Herbert Simon's experience at the Cowles Commission (1947–1954)

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Abstract

Surprisingly Simon's activities at the Cowles commission remain largely unexplored; while Simon and the Cowles shared a twofold wish to operationalize economics and to formalize human decision making. This is also during his time at the Cowles commission that Simon produces his emblematic paper formalizing bounded rationality. Furthermore, Simon claims that his participation at the Cowles was decisive in his awarding of the Nobel Prize. The aim of the paper is to produce such scrutiny. As such the claim of the paper is that Simon's relationship with the Cowles commission and its members was a bittersweet one. Indeed, such a collaboration started enthusiastically from both sides and ended surrounded by indifferences. We offer three explanations to this bittersweet relationship. First, both the Cowles and Simon shared a wish to formalize decision making problems; although, they had different conceptions about mathematical tools and the articulation between theory and empirics. Second, the irreconcilability of their conception of optimality threatened their common interest in operational research. Third, and more globally, Simon's and the Cowles's research agendas were not stabilized during this period explaining the enthusiastic phase as well as the cold one, once these two research agendas stabilized, but in different directions. The paper distinguishes four periods from 1947 to 1954 during Simon's time at the Cowles. Each section of the paper deals in turn with one of these four periods.

Key words : Simon – Cowles Commission – Rationality – Optimization – Models

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0. Introduction

The recent Nobel Prizes in economics (e.g. Abhijit Banerjee, Esther Duflo, and Michael Kremer in 2019; Joshua Angrist, David Card and Guido Imbens in 2021) tend to insist on the importance for economics to be an applied discipline. The understanding of human behavior and decision making seems intimately linked to such a wish of applicability as another recent Nobel Prize in economics highlights — the attribution of such a Prize to Richard Thaler in 2017. Already during the second half of the 20th century, Herbert Simon's research emphasized these two dimensions. First, Simon is often presented as the canonical figure of "bounded rationality". Second, his attempt to make economics an operationalizable discipline is also famous, as his numerous participations into several institutions highlighted. Simon (1982) claimed that a significant effect of the Cowles Commission on his intellectual trajectory was to encourage him to translate mathematically part of his previous research in organization theory and decision making, the most appropriate example being his 1955 "Behavioral model of rational choice". Since then, various authors have shown that Simon's activity at the Cowles Commission was not confined to that model (Augier and Kreiner 2000, Augier and March 2004, Mirowski 2002). However, few, if any, have provided a detailed account of the various lines of research Simon had followed over the seven years (1947-1954) he spent at the Cowles Commission. The aim of this article is to fill the gap and thereby to provide a better understanding of the process which led to Simon's 1955 model.

The fact that Simon was connected to other institutions while he was at the Cowles commission may have contributed to downplay the importance of his interactions with the Cowles Commission. Judy Klein has emphasized that Simon's collaboration with engineers on resource allocation issues at Carnegie Institute of Technology where he was involved in the foundation of the Graduate School of Industrial Administration led him to "break from the standard approach to rationality" (2015: 29). Sent (2000), Mirowski (2002, 263), Crowther-Heyck (2005) and Klein (2016) also stressed that his RAND activities at the Systems Research Laboratory, which generated a shift of interest from rational decision-making to human problem solving, paved the way to his future work on computer simulation and artificial intelligence. Petracca (2021, 728) put forward the idea that Simon's double affiliation with the Cowles and the Ford Foundation might explain his "modular approach rationality" – one focusing on cognitive limitations (Simon 1955) and the other on environmental limitations (Simon 1956a) that Simon used later on to adapt to various audiences. But in not documenting and delving into the seven years long involvement of Simon

into Cowles Commission's activities, all these studies tend to leave partly unexplained Simon's intellectual path. Simon might be responsible for it. Simon left the impression that at the end of the day, his stay at the Cowles Commission had a limited impact on his later activities, even if he admitted that these years were instrumental in helping him to win the "Nobel Prize" in economics (Simon, 1996: 101–104, 325–326). Besides, his impact on the Cowles Commission is often downplayed – compared to authors like Koopmans or Marschak – by historians (Hildreth 1985, Mirowski and Nik–Hah 2016, Herfeld 2018, Düppe and Weintraub 2013, Dimand 2019).

In this article we show that Simon's 1955 model resulted from a modeling strategy that he called for while he was at the Cowles Commission and interacted with its main protagonists. The modeling strategy was implemented in two different ways. Simon listed three "canons" to describe it (Simon [1951] 1954, 88). First, concepts that lie at the core of social science theory should be translated into mathematical concepts. Simon and other Cowles' members shared a desire to use mathematics to formalize decision-making problems. Their conception of the mathematical tool and of the articulation between theory and empirics, however, proved to be very different. In 1956, Simon observed that "the term 'model'" was "simply a synonym for theory" and was used to refer to a "mathematical theory". He distinguished mathematics from two other kinds of "scientific language", the "verbal" and the "analogical" ones (Simon and Newell 1956a, 66). Second, these concepts should not be incorporated into a single model but in a number of partial models. Third, realistic models should be built by taking into account the limits of rationality. While that strategy initially led Simon - driven by an interest in operational research shared with other Cowles members - to build models he saw as mere relaxation of the economists' principle of rationality and optimization, it eventually led him to redefine the very concept of rationality as a process of adaptation (search for a better option) rather than a concept of optimization (search for the best option).

This investigation is based on various types of archives materials which comprise annual research pre-reports Simon addressed to the Cowles Commission research directors, Cowles Commission annual reports of research activities, referee reports Simon received on his works published in the Cowles Commission Discussion Paper series from Cowles researchers as well as correspondences between Simon and the protagonists involved in the Cowles Commission activities. The pre-reports show how Simon linked his activities to the Cowles Commission research and how he situated himself in relation to it. The reports provide a clue as to how other Cowles' members understood and located Simon's contribution in the research agenda of the Commission. In addition, these materials highlight both the instability of the conceptual categories

used at Cowles Commission and the difficulty of translating Simon's ones into that of the Cowles Commission. Another type of material are the papers Simon published as a consultant for the Cowles Commission which prove to be useful for reconstructing the steps which led him to develop his 1955 model. Lastly we consider Simon's correspondence, especially with Cowles' research directors, Jacob Marschak and Tjalling Koopmans which capture the changing nature of Simon's relationship to the Cowles Commission as well as his evolving perception of that relationship. Taken together, these different types of material shed new light on "the exact nature of the relationship between Simon's propositions and the classical model of rationality", which, as Philippe Mongin admits, remains "very obscure" (Mongin 1984 23).[2]

The paper examines four distinct periods. Section 1 focuses on the 1947-1949 period to show that Simon did not enter the Cowles Commission to study rational decision-making but to analyze the effects of technological changes. Section 2 and 3 demonstrate that between 1949–1951, Simon attempted to integrate various administrative aspects into models of resource allocation derived from Koopmans's works. Section 4 scrutinizes Simon's early 1950s reflexive summary on the strategy he had followed so far. Lastly, section 5 shows that Simon's willingness to discuss the model he had designed in 1952 was coldly received by Cowles' members. Beyond its apparent simplicity, this chronological plan is justified for three reasons. Firstly, this design allows, thanks to the study of archival documents, to reveal the moving convergences and divergences between the unstabilized research agendas of Simon on the one hand and the Cowles Commission on the other. Second, by emphasizing both the conceptual and formal content of the different models produced by Simon within the Cowles, it allows to account for Simon's move from *Administrative behavior* to "A Behavioral Model of Rational Choice". Third, this chronological outline helps to prevent against the pitfall, which can be found in the literature to varying degrees, of studying Simon's 1952/1955 years either through the prism of contemporary debates on behavioral economics or through the prism of his later work and autobiographical accounts.

[2] Mongin had dealt with this relationship from an analytical perspective through the issues of the nature of models of rationality (1984), the role played by information (1986) and the concept of optimization (2000).

1. Simon's debut at the Cowles Commission (1947–1949): From Administrative Behavior to Technological Change

Simon joined the Cowles Commission as a research consultant the year of the publication of *Administrative Behavior* (1947) based on the PhD thesis he prepared in the Department of political science of the University of Chicago. This Department, which Simon entered in 1936, was possibly the most influential in the field of political science in the US (Crowther-Heyck 2005: 41-42). Its leading members, including Charles Merriam, Harold Lasswell, Harold Gosnell and Leonard White developed an approach of policy sciences that was rooted in the intellectual traditions of the Progressive era, notably Pragmatism (Dunn 2019). Simon's (1943) dissertation bears the mark of this influence, as evidenced by his references to several pragmatist scholars, especially William James and John Dewey. However, his curiosity brought him beyond the limits of political science and philosophy. He explored Chester I. Barnard's (1938) views on administration, as well as the work of the mathematical economists of Chicago, such as Henry Schultz, which singled him out in the political science Department.

Simon's thesis sought "to understand the nature of choice, and its relation to administrative processes," which explains the diversity of his sources (Simon 1943: 1-2). He was led to "look into the anatomy of the process of choice or decision" and "define what is meant by objectively rational behavior" (Simon 1943: 13). He found in economic courses and economic literature useful insights to address the issue. His interest in the economic theories of rational choice is even more manifest in the first edition of *Administrative Behavior*, which takes into account the commentaries he received, following the mailing of a mimeographed preliminary version to diverse researchers – political scientists, but also psychologists, economists, sociologists and mathematicians – and to some businessmen (Crowther-Heyck 2005: 130-131). This clearly appears in chapter 4 of the book, entitled "rationality in administrative behavior", which reformulates the third chapter of his dissertation. Simon himself mentioned this process of "reformulation" inspired by the "remarkable work of John von Neumann and Oskar Morgenstern [1944]" (1947a: 66-67). Two years before, Simon (1945) had published a very favorable review of their work, one of the first reviews of this classic of game theory that played a major step in the (re)discovery of expected utility theory[3]

[3] As Sent (2001) however shows, this enthusiasm did not persist very long. See also Simon (1956b).

In an interview he gave on the 40th anniversary of the publication of *Administrative Behavior*, Simon asserted: "[t]he big problem for me, from the very beginning of my work with Clarence Ridley [1938], was to reconcile the way that decisions were actually made in organizations with the way that the economists pretended that they were made" (Golembiewski 1988: 286).[4] This issue is the crux of the fifth chapter of his book that first aims at identifying the limits to the implementation, in "real" or "actual behavior," of the "objective rationality as defined in the [fourth] chapter." (Simon 1947a: 79-109). These limitations relate to the "incompleteness of knowledge," the difficulties faced by the individual to anticipate the value of the consequences induced by current choices, and the impossibility for him or her to conceive the entire "scope of behavior possibilities" he or she might actualize. In other words, Simon's already put forward some limitations that run counter to the hypothesis of "complete information" characterizing "an economic man".[5] Once emphasizing "the departure of actual behavior from the norm of rationality", Simon analyzed "the psychological process of choice" building on William James, John Dewey, and Edward C. Tolman. Then he considered to what extent the organization may allow "the individual to approach reasonably near to objective rationality" by acting on "the psychological environment of choice." The fifth chapter of *Administrative Behavior* was thus already laying the foundations of the notion of "bounded rationality" (Golembiewski 1988: 284) and paving the way to the analysis of the psychological mechanisms underlying organizational decision-making. This point is worth emphasizing for understanding Simon's later activities at the Cowles Commission.

Simon's first contacts with the Cowles arose from William Cooper's invitation to attend the Cowles seminars.[6] Cooper – who collaborated with Simon at the Cowles – later became a leading

[4] C. Ridley was one of Simon's instructors, who directed the International City Managers Association (ICMA). From September 1936, Simon served as a research assistant to Ridley on a project aimed at addressing the measurement problems of municipal government services (Simon 1996: 64; Crowther-Heyck 2005: 77-82). The first edition of Ridley and Simon's report was published in 1938. Thanks to the reputation he gained as an authority on measuring public services, Simon was given by Samuel May, the director of the University of California at Berkeley's Bureau of Public Administration (BPA), the responsibility to write a research proposal to be submitted for funding by the Rockefeller Foundation. Simon's project on measuring governmental services having been granted for a three-year term, he was hired to manage the research from 1939 (Simon 1996: 75-83; Crowther-Heyck 2005: 82-95).

[5] On the state of knowledge at that time, see Edwards's literature reviews (1954, 381)

[6] Simon met Cooper in 1935 at the University of Chicago where they were both students. In 1949, they became colleagues at the Carnegie Institute of Technology in Pittsburgh, following Cooper's suggestion to recruit Simon (Simon 1996: 101, 135-13; Cooper 2004).

researcher in operations research and management science, notably in linear programming. In 1947, Simon became a Cowles Commission research consultant. Retrospectively, Simon considered that he received from within Cowles' economists his fourth (and final) education in economics (Simon 1996: 101-102). In the early reports of the agency, he was presented as a political scientist while most of the other Cowles members were economists, statisticians, or mathematicians. Simon's status made him an outsider. In fact, he did not contribute as much as the full research associates at the Cowles Commission between 1947 and 1954. But in addition to his contributions to reports, Simon nevertheless wrote no less than eleven papers, including eight which were identified as economic papers by the agency.

Simon's involvement in Cowles research originates in a paper on the economics of urban migration. He used analytic techniques that he had learned from Kenneth May and Ronald Shephard, two doctoral students of mathematician and economist Griffith Evans[7], with whom he collaborated at the University of California at Berkeley's BPA, between 1939 and 1942.[8] Simon sought to design a simple model highlighting how technological change may impact urban-agricultural productivity ratios and entail migrations (1947b). The paper led Jacob Marschak and Sam Schurr to ask him to address the macroeconomic implications of civil atomic power as part of an ongoing study on the consequences of economic atomic energy for productivity (Simon 1996: 103). This might appear surprising since there seems to be no explicit link between migrations and nuclear power. But what caught Marschak's attention was Simon's treatment of the effect of productivity differentials as evidenced in the Monograph he wrote in the edited volume of Marshak and Schurr (1950) dealing with the macroeconomic and geographic effects of atomic power (see Simon 1950a, 1950b).

[7] Weintraub (2002, 66) has shown that Evans's conceptions of mathematics and rigor were very different from those of later mathematicians, especially Bourbakists, that exert an influence on Cowles' agenda. This might help understanding Simon's differences with Koopmans or Debreu on that matter - as explained in section 4.

[8] Simon (1996: 83, 102, 124) claimed that his experience at UC Berkeley had a strong impact on his education in economics and statistics. Ronald Shephard who had collaborated with the statistician Jerzy Neyman was hired by Simon to work on the project he managed at the BPA. The second, Kenneth May, whom Simon described as "an excellent mathematical economist," was none other than the son of Samuel May, the Director of the BPA.Keneth May published in 1947 a paper on the aggregation of technological change (see, May, 1947). In the entry on "Evans" he wrote for *The New Palgrave Dictionary of Economics*, Simon (1987: 199) admits that he had been indirectly influenced by the mathematician, through, among others, May and Shephard.

Along that line, Simon pursued his investigation into the effects of technological change so as to estimate productivity changes across different industries.[9] All these results were summed up in a Cowles Commission discussion paper (Simon 1947c) in which the effects of technological changes – through (i) a shift in production function, (ii) a shift in cost curve, (iii) a change in the production – were described in terms of "trigger effect"[10]. On the basis of Wald's, Von Neumann's, Leontief's and Koopmans's linear models, Simon managed to produce his own linear model – which he claimed was similar to that of Leontief - from which he drew an admissibility theorem. He applied his model to the three definitions of technological changes he had previously offered. No theoretical results were presented: the aim of the research was essentially to offer a proper estimation tool. As the other members of the Cowles Commission, Simon moved in the development of new tools for economic analysis. Simon's involvement in linear programming helped to explain, as observed by Petracca (2021: 715), that he had not always rejected the notion of optimization as it is used by economists.

In 1949, the Cowles Activity Analysis Conference was held, initiated by Koopmans (Düppe and Weintraub, 2013: 1). The aim was to gather diverse groups of researchers involved in the development of planning tools for economic production. According to Düppe and Weintraub, this conference is crucial to understand how economics became a modeling science: "The conference was the 'coming out party' of the community that would transform the practices of academic economists for decades to come. It established the historical conditions for economics to become a modeling science" (2013, 1–2). This conference led to a Cowles Commission monograph edited by Koopmans (1951). The first part, including two chapters by Koopmans, examines the theory of programming allocation; the second one develops possible applications; the third part concentrates on mathematical properties of convex sets and the final part highlights the issues of computation. Simon, who had contributed to the conference, wrote a chapter dealing with application issues (Simon 1951a) hinging on his previous work on technological change (Simon 1947c, 1947d).[11]

[9] The CC 1948 report written by Koopmans refers to Simon's Staff discussion document under the heading "Research on Optimal Behavior".

[10] Simon defines such an effect as : "a sudden replacement of an old process by a new, or a very large increase in national income resulting from a reduction in cost of a commodity of only moderate importance " (Simon, 1947c, 1)

[11] This is emphasized in the Cowles Commission report: "Following the conference on linear programming in June, 1949, described in our previous report, a good deal of work has been devoted to the further development and application of a simple theoretical model of technology (...). Herbert A. Simon used the model for estimating the effects of a given technological change on the level of national real income from data available before the new process

In this chapter, Simon aims to apply the model developed by Koopmans in the Cowles monograph to technological change.[12] Simon focuses on special cases of Koopman's model. These special cases originate from restrictions that Simon added to Koopman's original model. These restrictions concern the demand side of Koopmans' model. As such Simon obtains a reduced matrix. Simon claims that such restrictions are necessary to identify the impact of technological change on the total production outcome. Simon uses linear programming to analyze the trigger effect he defined in his previous Cowles research. His contribution was commented on by Ausley Cole and Yale Brozen. Both commentators insist on the qualitative aspects technological changes bring into linear programming. More specifically, Cole warns that taking into account such qualitative dimensions may hamper the construction of a realistic model: "The basic difficulty may be that technical change - by altering the way in which things are done, by changing what consumers do and what they want as well – creates such a basically shifting world that we can put very few restrictions on the matrix we design to describe it." (Cole in Koopmans, 1951: 279) In a similar vain, Brozen argues that technological change might induce non–linearities.

It turns out that Simon did not join the Cowles Commission to work on models of rational choice. It was his work on the agricultural and urban population that led Marschak to invite him to participate in his project on nuclear power. For Simon, the focus then was on technological change.[13] It was the method of linear programming, developed by Leontief and Koopmans and used by Simon to estimate the impact of technological change, that was the first common ground between Simon and the Cowles Commission. Not only Simon was familiar with mathematical tools promoted by Cowles' economists, but his joint work with Hawkins, in defining a mathematical condition for linear programming, directly contributed to this mathematization process. But in addition to mathematical tools, a second object, common to both the research agendas of Simon's and the Cowles' research agendas in the early 1950s, explains their convergences of interest. It was the theory of decision-making.

2. Back to decision theory (1949–1951): "Non identity and "division of work"

in question is introduced. This research topic originated in the project on economic aspects of atomic power." (Cowles 1949–50: 7)

[12] In this monograph, Koopmans mobilized Hawkins and Simon's (1949) eponym mathematical condition in building his model (Koopmans, 1951: 53 [chapter III] and Koopmans, 1951: 148 [chapter VIII]). One can also note that Georgescu–Rogen's chapter also refers to this mathematical condition (Koopmans, 1951: 169 [chapter X]).

[13] For a review on the analysis of technological change at the Cowles Commission, see Godin (2019).

As he reported to Hurwicz[14], from August 1st, 1950, to February 1st, 1951, Simon had mostly worked "on models embodying various administrative and organizational aspects of the resource–allocation problem" along three lines of research referred to as "Non–identity of interests," "Division of Work" and "Communication" in his 1949 Cowles Discussion Paper entitled "Administrative Aspects of allocation efficiency". We deal with these three lines of research in turn.

In the "theory of Koopmans and others,"[15] Simon argues that an optimal allocation can be accomplished by any organization on a centralized or decentralized basis. This is because according to such theories, all participants working in any organization are assumed to work for the maximization of the same objective function, to accept the rules set out by the "umpire."[16] But it would make more sense, Simon argued, to assume that some of these participants have separate objective functions and that conflicts of interest may occur.[17] It took Simon a couple of months to produce a first model meeting this objective. The model was presented at the Cowles seminar in Chicago on October 14th, 1950 on the basis of a Discussion paper circulating from June 1950[18].

His model involved two participants: a Boss (B) and a worker (W), each with his or her own satisfaction function, in accordance with the principle of "non-identity of interests" and seeking to show when W is ready to accept the authority of B. When an agreement allows to increase the satisfaction of both participants, Simon argues, the system can be considered "viable". In general, there will be a whole set of possible agreements that will be advantageous to both participants – a set that Simon (1951b) referred to as the "area of viability." Reaching this area does not however mean that a labor contract - such a contract being signed when W is ready, in exchange of a predetermined wage, to perform a given set of tasks on which depend the sole satisfaction of B - will be settled. In fact, if B and W follow a "rational procedure", they will first agree on a specific set of tasks and then bargain about the wage according to the specification of their satisfaction. A

[14] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03225/bdl0001/doc0001

[15] At that time, Cowles Commission Monograph no. 13 edited by Koopmans and entitled "Activity Analysis of Production and Allocation" (see Koopmans, 1951) was still in preparation.

[16] Herbert A. Simon, "Annual Report of Activities, July 1, 1949–June 30, 1950", May 12, 1950, doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03223/bdl0001/doc0001

[17] On this issue, see Mongin (1984, 24-25).

[18] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03192/bdl0001/doc0002

sale contract will thus be settled, making explicit that W has agreed to perform a specific set of tasks in return for an agreed-upon wage.

It is in fact only in the presence of uncertainty, Simon concluded, that workers will agree to go for a labor contract. Only then will the employer have the possibility "to postpone decision in order to gain from information obtained subsequently" (Simon, 1951b: 304). In this case, W might thus be induced to commit to perform some tasks for B (as long as these tasks fall within his or her "area of acceptance") but without B being aware, at the time of contracting, which future acts would be most advantageous to him or her. Under these circumstances, W may agree upon the capacity of B to exercise its authority over him or her,[19] with the probability of an agreement increasing with the degree of uncertainty.[20] In the end, Simon admits, the analysis boiled down to applying Marshak's (1949) analysis of liquidity preference showing that it may be advantageous for investors, when faced with uncertainty, to keep liquid assets and postpone investment decisions in order to gain from further information in the future, to the labor market.

Even if Simon thought that the assumption of rational utility maximizing behavior remained "the most serious limitation" of this model (Simon, 1951b: 305), he was nonetheless convinced that it could help build a bridge between the theories of factor allocation of the economists and the theories of organization. This is particularly obvious in the second model he dedicated to a comparison between theories of organizations ("O–theory") and theories of the firm based on profit maximization ("F-theory") (Simon, 1952a). The model circulated in a Discussion Paper dated from July 1950 and was presented in October of the same year at the Cowles Commission seminar in Chicago. On March 29th, 1951, Hurwicz wrote a long and laudatory review of the paper. [21] With the intention to draw a simple diagrammatic analysis, Hurwicz considered the case of an economy with two participants - Simon starting from a situation with three participants, the firms, the workers and the customers - thereby highlighting its closeness to Simon's first model. With

[19] The possibility of the emergence of a relationship of confidence between employer and employee leads Simon to introduce the difference between "short–run" rationality and "long–run" rationality (Simon 1951b: 302).

[20] It is noteworthy to stress that Simon refers to "increase of uncertainty" because he assumes uncertainty but still complete information, which allows him to provide a probabilistic measure of uncertainty, represented by the standard deviation of the satisfactions associated with a given set of tasks for the employer and the employee. But this model captures a central idea of Simon's thought according to which "organizations, in context of uncertainty, are a means for keeping a large set of possibilities open, and in that sense, appear as more flexible than the market" (Favereau and Walliser, 2000: 190).

[21] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03193/bdl0002/doc0001

axes corresponding to the satisfaction of each participant, Hurwicz could show that the "optimal" set of agreement between participants was in fact a subset of a larger "achievable" set. For that very reason, he concluded, the merit of Simon's paper was to highlight "(1) that the economists are only aware of the existence of the [optimal set] while administration theorists think all of the [achievable set]; (2) that the economist is apt to ignore a part of [the optimal subset] (that part which corresponds to 'all or none' type of bargaining)."[22]

These two models developed by Simon reveal a resolute will to find a way to move smoothly from economic theory to administrative theory, with the ultimate goal to put forward the idea that the former is a special case of the "area of cases" grasped by administrative theory (the employment relationship reduced to a sale contract in the first model; the decision-making process reduced to the optimum of the entrepreneur in the second model).

In collaboration with other colleagues of the Cowles Commission, Simon followed almost at the same time two other lines of research. On December 3rd, 1949, he shared with Koopmans his enthusiasm for his research into the problem of "division of work" within firms.[23] A couple of months later, he reports to him about his progress and his intention to derive "new theorems" from Reiter's work on the implications of "indivisibilities" of the factors of production.[24] A preliminary scheme was finally outlined in April 1950 in his three-page Cowles Commission Discussion Paper. Although Simon felt confident in the possibility to go further in this direction, no paper was finally published later on.

3. Pursuing with Decision Theory: "Communication" problem and servomechanism

The line related to the problem of "communication" proved to be more promising. Based on the premise that the firm is an organization within which operations are carried out by multiple centers of decision, Simon thought he was able to tackle problems mentioned as "dynamic allocation problems" in Cowles reports (Cowles 1949–50: 8-9). In a letter dated on February 13th, 1950, he notified Koopmans of his intention "to make a frontal attack upon the formalization of

[22] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03193/bdl0002/doc0001

[23] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0005/doc0001

[24] Letter from Simon to Koopmans, 13 February 1950. Reiter's scheme was set forth in a Cowles Discussion paper circulating from April 14, 1950.
http://doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0008/doc0001

the decision-making process within organization" through the introduction of servomechanical theory : "At the moment, Simon argues, this seems to me the most fruitful approach to the intra–organization division making process."[25]

The applicability of servomechanism models to the theory of the firm was first discussed at the Cowles Commission in 1949 by William Cooper – Simon's colleague at Carnegie Institute of Technology. To show the interest of that approach, Cooper explained, consider a person controlling a machine producing a single product (call it an operator) who would decide to increase production when the actual cost is below a standard cost, and to decrease it otherwise. Put in mathematical form, the decision of production of the operator can easily be expressed with the help of a dynamical system whose solution will tell if production will stabilize or constantly deviate from its stationary level. What happens now if the operator is in charge of the control of multiple machines, each connected to each other? For each machine, a specific adjustment process will again have to be specified. But, with reference to Lloyd Metzler's, Oskar Lange's and Paul Samuelson's works, Cooper argued, the risk is high of making the analysis of the whole production an unsolvable problem. So, "despite the powerfully suggestive analogies of this theory for administration and economics, and despite the recent extension of this theory in the new discipline of cybernetics developed by Professor Wiener, much work must be undertaken before it can be applied to business firm theory in fruitful form" (Cooper, 1949: 28).

It is with the will to meet that challenge that Simon decided to work on servomechanism theory and its possible applications to the analysis of decision-making procedures in organizations which was the object of a third Cowles Discussion Paper entitled an "exploration into the use of servomechanism."[26] Suppose, Simon says to Koopmans, "that the person making the decision as to the rate of production in a plant has given information about (a) new orders and (b) inventories of finished product. What kind of decision rule will make sure that orders are filled promptly and that inventories do not accumulate?" Following the terminology of engineers familiar with closed loop control systems, orders can be called 'inputs', manufacturing rate 'output', and inventories 'error–rates'. "We can then study the behavior of the system under different inputs with various feed–back arrangements (i.e., decision rules)."[27]

[25] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0008/doc0001

[26] The paper completed during August was discussed on December 15th and 16th, 1950.

[27] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0008/doc0001

As he pointed out in the conclusion of his 1952 *Econometrica* article (Simon, 1952b), one of the merits of this analogical approach was to permit a high degree of precision. Thus, even though these theories were still in their infancy, he believed they could allow for the definition of specific decision rules that could prove to be much more implementable, albeit completely mechanical, than those derived from models based on "conscious" optimization. A first tension, between Simon and Koopmans, on the very way of defining optimization is at work here. In a summary on the RAND Project for the period August 1st, 1950 to February 1st, 1951 Simon let Hurwicz know that he planned "further development of the servomechanism model, and its application to a wider range of situation; and for the development of models incorporating others of the psychological and sociological phenomena present in administrative decision–analysis situation" (Simon to Hurwicz, January 22, 1951[28]). It is this line of research that Simon was following with Cooper, Rosenblatt, and others at Carnegie Mellon.[29]

Simon's three models (1951b, 1952a, 1952b) were reviewed in the Cowles Annual report entitled "Rational Decision-Making and Economic Behavior", which was built in the context of the launching of a joint research program between the Cowles Commission and the RAND Corporation on "Decision-Making under uncertainty" (Cowles 1950–51: 6). Simon's works were presented under the heading "rational behavior" which were in contrast to works presented under the heading "actual behavior". However, Simon himself, as Marschak, considered at this time that his works directly contributed to a better understanding of actual behaviors within organizations.

4. Simon's clarification on his own modeling strategy (1951–1952)

On June 12th, 1951, Simon[30] informed the sociologist Paul Lazarsfeld of his wish to be associated to his book on *Mathematical Thinking in the Social Sciences*. At that occasion Simon decided to provide some "considerations" about the "canon of strategy" that have guided his current research so far. These three aforementioned canons were summarized as follows. First, concepts

[28]http://iiif.library.cmu.edu/file/Simon_box00041_fld03223_bdl0002_doc0002/Simon_box00041_fld03223_bdl0002_doc0002.pdf

[29] This work was later on pursued at Carnegie Mellon in collaboration with Franco Modigliani he met at the Cowles Commission in the late 1940s, Charles Holt and John Muth (see Holt & al. 1955). The fourth then published in 1960 a book on planning production (Holt & al. 1960).

[30] doi.library.cmu.edu/10.1184/pmc/simon/box00087/fld07031/bdl0001/doc0001.

The book was finally published in 1954.

and postulates of administrative theory shall be translated in mathematical terms. Second, they shall not be incorporated in one mathematical model but in a "number of partial models". Third, rational models shall be amended to address the most significant "boundaries to the area of rationality" in human behavior (Simon 1954: 390–394).

In models of optimization, Simon argues, two major types of boundaries of rationality require to be taken into account. The first is related to the fact that individuals have incomplete information about human conditions. The second is related to uncertainty and to the fact that individuals have incomplete information on non–human conditions. Boundaries of the first type materialize in economic theories of perfect and imperfect competitions. In both cases, Simon argues, individuals are assumed to have an insignificant effect on the price level they all take as given. For that reason, the maximization rule can be applied. But maximization is possible only because the economists postulate that agents take as given the patterns of behavior of the other individuals. Simon was obviously aware that such a simple view of maximization could be abandoned in favor of the game–theoretic approach developed by von Neumann and Morgenstern. Yet, Simon argued that this implies a redefinition of the very notion of rationality and requires to attribute to human beings a "cleverness" they seldom exhibit. In other words, Simon stressed the difference between what is now called parametric rationality and strategic rationality. Simon believed that economists' traditional models of maximization proved to be more useful for approximate "actual rational behavior", game theory being better suited for investigating "optimal behaviors" (1954: 396).

In addition, Simon lamented the static character of the traditional definition of rationality (1954: 398). Assuming that the adjustment toward an optimal equilibrium could be gradual, he explained that a new notion of rationality may be identified. It concerns "the ability of the individual to distinguish 'better' from 'worse' directions of change in his behavior and to adjust continually in the direction of the 'better'". On this basis, Simon sketched the distinction between models of optimizing behavior and models of adaptive behavior.[31] "A rational process in which the choice of a 'best' is central we will call optimization; a rational process in which movement toward a 'better' is central we will call adaptation" (1954, 398). These two species of rationality are not necessarily mutually exclusive. Drawing on servomechanism analogy, Simon argues that we can in fact imagine systems "possessing a stable equilibrium position toward which the system

[31] The fact Simon speaks about "optimizing" rather than "optimal behavior" is rather meaningful, since he deals with a "dynamic definition of rationality" (1954: 397).

continually moves" but "without postulating an optimizing mechanism", that is to say without postulating conscious deliberation or calculus explaining the process of adaptation (1954: 399). Here, Simon proposes a first meaning to the concept of adaptation. But contrary to his future conception, it is still embedded in the economists' vision in terms of convergence toward an optimum.

According to Simon's second and third canons of strategy, the production of realistic models shall not be based on a unique mathematical model - such as the axiomatic of rational choice - but on a plurality of mathematical models. Simon manifests optimism, arguing that "once we have learned to imbed particular pieces of social reality in particular pieces of theoretical models, the interconnection among these will begin to suggest themselves" (1954: 391)[32]. He highlighted the heuristic power of mathematics, arguing that "by translating from the specialized concepts of the several social sciences to the common language of mathematics unsuspected relationships will be discovered among theories that have been developed independently in these several sciences." (our emphasis) (1954, 390). To illustrate this point, Simon refers to his formalization of organization theory and the possibility to design a model encompassing the optimizing model of the theory of the firm. Simon's plea for a plurality of models was based on the conviction that it may be possible to eventually reunify, or at least interconnect, some models from the diverse social sciences thanks to mathematics as a language.[33]

In his June 1951 letter to Lazarsfeld[34], Simon enclosed a first draft that Marschak, who was also involved in the edition of the book, should have read. On October 9th, Marschak told Simon that he "enormously enjoyed" his paper and thought it was "a very appropriate subject for the

[32] The second part of the paper was entitled "Models of adaptive behavior" and was based on a presentation of several attempts that have been made to translate theories of psychology and sociology in mathematical forms. The first model deals with the way an individual adapts his or her motivation to the level of difficulty of the task he or she has to perform. It echoes Simon's future analysis of the revision of aspirations (1955). The second one concerned George Homans' analysis of interactions in *The Human Groups* (1950). Simon's aim is first to demonstrate that the translation of verbal models into mathematical language is possible and second to show that they "can be employed to clarify the similarities and differences among theories and to draw new conclusions, by mathematical means, from the postulates" (*Ibid*: 413). In other words, he emphasizes the heuristic power of mathematical thinking.

[33] "I will simply assert, with J. Willard Gibbs, that mathematics is a language; it is a language that sometimes makes things clearer to me than do other languages, and that sometimes helps me discover things that I have been unable to discover with the use of other languages." (Simon 1954: 388).

[34] doi.library.cmu.edu/10.1184/pmc/simon/box00087/fld07031/bdl0001/doc0001.
The book was finally published in 1954.

[Cowles'] Seminar" planned on November 15th, 1951.[35] Marschak suggested that Simon should present the first part, which he viewed as a "discussion of a gradual relaxation of the rationality principle", at the Staff Meeting, that is to say between Cowles' members only.[36] In the activity report addressed to Koopmans in May 1952, Simon insisted on "the common denominator" of all his previous works since *Administrative Behavior* which, in his view, derived from his decision to produce "fundamental knowledge about human behavior in organization". But if he argued, contrary to Koopmans, that the emphasis should above all be put "upon actual rather than optimal behavior", he assumed that the analysis of both types of behavior were compatible. It turns out that in developing his "behavioral model of rational choice", Simon eventually broke with that line which indicates that that his model was not a straight formalization of the insights of *Administrative Behavior* but rather an attempt to step outside a framework that Simon had himself contributed to explore.

5. Breaking new grounds in the field of decision theory (1952–1955)

In 1952, Simon received an invitation from the RAND to spend the summer at Santa Monica to which he answered favorably.[37] Marschak, also associated with both the Cowles Commission and the RAND, wrote to him to schedule meetings there.[38] Simon put great hope on the fact that "this should give a good opportunity for all three of us [with Koopmans] to work together".[39] A letter from Simon to Marschak from November 11th, 1952, attested that they all met up in California.[40] Simon undertook many activities during this RAND summer, which proved to be

[35] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0005/doc0001

[36] Letter from Marschak to Simon, 15th October, 1951,
doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0006/doc0001.

[37] A year earlier, he had to decline a first invitation because of an "awful lot of things on the agenda" concerning Carnegie School. See Letter from Simon to Merill Flood, May 3rd, 1950.
doi.library.cmu.edu/10.1184/pmc/simon/box00005/fld00367/bdl0001/doc0004

[38] Letter from Marschak to Simon, May 2nd, 1952.
doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0007/doc0001

[39] Letter from Simon to Marschak, May 9th, 1952.
doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0007/doc0002

[40] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0008/doc0001

critical for understanding his later works, some going far beyond the scope of our statements.[41] His 1955 model "A Behavioral model to Rational Choice" was written during this summer, published first as a RAND paper and then three years later in the *Quarterly Journal of Economics* (Simon [1953] 1955). Yet, one better understands it in relation to what Simon undertook before 1952 within the Cowles Commission.

The report that Simon sent to Hurwicz provides insights into the context governing the writing of this manuscript.[42] In September 1950, at a meeting of the Econometric Society, Simon discussed a paper by von Neumann who warned against the man-machine analogy (Sent 2000: 394). Later on, during the summer 1952 at Santa-Monica, von Neumann gave a talk "emphasizing the difficult problem that had to be solved in order to program a computer to play good chess" (Simon 1996: 166). Von Neumann was well aware of the incredible computational time required by a computer to determine the best chess strategy. The problem, Simon thought, was however "overestimated" by the reference to an optimal solution (1996: 166). Taking over arguments introduced in his entry to the Lazarsfeld volume, he claimed that one could build a model based on the searching of a good strategy (model of adaptation) rather than on the searching of the best (model of optimization).[43] In October 1952, Simon told Charles Hitch, who operated as director of the RAND Economics Division, that he had finished the revision of the manuscript in view of its publication.[44] It was published on January 20th, 1953.[45] The model it contained was presented as

[41] Simon worked as a consultant for the Research System Laboratory on the simulation of an aerial defense center and published in this regard another RAND manuscript: "Observations and comments on the organization studies of the Systems Research Laboratory". It paved the way to his close relationship with Allan Newell and their future work on computer simulation and artificial intelligence. See Simon (1996), Sent (2000), Mirowski (2002), Crowther–Heyck (2005), Klein (2016).

[42] Simon to Hurwicz, 22 January 1951, report for the activities on the RAND project. http://iiif.library.cmu.edu/file/Simon_box00041_fld03223_bdl0002_doc0002/Simon_box00041_fld03223_bdl0002_doc0002.pdf

[43] See Simon "Rational Chess Strategy", Appendix B, May 12, 1953, doi.library.cmu.edu/10.1184/pmc/simon/box00016/fld01122/bdl0001/doc0001

[44] Letter from Simon to Hitch, October 6, 1952, doi.library.cmu.edu/10.1184/pmc/simon/box00005/fld00367/bdl0010/doc0001

[45] Herbert Simon, "A Behavioral Model of Rational Choice", RAND Paper P-365, January 20th, 1953, doi.library.cmu.edu/10.1184/pmc/simon/box00006/fld00391/bdl0001/doc0001 : 1.

"the description of a rational choice by organisms of limited computational ability".[46] If the published version in the *Quarterly Journal of Economics* contained only few references to the problem of programming a computer to play chess, the simplifications advocated by Simon to model rationality were already developed in the 1953 RAND version.

The objective displayed by Simon in this text was "to replace the global rationality of economic man" (Simon, 1955: 99) by a more realistic representation of actual behavior of an individual of limited knowledge and ability. The term actual, which plays an important role in structuring Cowles Commission reports, was used several times by Simon. While the "empirical propositions" modeled in his previous articles were based on analyzes of administrative science, in particular those of Barnard (Simon 1951b, 1952a), Simon starts here from the "introspective evidence" to suggest that actual behavior differs from the "global rationality of economic man" (1955: 99). This also contrasts with Cowles Commission reports which explicitly excluded introspection in the same way as all non–quantitative methods. The terms limitations, limited and limited rationality are this time used by Simon to define the "access to information and the computational capacities" of organisms (1955: 99), rather than to express the bound of the domain of validity of rational choice theory (Simon 1954). And they appear mainly in passages added between the first RAND version and the published version (1955: 102, 112-114).

Hinging on the survey offered by Arrow (1951b), Simon begins his argument by presenting the three variants of the "classical concepts of rationality" (1955: 103). The first is the "Max–min rule"; the second the "Probabilistic Rule" (expected utility theory with objective probability); and the third the "Certainty Rule". These variants share common hypotheses which Simon suggests to modify for introducing both more realism and simplicity (1955: 106). The first modification is a simplification of the pay–off (or utility) function now based on the assumption that only a limited number of values are taken into account by the choosing organism. For instance, these values are "satisfactory or unsatisfactory" or "win, draw or lose" for the chess player. On that basis, Simon defines a new decision rule implying two steps. The first step consists in searching "for a set of possible outcomes such that the pay–off is satisfactory for all these possible outcomes" (1955: 106), which Simon calls a satisficing set. The second involves searching for an option belonging to this satisficing set. The second modification introduces an information-gathering step, which is required to guarantee the uniqueness of the solution of the decision procedure. Simon assumed

[46] The word "organism" is purposely used by Simon because the model can be applied to an individual as well as a group or an organization.

that "alternatives are examined sequentially" (1955: 110). It is an alternative to the assumption that the mapping of the set of alternatives of choice is perfectly known in advance. Simon illustrates these first two modifications with the chess game. This way, the computer, like the chess player, no longer aims for the "best move", which requires complete information and heroic computational abilities, but for a "good move" (1955: 108).

The third modification introduces a simplified pay–off function in order to give up the assumption of a complete ordering of the pay–offs. This leads Simon to define a last decision process, which can be interpreted as an adaptation of the previous one to this simplified pay–off function. The redefinition of the satisfactory pay–off proposed here corresponds in some cases to an "aspiration level concept" – which may change with the ease or difficulty in discovering satisfactory alternatives. In other cases, when a decision involves two or more organisms, it corresponds to what Simon labeled a viable solution in his previous models on the "non-identity of interests" (1951b; 1952a). Even though Simon keeps one of the main ideas of his previous models, he can now do without, and even against, the assumptions of rational utility-maximizing behavior incorporated in the framework of neoclassical economics. The next step allowed by this alternative conception of rationality, which is beyond the scope of our argument, would consist in giving up this type of modeling to favor computer programming (Newell and Simon 1956b).

Simon displayed a clear will to discuss his model with Cowles' members. In a letter from March 1953, he recalled to Koopmans that he had still not received "[his] comments and reactions" on his manuscript.[47] In his answer, Koopmans made no allusion to Simon's request.[48] This reaction is an unequivocal sign of neglect toward Simon's strategy to model rational choice. A month later, Simon addressed Marschak a Progress Report on the "Research on Decision Making under uncertainty" he undertook under the Cowles Commission contract.[49] A part of it is devoted to his RAND manuscript. He explains that the central idea is to assume a flat payoff function, that allows to think in terms of "a dichotomy between 'satisfactory' and 'unsatisfactory' payoff". He stressed that this modelization "drastically" simplified the "discovering of an optimal strategy". This is the first simplification of his 1955 model. Simon stressed that his perspective put the very definition

[47] Letter from Simon to Koopmans, March 9th, 1953, doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0033/doc0001.

[48] Letter from Koopmans to Simon, March 11th, 1953, doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03185/bdl0033/doc0002.

[49] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0013/doc0001

of optimality at stake. He writes that "rules for optimal decision making, if they are to be of any real use, must be 'optimal' in relation to the information possessed by the decision maker and the size of the computational problems he can handle." To defend his modeling strategy, he illustrates it by applying it to chess computer programming: "The number of alternatives that needs to be examined in an eight move combination is reduced from about 10^{10} to 10^{2}" (Simon to Marschak; April, 11 1953).[50]

As they were planning to spend part of their 1953 summer together in Santa Monica, Simon repeated to Marschak, in a letter sent in June, that he hoped to discuss "the general lines of development" he followed.[51] He regrets the lack of enthusiasm shown by the Cowles' members during the last months. He confesses that he has valued "the opportunities [the Cowles Commission] has provided for interchange of ideas" but feels "that the communications lines have been somewhat weak during the past year."One can note that in his last report to the Cowles Commission, Simon somewhat modifies the presentation of his research. Rather than suggesting a redefinition of rationality, he describes it as a "work in the description of decision rules that are 'approximately rational', in the sense of taking account of the computing and other limitations of the decision–maker".[52] But he then put forward again the dichotomy between "optimal" and "feasible" behavior, which was implicitly present in his May 1952 report to Koopmans. In the version published in the *Quarterly Journal of Economics*, Simon argued that such a distinction echoes the distinction used in the practice of linear programming between "computations to determine the feasibility of a program" and "computations to discover the optimal program" (1955, 108).[53] It is based on a shift from the traditional assumption of complete pre-ordering and complete information, which is involved by the simplifications introduced in his 1955 model.[54]

[50] See also Simon (1955, 107). The compatibility of Simon's theory of bounded rationality with the concept of optimization has been discussed by Mongin (1984, 1986) and Quinet (1994).

[51] doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03186/bdl0015/doc0002

[52] Herbert Simon, "Report of Activities, July 1st, 1952 to June 30th, 1954", 12th May 1954.

[53] The words "feasible" and "feasibility" used by Simon echoes the distinction made by Kuznets, in another context, namely his work on allocation of resources for the War Industry Board during World War Two, between "feasibility under ideal condition" and "realistic maximum feasibility". See Lacey (2011).

[54] He wrote in the manuscript that "in most global models of rational choice, all alternatives are evaluated before choice is made. In actual decision-making alternatives are often examined sequentially" (Simon 1953, 12).

"As examples of the kinds of limitations on rationality that are incorporated in these models, the following may be mentioned: it is assumed that the decision-maker is searching not for 'optimal' but for 'satisfactory' choices; the total set of alternatives open to the decision maker is not assumed to be known in advance. These models are shown to correspond in important respects to known characteristics of human and animal choice processes." [55]

The Cowles Commission report of 1952-54 for which Simon wrote was the last one written by Koopmans since the agency would then move to Yale under the direction of James Tobin. In that report, the classification system has radically changed. Simon's RAND manuscript appears with Simon (1952a) under the rubric "Theory of Organization" (Cowles 1952–54: 28). The absence in Simon's archives of any further correspondence with Koopmans after August 1953 and the end of his collaboration with the Cowles Commission testify to the fact that this channel of communication has been closed. The fact that Cowles' economists ignored Simon's alternative strategy, which departed from their way of modeling and thus defining rationality and optimality, is confirmed by three facts. First, none of the persons he mentions in his acknowledgements of the published version of "A Behavioral model of Rational Choice" in *The Quarterly Journal of Economics* belongs to the Cowles Commission, confirming that he failed to truly discuss his model with them.[56] This failure might participate in the explanation of Simon's later trajectory. He immediately engaged in a deep intellectual relationship with new colleagues at RAND, especially Allan Newell and Clive Shaw. The logic underlying Simon's modeling strategy by taking into account the limited capabilities of the organism would be at the core of their common attempts to program a computer to solve problems. Second, Simon argues that he came to realize at that period, through a discussion with Koopmans, that his conception of mathematics was different from those of other members of the Cowles.

> "While we were both committed to 'hardening' the social sciences with the help of mathematics, mathematics meant something entirely different to Tjalling than it did to me. […] For me, mathematics has always been a language of thought [...] my language of discovery. It is the tool I use to arrive at new ideas. This kind of mathematics is relatively unrigorous, loose, heuristic. Solutions reached with its heir have to be checked for correctness. It is physicists' mathematics or engineers' mathematics rather than mathematicians' mathematics. For

[55] Herbert Simon, "Report of Activities, July 1, 1952 to June 30, 1954", 12 May 1954, doi.library.cmu.edu/10.1184/pmc/simon/box00041/fld03223/bdl0007/doc0002

[56] Gerald Thompson was a mathematician who worked on modeling von Neumann general equilibrium growing economies. Norman Dalkey is a game theorist of the RAND. Herbert Bohnert is a logician. For lack of accurate information, we have not identified Robert Wolfson.

> Tjalling Koopmans, it appeared, mathematics was a language of proof. It was a safeguard to guarantee that conclusions were correct, that they could be derived rigorously. Rigor was essential. (I have heard the same views, in even more extreme form, expressed by Gerard Debreu; and Kenneth Arrow seems mainly to share them.) […] It is his view, of course, that prevails in economics today" (Simon 1996: 106–107)."

This recognition of difference regarding their utilization of mathematics appears very late, all the more belated that Simon dates it to back 1953 in his autobiography while referring to an event that took place in October 1955. But it is further evidence that Simon truly believed he could bend the direction taken by the explorations of Cowles economists in modeling rationality. Mirowski and Weintraub (1994) have highlighted the importance of the Bourbakist stance of Cowles' mathematical economists. Such a conception of mathematics as an "autonomous abstract subject" directly runs counter to Simon's conception of it as a heuristic language[57] . One of the origins of this difference might lie in the fact that Simon was trained in mathematics by students of Griffith Evans (see supra Section 2), whose opposition to Bourbakism has been documented by Weintraub (2002). Such a difference did not prevent dialogue. For instance, Simon was praised by Arrow (1951a), in the preface of Social Choice and Values, for helping him to develop "the economic implications of the mathematical results" he reached. However, this is one reason it explains why Simon thought one must begin with the study of actual behavior while Koopmans thought that theory should come first, and consequently why Simon did not provide an axiomatization of his theory of rationality - an urgent task according to Mongin (1984: 23, 59) while not compatible with Simon's plea for a plurality of interconnected models.

Thirdly, Koopmans published in 1957 his famous book on Three essays on the state of economic science. At that occasion, he made only one reference to Simon (1955) and presents this model as "an exploratory discussion of limitations to the decision-making process" which does not "endow the decision makers with analytical and computational abilities and assume them to have information-gathering opportunities such as are unlikely to exist or to be applied in current practice" (1957: 141). Unsurprisingly, this mention appears after Koopmans' criticism of Friedman's instrumentalism and a discussion of the assumption of profit maximization. Koopmans argued that we should "look upon economic theory as a sequence of conceptual models that seek to express in simplified form different aspects of an always more complicated

[57] "The predominant view in American mathematical circles was the same as Bourbaki's: mathematics is an autonomous abstract subject, with no need of any input from the real world, with its own criteria of depth and beauty, and with an internal compass for guiding future growth" (Lax, quoted in Weintraub 2002: 102)

reality" (1957: 140-142). Such an affirmation echoed Simon's plea for a plurality of models. Nevertheless, Koopmans's difference with Simon appears onto the next page, when he states that "we are concerned with the prior question of [models'] logical truth and clarity", even if "perception of additional aspects of reality must necessarily precede the recognition in model formulation" (Koopmans 1957: 143). Koopmans's stance appears consistent with the one he already took at the end of the forties during "the measurement without theory controversy" (Mirowski 1989). If Simon had paid more attention to this latter, he might not have placed so much hope in his ability to bend the research agenda of his fellow Cowles economist.

6. Conclusion

At the occasion of the last edition of *Administrative Behavior*, Simon wrote that this book "has served [him] as a useful and reliable port of embarkation for voyages of discovery into human decision-making: the relation of organization structure to decision-making, the formalized decision-making of operations research and management science, and in more recent years, the thinking and problem-solving activities of individual human beings" (Simon [1947] 1997, viii). This paper has attempted to clarify the different steps he went through when he was at the Cowles Commission. It has been shown that Simon followed three main lines of research he finally abandoned when he came to develop in 1952 his "behavioral model of rational choice". On the basis of various archives materials, it was in particular possible to highlight how consistent these different models were and to emphasize how close Simon was with economists like Marschak or Hurwicz and other members of the Cowles Commission. It seems that Simon for a brief time was willing to build a unique framework allowing to naviguate from economic theory to administrative theory. This certainly explains why he decided to stick to economic issues and to leave unaddressed parts of the ideas like the role of individual habits and organizational routines that were also present in his previous studies (Brette et al. 2017).

Simon repeatedly argued that his 1955 model came "closest to the mathematical format with which economists are comfortable" (Simon 1996: 165). Ironically, the reconstruction of his intellectual trajectory proved that it is in breaking with models of rational choice that he managed to craft his 1955 model. Clearly, this did not escape to Simon's colleagues at the Cowles Commission who were reluctant to discuss it as they show growing interest in axiomatic theory. By a second irony of history, an economist like Stigler (1961) and others from game theory (Sent

2004) will see no contradiction in interpreting his model as a special case of optimization under constraints. Still today, the model is open to diverse and contradictory interpretations. We hope that this article, in tracing Simon's initial trajectory marked by his stay at the Cowles Commission, will contribute to arrive at a more balanced view on his achievements.

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