subject *A* as something that is (covertly) contained in this concept *A*; or *B* lies entirely outside the concept *A*, though to be sure it stands in connection with it. In the first case, I call the judgment analytic, in the second synthetic (Kant,1998:130).

He used as an example for analytic judgments, “All bodies are extended”: in thinking of a body we can imagine of something extended in space; that seem to be just component of what is signified by “body.” He differed this with “All bodies are heavy,” where the predicate about heaviness is something totally distinct from that which I think in the concept of body in general” , and we must combine, or “synthesize,” the different concepts, *body* and *heavy* (therefore, these concepts have an “ampliative” function because they add something to a concept beyond what is “included” in it).

Naturally, he delimitates the category of the analytic principally in order to oppose it with what he considers as the more relevant category of the “synthetic,” which he famously thinks is not limited, as one could at first suppose, solely to the empirical (that supplying a positive consideration of the “analytic” was not Kant's concern is perhaps emphasized by his scepticism [1929], for example about explanations outside of mathematics). While some minor *a priori* claims could be analytic in this sense, for Kant the very interesting ones were synthetic. He asserts that even so simple an example in arithmetic like “7+5=12,” is synthetic, since the concept of “12” is not contained in the concepts of “7,” “5,” or “+,”: comprehending the correctness of this reasoning would seem to need some type of effective synthesis of the mind binding the various elements of thoughts. Therefore, we arrive at the “synthetic *a priori* [3]” category: probably the most relevant concept of his theory. He tries to demonstrate that “synthesis” was the origin of relevant kinds of *a priori* knowledge, that is not limited to maths, but also considers geometry, the groundings of physics, and philosophy in general, a theory that could be considered as a starting point for much of the philosophical debates of the successive century.

These argumentations supports the interpretation of the analytic/synthetic distinction that is not limited by the logic the Prussian philosopher receives from Aristotle: the denials of synthetic statements are not contradictions, although the denials of analytic statements are. This apprehends what Kant states without forcing us to any specific understanding of the logical structure of statements. And it helps the comprehension of the epistemic inquires we are discussing. I recognize that an analytic statement is correct because to negate it would be to assert a contradiction. However, the same is not true for synthetic

[3] I will discuss Poincarè’s interpretation of Kantian ‘’synthetic a priori’’ in the next section; because of its central role in my hypothetical epistemic approach, I decided to dedicate an entire section to it.

statements. To recognize that a synthetic statement is true , I require something more than a comprehension of the significances of the words used.
What Hume and other empiricist thinkers explained is that this “something more” must be experience.
To figure out the inquiry Kant is evaluating, we should now cite the differentiation between *a priori* and *a posteriori* knowledge[4]. While “synthetic“ and ’’analytic” indicate diverse types of statements, “*a priori* ” and “*a posteriori*” indicate diverse types of *knowledge*. Therefore, the central question is not how we come into possession of some beliefs, but rather in how we cognize that it’s true. The question is one of justification, not of provenance.

Kantian reflections on the analytic/synthetic distinction deeply influenced 20th century philosophy and, obviously, the analytic school and philosophy of language. The American philosopher W. O. Quine was probably the most famous critic of this distinction and in particular of the ’’Analiticity’’ concept; he elaborated an interpretation of significance for language, influenced by behaviorism, in his famous work entitled:’’World and Object’’. In so doing, Quine hypothesized the researcher of significances as a field linguist approaching an unknown language. The only information available to this field are: at first. the non-verbal stimuli that the linguist consider to be influencing on his informer and, secondly, his informer’s assent or dissent to a sentence when is present a certain stimulus. Therefore, Quine states the only plausible conception of significance applicable to a field linguist, in this context, is that of stimulus meaning. The stimulus meaning of a utterance is the conformity of the stimulus conditions under which the informer agrees to a declaration of the expression and the stimulus circumstences under which the informer disagrees from a declaration of the sentence. Likewise, Quine states that the analytic/synthetic distinction disappears once we consider this behaviorist perspective to significance. Quine’s interpretation of philosophical tradition is that an analytic utterance is “true purely by meaning and independent of collateral information” (Quine,2013:59). According to Quine, a common example of analytic sentence is “Bachelors are unmarried”.

In Quine opinion, the incompatibility of the classic conception of analyticity within his theory of significance is not so terrible. While Quine, interestingly, is favorably disposed to intuitions[5] , he says, “The intuitions are blameless in their way, but it would be a mistake to look to them for a sweeping epistemological dichotomy between analytic truths as by-products of language and synthetic truths as reports of the world” (Quine,2013:61),

[4] The reform I would like to apply to the synthetic approach is strictly connected to the a priori/a posteriori distinction; both Kant and Poincarè agree with it. I think this distinction is useless and inadeguate; I will argue, in the next section, that our cognition is basically embodied and, therefore, we need to ’’biologize’’ Kantian apriority.

[5] See section ’’Intuitions, creativity and psychodynamics’’: they were important in Poincarè’s Syntheticy and relevant also in the Reformed Sintheticity, proposed in this paper; intuitions are considered, like creativity, embodied cognitive tools.

Quine’s position on the analytic/synthetic distinction has been most notably supported in the work of Donald Davidson, who goes so far as to suggest that Quine’s “ The dualism of the synthetic and the analytic is a dualism of sentences some of which are true (or false) both because of what they mean and because of their empirical content, while others are true (or false) by virtue of meaning alone, having no empirical content”(Davidson,1973:11).

Therefore, Quine considered there aren’t specific significances directly connected with language; on the contrary they are connected with the agents’ structures of belief.

Quine’s refusal of the analytic-synthetic dichotomy provoked one of the most intense discussions within the analytic framework. In my opinion, the most relevant response to him was Putnam’s ‘’The Analytic and the Synthetic’’(1962). Divulged about a decade after Quine’s ‘’Two Dogmas’’, Hilary Putnam’s work advances a sort of deflationist scenario talking about the question of analyticity.

Declaring that the question of analyticity should be examined as an issue inside rather than about semantics, Putnam states that Quine is clearly inaccurate. Certain utterances are analytic, and others not. However, Putnam supports Quine’s starting points. Putnam supposes that a semantic way is compatible with a deflationist answer of the question of analyticity. He asserts that if a satisfactory semantics has been arranged, conformed to show the origin of analytic utterances, we will discover these ones are naive. Therefore, Putnam seems to assent with Quine on a basic question: the difference between analyticity and syntheticity is not an adequate base to count one’s epistemic opinion upon. Logical positivism position was opposed. This is the reason that degraded their viewpoint.

Putnam’s perspective to the question of analyticity is characterized by two ideas. First of all, he is persuased Quine’s rebuttal of the analytic-synthetic dichotomy is defective; despite he acknowledges to Quine that it is not correct to think that all the utterances are analytic or synthetic.

Ready to accomplish his deflationist plan, Putnam designes a semantics he thinks can give a definition of analyticity and to examine analytic utterances. The semantics he develops can be considered a sort of descriptivism. It depends on the supposition that significance establishes reference, that significance derives from a set of acquired information. Putnam adopts the following assumption:

- Conventional general concepts that we found in science like ‘matter’ are rule cluster words. Their significance is made of an array of rules governing the use of the words.

Putnam utilized the second principle to affirm that a very large number of ordinary scientific assertions are not analytic. Assertions that have rule cluster concepts are not invulnerable to amendments.

Since the assertions and rules of a developed scientific theory will usually contain rule cluster concepts and since analytic assertions are those that rational scientist must hold impenetrable from changes and revisions, Putnam deduces that assertions like “f = m x a” are synthetic rather than analytic. Therefore, we could affirm that analyticity doesn’t involve relevant portions of ordinary language because the majority of ordinary concepts are cluster-ones. Since the assertions that constitute these clusters aren’t exempt to amendments , it follows that utterances incorporating these words cannot be analytic. The assumptions discussed are meant to demonstrate how analytic principles do not work. Putnam’s account as to how this type of principles works with another descriptivist principle:

-General concepts like ‘bachelor’ are one-criterion ones. Their significance is made of a cluster that has just one feature governing the use of the word.

The system of connections that regulates the significance of a one-criterion concepts comprises just one assertion (Putnam, 1962: 66). An example for this type of concepts is “Bachelors are unmarried humans”. It’s a classical analytic sentence. Since it is the unique criterion for the use of the word in question, we cannot abandon it if we want to maintain the word’s entrenched purpose. Nevertheless, this type of statements will be quite trivial.

Putnam’s descriptivist theory of meaning, therefore, supplies a reasonable description of analyticity: it derives from one-criterion concepts; moreover, his reasoning indicates that concepts whose significances are made of complex networks don’t produce analytic truths: they originate only from one-criterion concepts. Putnam supports a deflationist perspective: analytic models, deeply influenced by first order logic, are inadequate to play a significant epistemic function.

Rediscovering and reforming the synthetic approach

Poincarè considered science (in particular, mathemathics) as a synthetic a priori construction, following the Kantian perspective (Kant,1929:54). He stated that the ‘’proof by recurrence" has a central role in the mathematical scenario, permitting us to go by specific observations to general laws, using the principle of induction that is a ‘’synthetic judgement ‘’(Poincarè,1913:477). Moreover, He said that this method of thinking is not acquired by empirical data or from logic, but can be interpreted as a synthetic intuition. Using this concept, Poincarè showed that logicism ignored the relevant role of psychology in scientific and mathematical resoning. He then stated that there is a difference betwixt the framework of discovery (or creativity) and that one of justification; intuitive processes in the wider interpretation is connected to the first one while the logical processes[6] are related with the second one.
Kant himself showed, in a footnote of the ‘’Critique of Pure Reason’’ that: ‘’through analytic judgement our knowledge is *not in any way extended*[7], and that the concept which I already have is merely set forth and made intellegibile to me’’ (Kant,1929:49).

[6] Following Kant, these logical predicates are tautologies (Kant,1992:607)

[7] Italics mine.

Moreover, Poincarè showed that all new scientific findings have psychological justifications and that the scientific, and in particolar, arithmetical principles must not be part of the structure (in an analytical way), on account of they represent the ground of the structure itself. A justification by experience, in this case, cannot be found, because a test couldn't illustrate an arithmetical principle completely. The judgment that the principle can be considered true must be synthetic a priori: they are, however, psychologically established.

The opposing views of Poincarè and the supporters of logic here were radical. For Russell and for some German logicians like Hilbert and Zermelo inferences were universal logical rules without any psychological content. In other words, logical rules determine the content. On the contrary , Poincarè totally refused this interpretation of logic and he denied any obligation for an assumption of determined content to justify the limits on the use of inferences.
Interestingly, also Max Born was a caustic critic of logicism:

> ''He [Hilbert] distinguished two stages of logics: intuitive logic dealing with finite sets of statements, and formal logic (logistics), which he descrive as a game with meaningless symbols invented to deal with the infinite sets of mathematics avoiding contradictions (like that revealed in Russell's paradox). But Godel showed that these contradictions crop up again, and Hilbert's attempt is to-day generally considered a *failure*[8]. I presume that three-valued logic is another example of such game with symbols. It is certainly entertaining, but I doubt that natural philosophy will gain much by playing it '' (Born,1949:108).

As we can see, both Poincarè and Born rejected logic and both used a probabilistic approach to scientific reasoning. The Poicarè-Born perspective is adequate because the statistical characteristics of a relevant number of events do repeat era after era. This regular system of the nature allows the development of multiplex inference processors that can take advantage of these frequent statistical connections to boost choices under uncertainty, or to forecast a plausible event considerering observed frequencies.
As our French polymath said:

> All the sciences would be only unconscious applications of the calculus of probabilities. To condemn their calculus would be to condemn the whole of science (Poincare,1913:157).

This sentence is, in my opinion, extraordinarily innovative and one of the most important within the ''Foundations of Science''; in other words, statistics and psychology are considered the two most important pillars of modern science.
The word ''Reform'', used in different ambits, means literally ''give a new form to something''; I think a reform could be useful also in philosophy and in particolar I would like to apply it to Poincarè synthetic philosophy: his philosophy doesn't require huge

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[8] Italics mine.

changes. The first one is connected to the ‘’a priori’’ element, the second one is linked to emerging new trends in philosophy and cognitive science.
In my opinion, a reform must be applied to the ‘’a priori’’ element within the synthetic approach used by Poincarè and based on Kant. I will follow the brilliant reasoning of psychologist Allan Hobson (I will recall his studies also in the next sections).
The central idea is that Kantian apriority, called also ‘’trascendental ego’’ allows us to generate (or synthetize) an interpretation of existence that is wider than a pure worldview. It is quite clear that apriority cannot still interpretated like a totally abstract characteristic of our minds (like in idealism) but as a (genetically) embodied, psychological tool; therefore we should ‘’biologizing Kant’’: the ego ‘’is trascendent from flesh to feeling, and trascendent from flesh to thought and consciousness’’(Hobson,2014:116).
However, in the analytic tradition, psychologism and in particular unconscious processes like intuitions and emotions are totally ignored. Moreover, the conscious mind has been considered, in some cases, as a detached entity (Chalmers,1996). Poincarè, on the other hand showed the central role of intuitions and emotions in cognition and, recalling Hobson, we can say that ‘’emotion is inherently cognitive’’(Hobson,2014;136). However, we should not forget that cognition evolved in agents with peculiar material features, bodies of a specific kind with structural aspects, and can consequently be supposed to be formed by and to be advantaged of these aspects for cognitive goals (Clark,1997).
This reform to syntheticity includes also a probabilistic/statistical perspective both to human cognition and nature; Poincarè dedicated more than a chapter to probabilistic, basically frequentist, reasoning (in particular the 11th of his ‘’Science and Hypothesis’’), including probabilistic causal reasoning (recently it has been introduced in cognitive science by Judea Pearl); I think that also a ‘’Bayesian epistemogy’’ (Hartmann et al.,2011), psychometrics, Monte Carlo methods and multilevel statistical modelling must have a relevant role in Reformed Synthetic philosophy.

Statistical mind and indeterministic world

Statistical reasoning is often introduced like a compact and banal strategy for handling with uncertainty. This shortsighted view misrepresents the intense account and different kinds of statistical practice.
Gambling techniques could be considered the precursors of statistics and as pointed out by Ian Hacking:’’ the first European probabilists were Italians’’(2006:6); Gerolamo Cardano and Galileo Galilei are two well known examples.
Cardano elaborated a system of mathematical statistics and used it to forecast results in games of dice and cards. One of the first works he wrote called “De ludo aleae” (Cardano,1663) described his new ideas on probability.
Also Galileo developed a theory on mathematical questions concerned with gambling and wrote some short treaties like in ‘’Sopra le scoperte dei dadi’’ (Galilei,1898).

The block named "frequentist" statistics is, de facto, a mix between two different strategies of hypothesis testing, elaborated in the last century: that of Ronald Fisher

(1956), asserting rebuff of a null hypothesis, and that of Jerzy Neymann and Egon Pearson (1933), asserting choices betwixt two reciprocally exclusive hypotheses. In my opinion, stardard courses in statistics give even less data about another approach grounded on the ideas of Thomas Bayes (1763). His perspective aims attention at the estimation of probabilities that a theory is appropriate and refurbishing that probability as information increase. Despite there are different interpretations of Bayes theorem, the most common are Bayesian objective probabilities and Bayesian subjective ones[9]: Bruno de Finetti (1974) was a great supporter of the last ones. All these statistical procedures have become central in contemporary science, because of their great versatility and, as we will see, statistical models are, probably, at the core of human cognition and physical world.

In many common situations we have various kinds of data about an object or event. In these situations, the relevant cues of a specific perception have to be combined with weights obtained by their accuracy. Currently, these psychological phenomena have been studied using the viewpont of optimal integration of probabilistic data, that supplies a flexible and adequate picture of these cue combinations; moreover, this perspective is consonant with evolutionary dynamics.

The idea that brain structures encode probability distributions implies a new perspective on neural computation. Neural computation is, usually, interpreted as a sort of nonlinear function approximation. In a probabilistic scenario, cognitive processings are defined as statistical inferences. This signifies that when a certain function is calculated, the results should derive from a combination of probability distributions of the function values. Prophetically, Max Born suggested to extend statistical procedures also to brain processes that can be interpreted like a ‘’consummate piece of combinatorial mathemathics’’(Born,1949:125).

These probabilistic inferences, however, permits to treat with complex calculations that couldn’t be given as function estimations, like cue combinations. Psychobiological researches (Knill et al.,2004; Tenenbaum et al.,2011) have showed that the brain structures accomplishes probabilistic inferences and makes so in an almost optimum manner in a vast assortment of tasks (moreover, this characteristic has been recently implemented in artificial agents[10]).

However, cue integration can be considered only a part of a complex set of Bayesian operations that the mind does. We could consider also binding data over time in perceptual tasks , choosing if different stimuli originate from the identical thing.

[9] Poincarè himself discussed the differences between subjective and objective probabilities (Poincarè,1913:158).

[10] Despite logic was the most common tool used in classical AI (PROLOG is a well known example) , a statistical approach emerged in the late ‘80s with the invention of Boltzmann machines (Hinton & Sejnowski,1986). Stochastic approaches (including Bayesian ones) has been also embedded in cognitive humanoids like the ICub (Metta et al.,2008;Lepora et al.,2012).

In various contexts, our brains must acquire information about perceptual stimuli, and fix the criteria of representation, response choice, and recognize relevant information in order to magnify benefits in a continually transforming physical ambience. A research on learning processes discovered evidences of prediction errors in dopaminergic neurons and in the insula, corroborating the hypothesis that the cerebral structures supervise a complex model of information and modify, dynamically, the criteria of problem-solving (Singer et al., 2009). In my opinion, this is consonant with the statistical and, in particular, Bayesian perspective, in which uncertainty is fundamental for reasoning and adaptability. However, we could interpret our brain as a statistical organism that continually try to forecast about the ambiance and bring up to date these trials grounded on what it feels (Doya et al.,2007;Clark,2013); in other words, minds utilizes data from past knowledges to forecast forthcoming facts to decrease uncertainty, that is fundamental for subsistence. Despite Bayesian approaches to the mind\brain have a very relevant role, there are other statistical tools that can be used in cognitive studies. For example multilevel statistical modelling (Woolrich et al.,2004; Beckmann et al.,2003). This type of probabilistic modelling can be useful if we recognize that our brain structures are hierarchically organized and therefore there are different levels of population distributions. Also psychometrics can be useful in this scenario if we would to investigate, statistically, cognitive abilities at an higher level like in a specific social context (Wechsler,2008).
Therefore, I agree with Hofstadter interpreting ''the human mind as a stochastic processor''(Hofstadter et al.,1995:128).

When probability and statistics are associated to the physical world, a concept rapidly emerges: indeterminism.
Fundamental to the concept of indeterminism is that, at a specific time in the physical world, there is a complex assortment of manners in which phenomena can develop. For example, before the throw of a coin there are two events that can occur, head or tail. This chance is not simply theoretical, but immanent. Admitting this, it should be obvious that the outcomes tails or heads cannot be contemporary.

The prodroms of indeterminism in natural philosophy were, probably, the kinetic theories on gases developed by Boltzmann and Maxwell.

Max Born played a fundamental role in the transition from a deterministic to a statistical approach in studying the physical world. Born interpretation was antiphatetic to Einstein's deterministic one. Einstein's opinion was that the statistical interpretation of quantum mechanics is wrong: one that forecasts probable outcomes for a wide set of experiments, but it cannot estimate, for example, the precise outlook of spontaneous radiation of a photon.
Born himself published some of Einstein's letters and his ideas were very clear: '' In our scientific expectations we have progressed towards antipodes. You believe in the dice-playing god, and I in the perfect rule of law in a world of something objectively existing which I try to catch in a wildly speculative way'' (Born,1949:122).

The probabilistic explanation of Quantum mechanics permits different choices (with computable statistics) that are fundamental if there are various possible outcomes. Indeterminism (in German, Unbestimmtheit) was also the concept used by Heisenberg. This concept should be preferred to that of uncertainty, which is often (mis)interpreted as a scarcity of information. Quantum indeterminism is not only gnoseological but it is an intrinsic limitation of knowledge.

Born, more interestingly, expands this indeterministic approach also in a macroscopic scenario; this is well explained in his paper entitled ''Is Classical Mechanics in fact Deterministic?''(Born,1969:78-83); after a very short historical reconstruction of classical mechanics (essentially Newtonian), he introduces the problem asking if it is sure that classical physics, de facto, allows predictions in all cases. His answer is negative. Recalling the reseachers on kinetic theory of gases, Born states that this theory is usually considered, de facto, determinate and the use of probabilistic methods is connected with our limited and incomplete knowledge of the precise starting state of a huge number of molecoles. He considered this deterministic approach inadequate and used an example for the demonstration:

> Let us consider the simple case of a moving spherical molecule, which rebounds elastically from numerous other fixed molecole (a kind of three-dimensional bagatelle). A very small change in the direction of the initial velocity will then result in large changes of the path in the zigzag motion; for a small angular change brings about larger and larger spatial deviations, and so it must finally happen that a sphere which was formerly hit is now missed. If the initial deviation in direction is reduced, the moment when the path is changed to another is delayed, but it will occur eventually. If we require determinancy for all times, the smallest deviation in the initial direction must be avoided. But has this any physical meaning? I am convinced that it has not, and that systems of this kind are in fact indeterminate (Born,1969:79-80).

From the time Newton postulated the deterministic prototypical model of the world, it has been a recurring thought in natural philosophy. Newtonian determinism was put on a pedestal: all physical studies should respect it, probabilistic reasoning and chance being considered synonyms of bewilderment.

Nevertheless, as physics developed, intrinsically chaotic processes were introduced, like Maxwell's distribution of particle speeds. As we have seen, in the past, this indeterminism was considered negatively; notwithstanding, in the 20th century, statistical models were formalized and improved to show that chance can be objective. While it appears totally reasonable to study chaotic phenomena with stochastic procedures, still, this natural step has met opposition due to some forceful prejudices in favor of the Newtonian interpretation and for this reason we can say, with Hacking, that determinism is ''anachronistic'' (Hacking, 2006:2).

Probabilistic knowledge and (dark) universe

Statistical rules and indeterminism are not present only in the macroscopic world (i.e. Born’s interpretation of kinetic gas theory) and in the microscopic one (i.e., quantum

mechanics, brain processes), but they have also a central role at the ''megascopic[11]'' level of the universe.
Dark energy and dark matter have become one of the most relevant questions in contemporary cosmology ever since the investigations of class Ia supernovae (SNe Ia): it showed that the universe is subjected to an (unexpected) incresing expansion (Perlmutter et al.,1999). Nevertheless, we have a very little amount of information about dark universe. We know about Dark Energy that: it is connected with the universe acceleration; it represents two-thirds of the universe energy density; it shows a gravitationally repulsive behavior (see Amendola et al.,2010).
A relevant number of empirical researches are actually seeking Dark Matter (DM) in the form of Weakly Interacting Massive Particles (WIMPs): the most common strategy used is to record occasional nuclei scatterings in the detectors of telescopes, and others has been e prepared in next years. Cosmological theory uncertainties (for example statistical distributions of WIMPs) have a central role in astrophysics.

There is a protracted history of productive relation between astronomy and statistics: Galileo Galilei was probably the first modern scientist that combined them (Babu et al.,1996:2; Galilei,1953); however, astronomical questions induced considerable progresses with the emergence of statistical methodologies during the last century. The beginning of the 21th century shows an increasing interest for interactions between astrophysics and statistics, creating the interdisciplinary science of astrostatistics.
The principal reason for the stronger connection between statistics and astrophysics has been the emerging role of large-scale researches. Contemporary researches use scales of space and time going from our solar system to remote nebulae, to the beginning of the cosmos, using scientific tools that can recognize signals of the electromagnetic spectrum going from radio (hundreds of kilometers) to gamma-rays (nanometers).
For a long time, astrophysicists have comprehended that the movements of stars and nebulae show the existence of a relevant number of gravitating matter that doesn't emit perceptible light; however, there is more to the cosmos than the eye can grasp.
The latest investigations reveal that the quantity of dark matter is massively higher than ordinary matter. Dark energy makes up about 70% of all the particles in the cosmos, and it is presently accelerating the expansion of the universe (Matarrese et. al.,2011). The crucial conclusion of this discussion is that we know only 5% of the universe, made of ''normal'' matter and that the majority of the cosmos is made of "something" completely unknown to our scientific tools.
The dark universe is recognizable because of its gravitational consequences.The most important of these is gravitational lensing: the curving of the light rays by dark matter or energy. In some observations, the curving may be so powerful that a large amount of dark matter function like huge lenses, creating various representations of faraway entities. Usually, dark matter create weak lensing; rather than creating various copies of astronomic

[11] For a clear definition of this concept, see Popa,2004:87.

objects, this kind of matter regularly deform the aspect of remote images in the universe. Statisticians and astrophysicists are now cooperating to develop nonparametric statistical strategies to deduce the dark matter density from observations (Kainulainen et al.,2009). As has been showed by Valkenburg et al. (2013), the nature of dark energy is intrinsically incertain due to underlying noise of the equation of state parameter from large-scale structures of the universe. Also Bayesian statistics is used for the investigation of the dark universe, in particular, it is used in the investigation of bias within dark universe data (Heneka et al.,2014). These researches provides an introduction to the use of statistical methods (both frequentist and Bayesian ones) in astrophysics, and treat nonparametric estimation and testing of theories for the dark energy equation of state with new methods that reveal relevant weaknesses of many deterministic approaches to cosmology.
I talked about dark energy and dark matter not only because they are a brilliant case study to demonstrate that incertainty and probability are pervasive at the biggest level possible: our universe, but also because their existence shows, in my opinion, that realism (in particular the naive one), supported by a relevant number of analytic thinkers, is inadequate because we cannot have a complete and direct experience of the majority of the universe; as I will explain in a further section, a (revised) conventionalist approach is more compatible with these recent discoveries about dark universe.

Intuitions, creativity and psychodynamics

As we have seen, Poincarè, following Kant[12], associated synthetic reasoning with intuitions. Recent trends in philosophy show a renewed interest in intuitions, studied from various viewpoints (Dennett,2014; Hartmann et al.,2011:616).
Born himself, talking about inferences by induction, stated that should be distinguished by causality[13]: inductions authorize us to combine and generalize a limited number of experiences into universal laws: the cycle of seasons, for example.
Therefore, inductions are wider than causal reasoning and usually their efficacy ''relies more or less on *intuitions* ''(Born,1949:7).
Intuitions shouldn't be considered like abstract ideas but as products of our brains: (mostly statistical) information-processing devices that were forged by evolutionary processes. To discover the structure of the brain, you need to know what problems it was designed to solve and why it was designed to solve those problems rather than some other ones. Considering the phenomenon of intuition, we discover that most descriptions include the following characteristics: unconscious (or protoconscious) information processing, holistic and fast associations. An important aspect of intuitions is that they emerge from activities that happen in the unconscious structure of our mind/brain. The notion of nonconscious

[12] For example, space is a "pure form of intuition" and belongs to the principles that the human mind provides for structuring and ordering sense experience

[13] I described Born's reflections on probabilistic causality in the next section.

processing connects intuitions to a shared opinion between psychologists that our mental processes are created by two diverse cognitive structures: unconscious and conscious. This unconscious structure is considered to be the more ancient, from an evolutionary perspective, of the two structures.

By the ‘80s, the connection between intuition and statistics has been considered. In cognitive psychology, we see some frictions between a naive and crass interpretation of intuition and statistics: despite, in some cases, our intuitions are erroneous, the theory is not.

The cognitive scientist Daniel Kahneman, well known for his studies on heuristics, is also one of the precursors of statistical intuitions.
The fundamental researches of Kahneman and his collegue Tversky (1982) have demonstrated that human beings usually resolve inductive questions utilizing a set of intuitive heuristics but also, that people, in a relevant number of cases, neglect statistical variables like sample size and correlations in those situations they use inductions.
An examination of the statistical intuitions displayed a quite constant custom in what could be named the "rule of small quantities," following it we can say that even limited specimens mirrors the entire sets from which they are extracted. This custom shows the idea that an hypothesis about a certain set can be performed by a statistical information in a sample without carefulness for its dimensions.
Because of it, the scholars give too much confidence in the outcomes of very limited samples and crassly misjudging the capacity to repeat these data. In contemporary studies, thesse bias deeply influence the choice of specimens of defective magnitude and the comprehension of resulting data.
Kahneman, has criticized this coarse use of intuition and developed a plan for the selection and adjustment of intuitive predictions, that try to establish what is most relevant and reasonable in the intuitive method and amending some mistakes to which it is susceptible. This method is used for two goals that researches are usually demanded to accomplish in the scenario of prevision or heuristics: the comprehension of uncertain data and the estimation of statistical distributions. The study of these operations shows two quite usual biases: non-regressiveness of forecastings and presumptuousness in the accuracy of appraisals. Kahneman (2003) proposes some techniques to improve these statistical intuitions. First of all, we should select a ‘’reference class’’. The scope of this step is to recognize a category to which the examined item can be reasonably included; we must also evaluate its the distribution of effects. Another important step is the so-called ‘’intuitive estimation’’: a detail of the data which the researcher has about a question is summarized by the distribution of outcomes in the reference class. Moreover, the researchers, in these cases, has a relevant number of characteristic data around the peculiar circumstance, that differentiates it from other items of the category. The researcher should formulate an intuitive appraisal using this specific data. As was previosly hinted, this intuitive appraisal should be non-regressive. The objective of these steps of the procedure is to correct these bias and obtain a more adequate estimate.

Some psychological researches (Policastro & Gardner,1999; Eubanks et al.,2010) have argued for the existence of a potentially different kind of intuition: it is connected with creative operations of synthesis in which different concepts are bounded in new combinations; this ideas agree with the perspective stated by some that intuition can be a central input in the creative process[14].
We interpret creativity to be the production of ideas, goods, or methodologies that are new or original and conceivably useful to the resolution of problems and innovation (Kaufman et al.,2011). Moreover, in my opinion we should interpret creativity as an evolutionary tool, these creative ideas are therefore useful for survival.
These ideas can be either a recombination of old concepts or the addition of new concepts to the scientific system;, creative ideas may be generated by people in any fields: Archimedes of Syracuse and Leonardo da Vinci are two well-known hystorical examples.

I will use the case study of ''Cognitive Gliascience'' (Spadaro, 2014) as an example of this ''reconbinatorial synthesis''. I created this concept because I agree that glia: the majority of brain cells, partecipate to cognitive processes like learning and memory as recent studies have demonstrated (Volterra et al.,2005; Han et al.,2013).
Discovered by Rudolf Virchow, he called them the ''cement of the neurons'' because he thought that they have only a passive role and their basic function was to ''sustain'' neurons (Virchow,1858). Different types of glia were then classified by Golgi and Cajal. The most interesting type of these cells is astroglia because they seem to cooperate with neurons in synaptic transmissions. The new data about the functional system of the brain forces us to modify the dogma of neuronal doctrine that the ground for the unification of information in the central nervous system is given only by the neurons and their synapses. Recent trends show that astroglia can integrate neurons and synapses into single structures.Furthermore, the astroglial sytem of connections supports complex transmission ways between brain cells, that guides, for example, direct move of ions. The emerging role of parallel processing and binding is relevant and may be wider (therefore, statistical approaches will be indispensable) than the binary encoded electrical communication of neural cells. I decided to use a cognitive approach because I think that computational models could be useful for the comprehension of these brain cells and because ''current knowledge about astrocytes, oligodendrocytes, and microglia and their dynamic changes is rudimentary in comparison to neurons, and little effort has been made to include glia into realistic computational modeling''(Fields et al.,2013:5). Moreover, I suppose that glia could partecipate both to the unconscious and conscious processes of the brain.

[14] Also analogical reasonings, combining elements of various fields, can be part of this intuitive creativity (Hofstadter et al.,1995).

Our French polymath states that some sort of unconscious thinking must be going on and has a relevant role in creativity. But if it is subconscious, he supposes it should be running on somehow at random. The main goal, therefore, is to find one of the very few fine combinations[15], between the colossal number of useless ones:

> The unconscious self, or, as we say, the subliminal plays an important role in mathematical creation […]. A first hypothesis now presents itself: the subliminal self is in no way inferior to the conscious self; it is not purely automatic; it is capable of discernment; it has taste and delicacy;it knows how to choose, to divine (Poincarè, 1913:390).

Therefore, scientific creativity is, in some cases, connected to unconscious processes, like dreams; two well known examples are: Loewi's frog experiment and Kekulè's benzene structure (despite he probably used the analogy of the ourobos only as an anecdote, I think this creative analogy is interesting).

In the study of these cognitive processes, I think we must avoid psychoanalytic (and, therefore, Freudian) approaches because of their incompatibility with verificational (and falsificational) processes. Moreover I think dreams cannot be reduced to expressions of repressed desires; to the contrary, in my opinion, dreams are embodied (mostly unconscious) labs of creativity. Contemporary psychodynamics (and in particular, the Hobsonian one) is probably the most adequate methodology in unconscious (or protoconscious) processes and dream studies , therefore, in my opinion, is totally compatible with Reformed Sintheticity.

A fundamental feature of dreams is that they are strongly associative: associations created during dreaming are freer than waking ones.

Some researches explored this utilizing a semantic priming exercise that calculated the reaction period to identify a concept when it's anteceded by a word that is connected with it. This research utilized weak and strong associations.

It has been discovered that semantic priming is connected to the state: conscious or unconscious. People got up from REM sleep displayed higher excitation by delicate primes than by forceful ones when getting up from REM. Moreover, we can observe that creative thinking takes place without particular exertion in REM sleep oneiric experiences. This creativity has been demonstrated to continue within vigil state improved cognitive skills if sleep included REM periods. During oneiric experiences, however, puzzling phenomena usually are not understood, and stay so just before the agent gets up (Walker et al.,2002; Hobson et al.,2007). Sometimes the content of these dreams is quite strange, but the agent may give an evenly strange interpretation of it, therefore: ''dreaming shows, beyond the shadow of a doubt, that we humans are deeply and intrinsically illogical'' (Hobson,2014:121).

[15] For this reason, I think we should replace Popper's ''Logic of scientific discovery'' with a ''Statistics and Psychology of discovery.''

At the moment the agent gets up, he identifies the oneiric experience as a dream, that is, as a form of reality[16]. Dreaming is, de facto, an extraordinary methodology of thinking that is perceptibly complex, full of emotions, analogical and creative. These oneiric experiences allow us the possibility to import into the ''real'' world the knowledge and the original combinations of concepts included inside them.

On Causality

The capacity to forecast future facts, describe past facts, and select adequate procedures to reach a goal is one of the most important cognitive abilities essential for survival.
How is evenness in nature discovered and explained? A possible answer that has been used in philosophical debates for a long time supposes that the nature holds causes that can produce effects and that human beings recognize these causal structures.
David Hume criticized this perspective in his writings. He examined cases in which folk recognize causal connections and didn't find any empirical element that could correspond to prove causal powers of fact. What he discover alternatively was sequences of fact pairs in a determined time, but no more beyond that.
Hume described causality, however, as a creation of our minds, and how the features of that creation emerge. He haven't talked about causality apart from experience, despite he gave the impression to acknowledge that there is something in the physical world and used causal concepts in his discussion. The inquiry is prolonged and indirect because the origin of the concept of causality, unlike that of the concept of a colour, cannot be discovered by easy probe of a peculiar case that we take as an example.
Hume, in the section entitled ''Of the Probability of Causes'' of the ''Treatise on Human Nature'' wrote that if there were only particular associations (e.g., if there weren't recurrences of the same kind of conjunction), then one could never generate the concept of cause (and effect). He said: ''The probabilities of causes are of several kinds; but are all deriv'd from the same origin, *viz. the association of ideas to a present impression''* (Hume,1874:428-9).
The relevance of constant association is commonly that by way of it our minds can create the idea of cause. Human beings have the idea that causal connection include necessity and effectiveness, but these are, moreover, concepts created from the analogy of reiterated circumstances of the association of two things. The nature of necessity is a disposition of our minds to go by one thing to the idea of its typical concomitant, an inclination produced by the occurence of constant association.
Hume wants to underline that we possess the concept of cause, not from finding out its presence in the associations we see betwixt events, both mental and physical, but only because of the happening of certain phenomena in our minds when our experience shows particular characteristics. In any specific occurrence of causality we see only the proximity

[16] This phenomenon can be considered as an element against naive realism.

of many things and the temporal connections between facts involving them, but those connections do not complete our idea of cause.
He inferred from this that causality is a mental impression produced by associations.

Hume's probabilistic causality hadn't a relevant impact on his contemporaries (for example, Kant maintained the classical theory on causality, despite he was a great admirer of Hume [Beck,1978]); Henri Poincarè rediscovered and developed, between the end of the 19th century and the first decade of 20th century, this approach to causality in his ''Science and Hypothesis'' (1913) and, in particolar in the section entitled ''The probability of causes''.
Considered the most relevant from the viewpoint of scientific purpose, questions about probability of causes are strictly connected with the knowledge of experimental laws. For example,

> '' This law, when I know it, can be represented by a curve. I make a certain number of isolated observations; each of these will be represented by a point. When I have obtained these different points, I draw a curve between them, striving to pass as near to them as possible and yet preserve for my curve a regular form, without angular points, or inflections too accentuated, or brusque variation of the radius of curvature. This curve will represent for me the probable law, and I assume not only that it will tell me the values of the function intermediate between those which have been observed, but also that it will give me the observed values themselves more exactly than direct observation. This is why I make it pass near the points, and not through the points themselves. Here is a problem in the probability of causes. The effects are the measurements I have recorded; they depend on a combination of two causes: the true law of the phenomenon and the errors of observation. Knowing the effects, we have to seek the probability that the phenomenon obeys this law or that, and that the observations have been affected by this or that error''(Poincarè, 1913:169-170).

Following Poincarè's interpretation, serious difficulties with deterministic causality emerge. The first one is that the majority of causes are not always succeed by their effects. Inexact recurrences can appear for two diverse reasons. Firstly, they can emerge because of the variety of different situations in which the cause emerges. Secondly, inexact recurrences can likewise emerge because of the breakdown of determinism. If a fact isn't determined to happen, then no other fact may be a sufficient reason for the fact we are considering. The triumph of quantum theory, and other scientific systems making use of probability, like statistical learning —have overwhelmed our deterministic vision of the physical world.
On the other hand, also Max Born , in his ''Natural Philosophy of Cause and Chance''(1949), discussed causality in connection with probality, following and developing, in my opinion, Hume's and Poincarè's ideas.
First of all, the German scientist explains that causality is not connected to logical dependance but to physical objects in nature, therefore experiments have a central role; it's quite clear that the number of observations is limited, therefore the definition of a rule (for example, the dependance of X by Y) ''trascends experience''(Born,1949:6) and a conventional approach to experimental data becomes standard.

Born describes two kinds of causation, the first one considers general causation, and the second one singular causation. General causality considers causes and effects as phenomena connected by statistical general rules that can be applied to many different cases; we could compare this interpretation with third Hume's criterion (Hume,1874:467); like Poincarè, Born states the so-called general causations implies that an event can have multiple causes combined in chains, these ones ''may be interlocked in a complicated way, and a 'network' of causes (even in a multi-dimensional space) seems to be a more appropriate picture''(Born,1949:129). Actually, a quite usual interpretation of these networks of causes is representing them like Markov chains: these are a set of casual variables having the feature that, given the actual state, the future is conditionally indipendent by past events.
Born considers also a causality related to single event; we could infer that specific chains of current phenomena are, *de facto*, connected by precedency and closeness, that we can compare with the first and the second humean principle (Hume,1874:466-67).

Despite these important reflections have changed our vision of physical world, regularity interpretations of the causality are still deterministic and, however, our limited knowledge of the physical world doesn't enable us to enforce such rigid conditions. As a consequence, a fairly good number of papers on probabilistic causality has recently emerged (see Berzuini et al.,2012 for a review), a preponderant part of which is involved with the question (now interpreted in a statistical manner) of categorizing betwixt causal and non-causal connections. Contrary to the deterministic research on this issue that tries to explain what it is that characterizes general uniformity from causality, most of this researches considers the question of inference, presenting pragmatic and interesting criteria for the investigation of probabilistic reasoning on causality. Judea Pearl's works are the most recent and detailed studies emerging from this tradition.

His influential theory (see Pearl,2000), who describes causal connections using the tool of directed acyclic graph, also named Bayesian network to underline the subjective conception of the input information. He used this definition:

> Bayesian networks are directed acyclic graphs (DAGs) in which the nodes represent variables of interest (e.g., the temperature of a device, the gender of a patient, a feature of an object, the occurrence of an event) and the links represent causal influences among the variables. The strength of an influence is represented by conditional probabilities that are attached to each cluster of parents-child nodes in the network (Pearl,1998:367).

However, this kind of networks describes ordered systems of variables presenting particular stability conditions that may guide the operations. This interpretation of controlled interventions is one of the most important element of a system of causal connections that refers to causality as a relevant device for forecastings. A net differentiation betwixt seeing and doing governs Pearl's interpretation of causal

relationships (and counterfactuals[17]), where the data obtained via ascertainment are always differentiate from those acquired via empirical test. This dicotomy has a very important function in forecasting the outcomes of controlled tests from ascertained probabilities, that from this point of view is the most relevant goal of probabilistic causal reasoning.
However, Pearl considers the descriptive application of causal systems to supply a comprehension of how statistical information are made and the hidden, underlying processes of counterfactuals. An imporatant function is attributed to the stability of probabilistic causal structures, that have to be enduring and quasi-constant across an array of circumstances. Systems having these apects of flexibility admit to making predictions that are embedded to keep for a broad number of situations. Surprisingly, Pearl's researches on *actual causes* states that though considered in its explanatory role causal relationships depend from the context. This conclusion derives from the consideration that the entire conception of causality is founded on modelling, that requires numerous elements, strictly connected with the frame of reference, like that of *sustenance*; this is "the capacity of the cause to maintain the effect despite certain *structural* changes in the model''(Pearl, 2000:309).
Pearlian interpretation changed our vision on causality. These structures cannot be wholly known , because of their complexity, but may be slighty studied using graphs. This strategy is efficient when it produces satisfying estimations of the hidden structures. However, the application of probabilistic causality in philosophy and cognitive science is still limited and a relevant number of advantages, like a more flexible and dynamic conception of intelligent systems, could emerge from its improvement.

In defense of conventionalism (and against naive realism)

In epistemology, there is a ''vexata quaestio'', since the last century, about the idea that an amount of assumpitions within science could be interpreted as conventions. Different approaches have been developed and bounded together under the the name "conventionalism". This theory seems to underline the social nature of science and its evolution. Poincarè was probably the greatest supporter of this approach:

> ''The birth of conventionalism in the writings of Henri Poincarè at the end of the nineteenth century was a major event in the history of philosophy, comparable in some respects to Kant's Copernican revolution.(Ben-Menahem,2006:5)''

Poincaré's conventionalism has deeply mutated last century philosophy. His ideas influenced also explicit detractors of conventionalism , such as Quine and Putnam: defenders of realism[18], were influenced by him. However, during the last century ,despite

[17] Since counterfactuals are closely connected to causation, Pearl developed a causal modeling semantics for counterfactuals (Shpitser & Pearl,2012).

[18] In particular, Hilary Putnam is a defender of naive realism (2013).

conventionalism was widely discussed, it was, in my opinion, overlooked. Also Max Born (1969) was skeptical about mainstream realism. He wrote:

> Reality to a simple, unlearned person is what he feels and perceives.[…] This attitude is called naive realism. The great majority of people preserve this state of mind throughout their life, even if they learn to distinguish between subjective experience, like pleasure, pain, expectation, disappointment, and objective experiences which have to do with things of the external world. But there are people to whom something happens which stirs them deeply and makes them sceptical. In my case it occorre thus (Born,1969:132).

In this section, basically on Poincarè's conventionalism, I will follow and review the brilliant Ben-Menahem (2006) work: it is the only recent (both historical and theoretical) treatise on conventionalism with interesting argumentations against (analytic) realism.

Although Poincarè's coventionalism is very complex, we should consider some central themes like the concepts of under-determination, holism, equivalent descriptions, conceptual relativity; all these ideas can be associated to Poincare's works. Conventionalism, that Wittgenstein fighted with and that Russell and Einstein (but also, more recently, Quine and Putnam) attempted to confute, is associated with the notion of ''underdetermination'': when an hypothesis is underdetermined by fact, we may develop other hypotheses, diverging in their matter, or are incompatible with one another, but they produce adequate predictions. Such hypotheses are theoretically divergent but empirically similar. In these cases, scientists usually have caution as to which hypothesis to use. We could say that their decisions are taken by convention.

The notion of underdetermination is connected with a mathematical analogy: when we have lesser equations than needed to solve the problem, we may modify, pragmatically, the variables and solve the equations. Poincaré utilized this analogy to support underdetermination in different contexts, like geometry[19]. The concept of underdetermination became quite famous despite it has been interpreted in various manners.

There is, first of all, a question about experiences, where facts are the authentic, unconventional ground of scientific development. For the French polymath, experience underdetermines geometry. Following this perspective, phenomena occur in an objective way, but the procedures in which a phenomenon is framed in spatial and temporal coordinates,in other words, the geometrical methodologies we use are, for Poincaré, conventional.

[19] Pierre Duhem, that we could consider as the co-founder of conventionalism,that is, in some cases, considered the father of underdetermination in science, it can be demonstrated that the first appearance of this idea in Duhem's writings follows Poincarés discussion of some optical experiments (Poincarè,1892).

Another important concept, connected to conventionalism, is that of ‘’incommensurability,’’ used for example, by Thomas Kuhn and other thinkers. Kuhnean Incommensurability is the ground of the argumentation that we cannot link paradigms between them or with reality; therefore, paradigms cannot be compared because there aren’t translation rules.In opposition to this interpretation, Poincaré states that exist a translation betwixt empirically comparable scientific systems and affirms that the selection betwixt them is conventional.Therefore, while empirical equivalences support conventionalism, it doesn’t erode scientific good sense. Using an analogy, we could say that temperature and weight are distinct:on one hand, you cannot estimate weight in grades or temperature in kilograms. On the other hand, there is no fact of the matter as to if the weight of a stone is 5 kilos or 500 hectograms. A unit could be, pragmatically, more useful than another.

Abandoning completely the idea of fact was in accord with some trends in the second half of the 20^{th} century (Van Frassen,1997), and it was intriguing to find anti-realism into previous thinkers, like in Poincaré that surely inspired his post-modern successors. We should consider that when one claims that there is a translation one should be capable to furnish one, that Poincarè did. Nevertheless, argumentations about incommensurabilty and impossibility of translation between theories are never been demonstrated; they usually use only rhetorics.

Poincaré considered these two questions: the underdetermination of theory and the necessary truth as deeply connected. Their common root is the birth and advancement of non-Euclidean geometries. Just considering there are various types of geometries, Poincarè stated, their axioms may no longer be interpreted like necessary truths. Alternatively, they have to be interpreted as implicit definitions. Therefore, the axioms are revoked not only the rank of necessity, but also the rank of truth: for Poincaré, an axiom is not true or false; it is a convention. The various kinds of geometries, apparently conflicting each other, are *de facto* corresponding: all these different approaches can explain the identical mathematical concepts. The major difference is the methodology they use to delineate them. The selection of a certain methodology is not connected to truth but to the best strategy for defining it. However, this strategy is conventional and, by the way, this conventionalist approach doesn’t nullify the idea of truth. This interpretation of geometry was originally used by Poincaré in maths. In a second time, he discussed the question about alternative geometries: he asked himself if can be said to be true as a matter of empirical fact. His comment is negative. Using the idea of underdetermination, he stated geometry is underdetermined by contingent facts.

Geometry is only one of the scientific fields where we can use conventionalism. Like the development of non-Euclidean geometries, in the last century, was the starting point for Poincarè's undetermination of theory, now we can extend conventionalism also to astrophysics and therefore to the entire universe; indeed the discovery of dark energy and dark matter has radically change our view of the universe. As we have seen in the previous section, we only know about the 5% of ordinary matter; moreover traditional (deterministic) approaches to these new types of energy and matter are not adequate. The so called ''ordinary matter'' (and ''ordinary energy'') acquire a relativistic meaning because, conventionally, we say that it is *ordinary* although it represents a very tiny part of the matter (or energy) in the universe.

We cannot ignore another relevant concept connected to conventionalism:the notion of implicit definition. Although the hard opposition of two of the most inportant thinkers of the last century: Frege and Russell, the Poincarè ideas have been influent in science. The majority of mathematicians doesn't consider the axioms of geometry as necessary elements, not either in the modal function of being valid in all possible universes. The substitution of the unclear idea necessary truth with the concept of convention had a great liberating effect. In contrast with the common idea of necessary truth, this new interpretation is more flexible and pragmatic. Moreover, the idea of implicit definition clarified the epistemic question of how necessary truths may be recognized. Despite it is not simply to recognize how we can comprehend what is true in all possible physical scenarios[20], it appears quite evident that we can control dictionaries and laws of our own making. These benefits of the conventionalist approach over previous justifications of necessity truth rendered it very effective and useful. We might suppose that the question of necessity has been concluded and probably resolved.

Clearly, not everyone accepted this conventionalist approach. Wittgenstein and Quine are two impressive examples: both of them were, at first, quite fascinated by conventionalism but, in a second time, changed radically their ideas. A well known paper by Quine is "Truth by Convention"(1966), which is highly critical of conventionalism: the idea that truth can be choosen using conventions is ''anathema to the realist''(Ben-Menahem,2006:15). Although Quine probably misinterpreted conventionalism, his point of view contributed to the abandon of this approach.

[20] We should consider, in support of conventionalism, that our knowledge is based on a *particular* type of perception, differing, for example, from other living beings (Nagel,1974); therefore there are different type of knowledge because there different kinds of sensitive perception.

In conclusion we can say that Poincaré's philosophy and his idea of conventionalism underlined the role of underdetermination, relativity and discretion. These concepts are very relevant and have a significant role in the *weltanschauung* of researchers and epistemologists. Moreover, conventionalism allow a freer approach to facts. it can be very useful to reevaluate this anti-realist approach.

Conclusion

This paper should be considered as an (incomplete) conceptual framework for a reformed synthetic philosophy, that is alternative to the analytic one.
Analyticity, has shown by Putnam and other influencial thinkers in ''Post-Analytic Philosophy''(Rajchman et al.,1985) is becoming inadequate and a more flexible and pragmatic approach is required. Despite Hilary Putnam and the other authors of this important book criticizes traditional analyticity, they were quite ''cautious''.
A new approach is necessary, and we should look at the ''adversaries'' of the analytical approach, in other words, the adversaries of logicism, determinism and anti-psychologism.

In my opinion, Poincarè and Born are not only two of the most important scientists of the last century but also the two most overlooked thinkers.
Poincarè, in deep contrast with Bertrand Russell, developed a very versatile project, characterized by prophetical ideas like that of statistical resoning (mental processes cannot be reduced entirely to logic), probabilistic causality, the great relevance of psychologism, the attention for unconscious processes like intuitions and creativity. On the other hand , Born fighted determinism and naive realism, showing a great philosophical sensitivity and, like Poincarè (that he probably met and admired[21]), developed a statistical interpretation not only of the microscopic world but also of the macroscopic one. I added that statistics has a fundamental role also at the megascopic level of the universe.
We should improve the use of statistical methods: like the Bayesian one, but also the frequentist one, the multilevel statistical modelling, psychometrics and so on (Pearl himself recognized that statistical approaches cannot reduced to Bayesianism: he said he is an ''half-Bayesian'' [Pearl,2001]).

Following Poincarè and Born, I think naive realism is incompatibile with science. Conventionalism shows more flexibility and coherence and become the most adequate approach after the discovery of dark matter and dark energy: ''normal'' Energy and ''ordinary'' matter represent a very small part of the universe.

As we have seen, the adjective ''cognitive'' has been usually used as a synonym of ''conscious'', I disagree with this interpretation; a vast majority of cognitive processes

[21] Born wrote he attended to Poincarè's lectures in 1909 at the Gottingen University (Born,1969:102). He defined Poincarè:'' the great French mathematician''(Born,1949:58).

(that we could consider like the ‘’dark energy’’ of our minds) are unconscious and, in my opinion, statistics can be more useful than logic (that work quite well with conscious processes) in their investigation. This could be a tentative scheme about the differences between analytic philosophy and the reformed synthetic one:

Analytic Philosophy	Reformed Synthetic Philosophy
Logic is the main epistemic tool	Statistics (and its subfields) is the main epistemic tool
Mostly anti-psychological; it ignored the role of unconscious processes	Deeply psychological; Psychodynamic neurology has a relevant role
Mind-body dualism (it has not been accepted by all analytic philosophers)	Embodied cognition (including biologized a priori)
Anti-intuitive	Intuitive
Deterministic (it includes classical causality)	Indeterministic (it includes probabilistic causality)
Mostly (naive) realist	Conventionalist

Evolution is not only intrinsic to biological systems but characterizes also concepts in science and philosophy; I think that the emergence of a great number of researches in philosophy, cognitive science and beyond on statistical reasoning, probabilistic causality, indeterminism, intuitionism, creativity, psychodynamics cannot be ignored. At the same time, I think these studies are basically incompatibile with the analytic approach and, for this reason, I tried to bind them in a different philosophical scenario.

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