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Hannes Leitgeb
Ilkka Niiniluoto
Päivi Seppälä
Elliott Sober
Editors

9 Patrick Suppes: From logic to probabilistic metaphysics

ANNE FAGOT-LARGEAULT [*]

for Alexandra

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[*]Collège de France & Académie des sciences, Paris

Introduction

As a brief introduction, let me remind the reader of two facts. First a quotation from Patrick Suppes, quite meaningful in the context of our Congress of logic, methodology and philosophy of science : "I count **probability** as perhaps the single most important concept in the philosophy of science" (Suppes, 2002, p.14); hence the title of this presentation. Second, as our President Elliott Sober said in his inaugural welcome talk, P. Suppes was President of DLMPS from 1975 to 1979; and he had been very active and contributive in the preparation of the first DLMPS congress, that took place in 1960 on the Stanford campus. He really was one of us. The present paper attempts to summarize : (1) Suppes' background and career, (2) his style as a philosopher of science, (3) his probabilistic metaphysics.

1 Suppes' background and career

Patrick C. Suppes was born in Tulsa, Oklahoma, on March 17, 1922. His mother died when he was four years old. He was raised by his stepmother, who encouraged his intellectual curiosity, while his father would see him follow his own trail in the oil business. He graduated from Tulsa High School in 1939. Later on he liked to say that his public school education had been very influential, due to his being admitted in a six years experiment of accelerated education for able students.

Suppes began college in 1929 at the University of Oklahoma, found it boring, went to Chicago, and back in Tulsa. At the time his interests were mostly in physics. In 1942 he was recruited to serve in the Army Reserves, returned to the University of Chicago and graduated in a "special meteorology program". Then during WW2 he served as a meteorologist in the US Army from 1943 to 1946, first on the Solomon Islands, then in Guam. In a 'Self-profile' that he wrote in 1979[1] he mentions having read Aristotle on the Solomon Islands. Note that the importance in Suppes' philosophy of the notion of habit is clearly reminiscent of Aristotle.

After the war Patrick Suppes earned a PhD (1947-50) in Philosophy from the University of Columbia, New York. His director of studies was Ernest Nagel. The topic of the dissertation was action at a distance, according to Descartes, Newton, Boscovich, and Kant. Such a topic points to an interest for the history of philosophical problems, in so far as it helps looking for better solutions or approaches. Such was typically Suppes' attitude towards the history of philosophy: "We can learn from the past, but we can also improve upon it" (Suppes, 1996, p.110).

Suppes' career was simple, straight and extraordinarily productive. From the fall of 1950 on, he spent 64 years at Stanford University, living on campus, building his re-

[1] 'A Self-profile', p. 3-56, in: Raju J. Bogdan, 1979, *Patrick Suppes*. Hereafter quoted as 'Self-profile'.

search facilities, accompanying the university's evolution from the initial 'farm' to a vast and busy industrial city. As a professor he would teach in the Philosophy Department, and had links with the Departments of Mathematics, Statistics, Psychology, Education. As a researcher he created the *Stanford Institute for Mathematical Studies in the Social Sciences* (IMSSS, initially 'Ventura Hall'), of which he was director from 1959 to 1992. Interested, long before the personal computer existed, in the possibility of using computers to teach mathematics or language and facilitate classroom learning, he launched with IBM a system of *computer-assisted instruction* (CAI) in East-Palo-Alto that low-achieving students in an elementary school could use experimentally from 1966 on. He also founded a *Stanford Education Program for Gifted Youth*, which he managed from 1992 to 2010.

In his lifetime P. Suppes was gratified with many honors and distinctions. He was elected a member of the National Academy of Education (1965), of the National Academy of Sciences (1978), of the IIP (International Institute of Philosophy), etc. Those however were not his raison de vivre. When he was offered an opportunity to become President of Stanford University he refused, arguing that he liked "research better than bureaucracy" ('Selfprofile', p. 52).

He was strongly dedicated to international relations between philosophers, was often invited abroad, travelled easily, co-edited a number of collective volumes. As an example, he was in Paris in November 1979 at the invitation of Jules Vuillemin, and gave a series of four lectures at the College de France. Those were translated into French and published (Suppes, 1981a). He was at the College de France again in 2005 at the invitation of the author of the present paper. He then gave a well-attended public lecture on "*Neuropsychological Foundations of Philosophy*", and participated in two seminars, having exciting exchanges with neuroscientists and neurosurgeons[2].

Formal talks were not his only, nor his favorite mode of communication. Planning to be in Paris in March, 2002, he welcomed the perspective of having an informal talk and discussion with philosophy students at the College de France. He suggested that we could take "Rationality and Freedom" as a theme. He sent us a series of papers he had written, some still unpublished. As our students had a hard time reading some of those papers, which were loaded with technicalities, Suppes sent an email:

> Very pleased to have the papers looked at prior to our meeting. Then we can have a real discussion rather than a lecture, which I would like very much. My use of ergodic theory in some of these papers is a bit heavy going for philosophers [...]. But don't be put off by the technical framework. The basic message is easy to communicate in discussion. And I do have something to say about free will. Perhaps the single best one-sentence formulation is this: Free will is a scientific problem, not a philosophical one. And the answer is positive, with no need to worry

[2]See: *Lettre du College de France*, February 2006, 16:8.

> about compatibility with determinism or indeterminism. Look forward to seeing you. Pat[3]

A letter followed, with detailed instructions on what to read exactly, and how the discussion could be carried. A copy of the letter may remind the reader of his handwriting (Figure 1.).

2 Suppes' style as a philosopher of science

To the question as to what kind of philosopher of science was Patrick Suppes, there may be two answers. Suppes was a kind of *Janus bifrons*. Having regard to his conducting theoretical *vs*. empirical research, he was two different philosophers of science. Whether the one completed the other, or whether he evolved from one to the other, is not that clear. Let us opt for the second hypothesis.

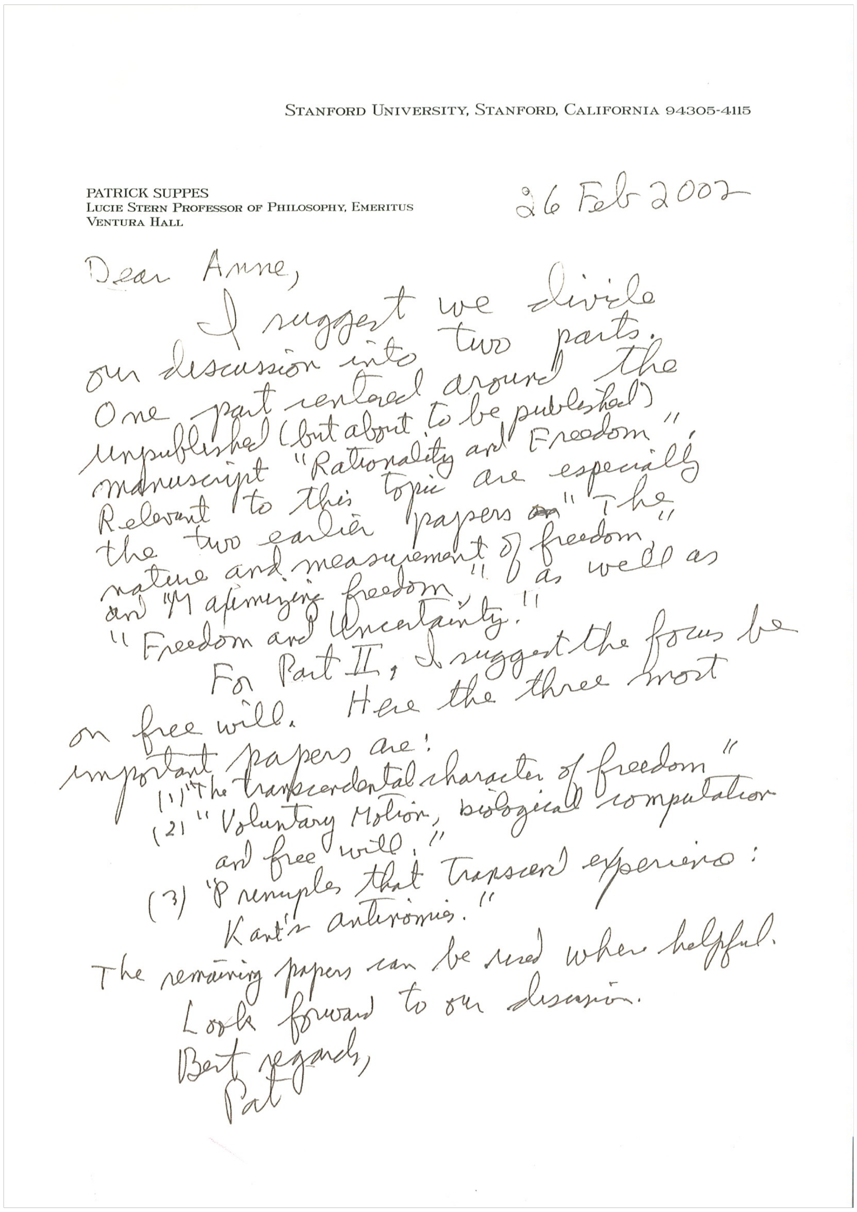
"In my younger and more formalistic days..." (see: Bogdan, 1979, p.208). The young Suppes, Nagel's student, was an analytic philosopher, interested in the logic and language of science, talking about primitive notions, axioms, theorems, proofs, formal methods... He dreamed of doing for physics what Whitehead and Russell (1910–1913) did for mathematics:

> If time and energy permitted, I would like best to write a kind of Bourbaki of physics showing how set-theoretical methods can be used to organize all parts of theoretical physics and bring to all branches of theoretical physics a uniform language and conceptual approach. (Suppes, 1969, p.191).

The more mature Suppes proved a real talent and inclination for laboratory investigations. "I found that I had a natural taste for elaborate analysis of experimental data." ('Self-profile', p. 28). He would then appear as a pragmatic philosopher, empiricist, associationist, neobehaviorist (however, anti-reductionist)—occasionally trusting his intuitions—mostly interested in experimental psychology, and admirer of William James, whom he easily quoted (James, 1890/1950). Here is how he sees himself:

> I think of myself primarily as a philosopher of science, but to a degree that I think is unusual among professional philosophers I have had over the period of my career strong scientific interests. Much of this scientific activity could not in fact be justified as being of any direct philosophical interest. But I think the influence of this scientific work on my philosophy has been of immeasurable value. I sometimes like to describe this

[3]Copy of an email sent: Sun, 24 Feb 2002, by <psuppes@mail-csli.stanford.edu> (personal communication)


STANFORD UNIVERSITY, STANFORD, CALIFORNIA 94305-4115

PATRICK SUPPES
LUCIE STERN PROFESSOR OF PHILOSOPHY, EMERITUS
VENTURA HALL

26 Feb 2002

Dear Anne,

I suggest we divide our discussion into two parts. One part centered around the unpublished (but about to be published) manuscript "Rationality and Freedom". Relevant to this topic are especially the two earlier papers ~~on~~ "The nature and measurement of freedom" and "Maximizing freedom" as well as "Freedom and Uncertainty."

For Part II, I suggest the focus be on free will. Here the three most important papers are:

(1) "The transcendental character of freedom"
(2) "Voluntary Motion, biological computation and free will."
(3) "Principles that transcend experience: Kant's antinomies."

The remaining papers can be used when helpful.

Look forward to our discussion.

Best regards,
Pat

Figure 1.

> influence in a self-praising way by claiming that I am the only genuinely empirical philosopher I know ('Self-profile', p. 45).

Continuity is claimed by Suppes, from the logic course taught at Stanford in the 1950es (Suppes, 1957/1967) to the monumental summa (Suppes, 2002) reflecting 40 years of research and published when he reached eighty years:

> Course notes materials were developed . . . that conceptually followed the final chapter on the set-theoretical foundations of the axiomatic method of my *Introduction to Logic*, first published in 1957. (Suppes, 2002, p.xii).

The objective remained of achieving the unity of science through the progressive "reduction of one part of science to another" (Suppes, 2002, p.467). The task, however, appears difficult: "one of the puritanical themes of this book is that scientific reduction is hard work. To finish it off with details and explicit representation theorems is even harder. [...] The problem was too difficult for me."(Suppes, 2002, p.467-8). In other words, Suppes acknowledges that he never succeeded reducing completely a piece of science to another.

While the objective of working towards the **unity of science** through achieving the program of reduction is neither abandoned, nor disavowed, another program opens up, that may be named Suppes' Aristotelian program. It aims at searching and analysing information about the world, even though the pieces of knowledge that are collected may resist the constraints of logic and mathematics. At this point, philosophy of science admits of a mixture of formal and informal methods:

> It is difficult to predict the general future of axiomatic methods in the empirical sciences. [...] The use of such methods permits us to bring to the philosophy of science the standards of rigor and clarity that are an accepted part of the mathematical sciences. A conservative prediction is that they will continue to be applied in foundational work throughout this century, even surrounded by a context of informal philosophical or scientific analysis. Such a mixture of the formal and informal [...] is both desirable and necessary, in the sense that many significant ideas in the philosophy of science are not expressed in a way that makes them suitable to formulate in terms of systematic axioms. Experimental and statistical practices in all parts of science are the source of the largest numbers of such examples. (Suppes, 2002, p.49).

Admittedly, as a philosopher of science, Suppes himself is a **mixture**: the diversity of his interests goes far beyond logical analysis. In the (already cited) *Self-profile* that he gave of himself in 1979, he enumerates seven research areas, where he thinks he has contributed something of value:

> I have grouped the discussion of my research under seven headings: foundations of physics; theory of measurement; decision theory; foundations of probability, and causality; foundations of psychology; philosophy of

> language; education and computers; and philosophy of science ('Self-profile', p. 9).

Let us take the example of the theory of measurement. Suppes contributed to build a set of methods of measurement for psychology (see: Suppes and Zinnes, 1963). He was especially happy with the initial theoretical paper he published with Dana Scott in 1958 (Scott and Suppes, 1958, Journal of Symbolic Logic, 23: 113-128): "A formal definition of a theory of measurement as a particular kind of class of relational systems is given and the general problem of axiomatizing a particular theory of measurement is studied." Measurement scales followed. He is now working on another subject, but he maintains that philosophy students should learn about measurement: "I continue to proselytise for the theory of measurement as an excellent source of precise but elementary methodology to introduce students to systematic philosophy of science" ('Self-profile', p. 16).

"My own empirical bent in philosophy is nowhere more clearly reflected than in my attitude toward the philosophy of language", Suppes wrote in 1979 ('Self-profile', p 40). Let us see how he attempted to elucidate the process of **learning**: learning how to speak and read, how to compute or conceptualize, as well as how to mount horses or bicycles.

> In 1956 my oldest child, Patricia, entered kindergarten and my interests in applications were once again stimulated, in this case to thinking about the initial learning of mathematical concepts by children. [...] In recent years the interest in mathematical concept formation has melded into my work on computer-assisted instruction ('Self-profile', p. 29-30).

While developing computer-aided learning experimental programs, he also looked into the history of philosophy:

> The concept of meaning has a much longer history in philosophy and logic than it does in psychology or in linguistics. It is possible to begin the philosophical story with Aristotle, but Frege and Tarski will do... ('Self-profile', p. 33).

He sees the meaning of a word, or phrase, as being context sensitive, and resting on a sort of sedimentation of numbers of associations in a multiplicity of linguistic environments. He certainly does not admit of the meaning of a word to be conceived as a stable unit, possibly a supernatural entity, a 'true' idea serving as an absolute reference for the variety of usages of the word.

> I have come to be skeptical of the long philosophical tradition of looking for various kinds of bedrocks of certainty, whether in epistemology, logic, or physics. Just as the natural notion of a person is not grounded in any hard and definite realization, and certainly not a physical one because of the continual fluctuation of the molecules that compose the body of a person, so it is with the meaning of expressions. ('Self-profile', p. 38).

Parenthetically, Suppes expected the use of computers in education to help the students think by themselves, and to free them from the tentative coercion of prestigious professors delivering an authoritative message from the pulpit.

> My vision for the teaching of philosophy is that we should use the new technology of computers to return to the standard of dialogue and intimate discourse that has such a long and honored tradition in philosophy. Using the technology appropriately for prior preparation, students should come to seminars ready to talk and argue. ('Self-profile', p. 44).

He certainly did not underestimate the difficulty of the programming. But he was optimistic about the future of the computer-teacher. Not all of his predictions have been confirmed.

> There are many good teachers and many bad ones. We understand some of the features that distinguish these two groups but we scarcely have a detailed constructive theory as to how to model the best and how to eliminate those features characteristic of the worst. [...] The computers that are used for instruction 20 years from now will, almost without question, no longer be silent but fully talking - and talking with a great deal of instructional sophistication. The silent computers that dominate the present scene will definitely be a thing of the past by the end of the century. (Suppes, 1981b, p. xxviii).

Rational decision and action is another topic that Suppes tackled with the tools of both mathematics and psychology. As a formal tool, he liked best the Bayesian model, the implicit assumption of which is that you should always choose so as to maximize your expected utility. He also praised the Aristotelian model, where it is assumed that you should always act "for good reasons". He insisted on not dissociating rational decision from rational action, and explained that a wise decision maker should take into account both whatever information he may gather on the actual state of affairs, and a clear notion of what he wants promoted:

> Both beliefs and values are essential ingredients of the expected utility model. A person with beliefs but no values does not know what to choose, and a person with values or feelings but no beliefs can easily choose foolishly. (Suppes, 1984, p.207).

But the standard models of the decision making process analyze decision making as a mathematical computation. That is a simplifying fiction. Explicit expected utility computations are rare. William James knew better than our economists. "The actual computations we do are fragmentary, occasional, contextual, driven by associations internal and external."[4] In other words:

[4] P. Suppes, 'Rationality and Freedom', manuscript, Paris, Collège de France, March 2, 2002. The manuscript is mentioned in Suppes' letter (Figure 1).

> A theory of rationality that is posited on some exemplary style of rational deliberation, conscious, measured and complete, is utterly mistaken as a psychological account of how any of us go about making decisions about practical problems or solving theoretical ones. (Suppes, 2005, II, 3).

But wouldn't a psychological account of our decisions end up with the certified report that what we call rationality reduces to psychological determinism? Not so, Suppes answers: "the Brownian movement has killed and buried determinism"[5]. Kant was mistaken. His 3rd antinomy[6] suggested that determinism is certain, free will is conjectural. As a matter of fact, free will is certain, while the question of determinism/indeterminism remains fuzzy:

> The Kantian thesis has been properly stood on its head. Free will, as exemplified in voluntary motion, is the hard empirical fact. Determinism (or, if you prefer, indeterminism) is the transcendental metaphysical assumption out of reach of detailed confirmation [...] I have taken a biological line of argument that makes free will a natural concept exhibited in the behavior of other species. This is clearly a scientific line of attack. (Suppes, 1994, pp.462, 466).

(Remember: "Free will is a scientific problem, not a philosophical one"—end of part 1). At that point, Suppes' message is that while Kant's program is clearly dead, an empirical approach of the notions of 'truth' or 'belief' can be seen as a modern version of Aristotle's program.

3 Suppes' probabilistic metaphysics

"Randomness is in nature, and not simply in our ignorance of true causes" (Suppes, 1984, p.23). When did Suppes start giving randomness a real, ontological dimension? At least as soon as 1974, when he gave a series of invited lectures in Sweden:

> In 1974, I gave the Hägerström lectures in Uppsala, Sweden, entitled 'Probabilistic Metaphysics'. In those lectures I took as my starting point Kant's criticism of the old theology; my purpose was to criticize various basic tenets of what I termed the new theology ('Self-profile', p. 47).

Following a suggestion from Amartya Sen, Suppes reworked his lectures. The book came out ten years later. In that book the attack on the "new theology" is straight and forceful. According to the author, the new theology, initiated by Immanuel Kant, and tacitly assumed by virtually all philosophers of science after Kant, asserts that:

[5] "Le mouvement brownien a sonné le glas du déterminisme", in: Suppes, 1981a, p.57.

[6] Kant, Critique of pure reason (transcendental dialectic, 3rd antinomy).

1. the future is determined by the past,
2. every event has a sufficient determinant cause,
3. knowledge must be grounded in certainty,
4. scientific knowledge can in principle be made complete,
5. scientific knowledge and method can in principle be unified (Suppes, 1984, p.2).

All five tenets will be found disputable. "We should be able to construct a general metaphysics or epistemology on other grounds" (Suppes, 1984).

For the construction of the new metaphysics, two elements are preserved from the old metaphysics. From Aristotle's *Metaphysics*, the analysis of 'being' is retained. Let us note that Suppes gives a remarkable account of the aristotelian notions of matter, form, and substance:

> Matter qua matter is purely potential and without attributes (Metaphysics, 1029a19). A substance has both form and matter. The nature of a substance is complex. It is neither simply the form nor the matter (Physics, 191a10; Metaphysics, 1043a15). There is no principle of individuation for matter qua matter...The principle of individuation for substances does not require sameness of matter for sameness of substance. For example, an animal is both intaking and excreting substance, but we still speak of the identity of that animal through time. (Suppes, 1984, p.5; see also Suppes' paper in *Synthese*, (Suppes, 1974)).

From Immanuel Kant the project of a critical philosophy is retained as a method. Unfortunately Kant had rejected the use of probability. Therefore his possible contribution to the contents of the new philosophy of science is nil.

Building a general philosophy of science is a huge enterprise. In the Introduction of his *Probabilistic Metaphysics*, Suppes gives a list of eight basic "metaphysical propositions". Four of these will be minutely argued, each in a whole chapter. These are:

1. "The fundamental laws of natural phenomena are essentially probabilistic rather than deterministic in character." (Suppes, 1984, chap. 2, p.34).

2. "In general, causality is probabilistic, not deterministic in character, and consequently no inconsistency exists between randomness in nature and the existence of valid causal laws." (Suppes, 1984, chap. 3, p.70).

3. "Certainty of knowledge—either in the sense of psychological immediacy, in the sense of logical truth, or in the sense of complete precision of measurement—is unachievable." (Suppes, 1984, chap. 4, p.99).

4. "There is no bounded fixed scientific theory toward which we are in general converging." (Suppes, 1984, chap. 5, p.117).

Assuming the "ontological character of randomness" (Suppes, 1984, p.208) entails that: 1) unified science, as cherished in the old days, was a dream; 2) learning is merely building habits; 3) there are limits to the rationality of our 'rational' strategies of action. Let us briefly comment on those three points.

1. The idea of **unified science** was promoted in the early 20th century by Neurath and others (Neurath, Carnap, & Morris, 1938, vol.1, part 1) with the ambition that psychology and other social sciences might be reduced to biology, biology could be reduced to physics and chemistry, so all sciences would converge, using the same (mathematical) language and methods. But science is plural and will remain plural. Suppes sketches a program adapted to "the plurality of science" (Suppes, 1984, chap.6):

> the rallying cry of unity followed by three cheers for reductionism should now be replaced by a patient examination of the many ways in which different sciences differ in language, subject matter, and method... (Suppes, 1984, p.125)

Plurality in science reflects the diversity in the world. Suppes' anti-reductionism is ontologically based, and not only an affair of methodology:

> the important central features of meaning and correctness of a program are in a strong sense irrelevant to the particular physical realization in which the program is embodied (Suppes, 1984, p.130).

You cannot reduce the mental conception and design of a program to its realization in a brain or a computer. Suppes wants psychology to be a science of the mind, as serious and dignified as physics.

2. How do we **learn**? How do we know that Rome is not the capital of France? "three processes—talking, listening, and reading—are the main methods by which information is transmitted and intellectual skills are learned." (Hintikka, Suppes, & Moravcsik, 1973, Preface). Don't we have to learn logic? How do our intellectual skills develop?

> It is misleading to say that we are making a deduction to arrive at the conclusion that 'Rome is the capital of France' is false .. [...] The approach to computation about such things and processes, characteristic of our minds, was well recognized by Hume, the godfather of the central mechanism of association, and already foreshadowed by Aristotle. What I shall insist on here is the universal role of association as the main method of computation in the brain (and in the mind, if you will) in dealing with ordinary experience. (Suppes, 2005, II, 3).

What about our being able to correct errors of judgement or of calculation, like mistakenly applying a probabilistic causal law to individual cases? "Certainly it would be ludicrous to think that there is a logically valid inference from the mean data to the individual data. But [...] ordinarily much of what I know about individuals is based upon generic causal relations." (Suppes, 1984, p.61).

3. **Rational behavior** cannot be entirely disconnected from its factual context (internal: moods, hormones; or external: weather, needs of our children, unexpected

situation, etc.). “Intentions and actions are afloat on a sea of random happenings.” (Suppes, 1984, p.208). Most of the time we don’t explicitly rationalize before doing. We decide without much thinking, because we trust our habits. For complex tasks we may use recipes or “justified procedures”, as do the “rational cooks and carpenters”. In important circumstances we will effectively compute, using for example the Bayesian model - note that the Bayesian theory provides a rational for changing beliefs, given the acquisition of new information; but an analysis of the process of information selection is missing, leaving the subject free to pay or not pay attention to possibly relevant information. Finally, trained subjects may have rational intuitions. “Intuitive judgment is a skill like jogging, playing tennis, or finding mathematical proofs. Even simpler and more universal examples are walking and talking.” Suppes ambitioned to develop “a proper educational psychology for teaching those skills.” (Suppes, 1984, p.218). Let him conclude:

> What we teach our students or ourselves about practical decision making cannot be wholly reduced to algorithms or even to implicit axioms, but we can, on the other hand, improve on Aristotle just because we can apply axioms and procedures as appropriate. The use of modern quantitative methods of decision making is necessarily limited but powerful when properly applied. The role of judgment and practical wisdom in applying such methods will continue to be of central importance. The tension between calculation, qualitatively justified procedures, and judgment will not disappear. Nor will its philosophical analysis. (Suppes, 1984, p.221).

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Author biography. Anne Fagot-Largeault, PhD (Stanford 1971), MD (Paris 1978), Docteur ès lettres et sciences humaines (Doctorat d'Etat, Paris 1986). **Currently** emeritus professor of the College de France (philosophy of life science). Member of the French Academy of Sciences, of the International Academy of Philosophy of Science; associate member of the Royal Academy of Belgium (humanities section). Member of the College of experts of the French Biomedicine Agency for the research on human embryos and embryonic stem cells. Member (2007-2011) of the Executive Committee of the DLMPS. Has been a member of Data and Safety Monitoring Committees for international clinical trials in aids, cancer, cellular therapy.
Career: teacher of philosophy in high school (1961-1966); assistant professor at the university of Paris-12 (1971-87); full professor in philosophy of science at the universities of Paris-10 (1987-95) and Paris-1 (1995-2001); inaugural lesson at the College de France in 2001. Medical practice at the Henri Mondor hospital (Assistance publique de Paris, 1978-2003) mostly as a psychiatrist in the emergency room.
Research: centered on the philosophy of life sciences, developed along three lines: (1) diagnostic reasoning, inductive logic, statistical and probabilistic methods, heuristic procedures; (2) investigation of causal links, validation of causal hypotheses, causal explanation, evolution and the ontology of becoming; (3) ethics of medical practice and investigation, methodology of clinical & of epidemiological research, epistemology of bio-medical sciences, bio-medical anthropology.
Publications: see www.college-de-france.fr.