



Grokking Condorcet's 1785 Essai¹

Arnold B. Urken²

Résumé

“Grokking” un système veut dire développer une compréhension intuitive en trouvant les attributs structurels qui révèlent des aperçus généraux. Ce texte suit cette stratégie de comprendre l'Essai de 1785 de Condorcet par réexaminant les analyses de deux philosophes, Baker et Daston, et trois théoriciens de vote, Young, McLean, et Schofield. En utilisant des idées théoriques, tous ces analystes grokkent et éclairent la complexité des théories de Condorcet sur les sujets de vote, la probabilité, et les effets du design des systèmes sur les résultats collectifs. On discute les implications de ces analyses pour indiquer des idées nouvelles et des questions irrésolues.

Abstract

“Grokking” a system involves developing an intuitive understanding by identifying underlying structural attributes that reveal general insights. This paper explores this approach to understanding Condorcet's 1785 Essai by reviewing analyses of the Essai done by two philosophers, Baker and Daston, and three voting theorists, Young, McLean, and Schofield. All of these analysts rely on theoretical ideas to grok and clarify the complexity of Condorcet's theories about voting, probability, and the effects of system design on collective outcomes. The implications of these analyses are discussed to suggest new insights and unresolved questions.

1. Introduction

Condorcet's Essai sur l'application de l'analyse à la probabilité des décisions rendues à la pluralité des voix [Condorcet, 1785] (the “1785 Essai”), is one of the most frequently cited, least-read, and poorly-understood works in voting theory. Scholars seem to agree that the Essai is a classic that must be cited even though the broad scope of its argument and its 495 pages are not easily accessible to modern readers. So it is not surprising that the Marquis' ideas are sometimes developed without taking account of a precise or accurate contextual appreciation of his arguments. To remedy this situation, this paper reviews the Essai to draw attention to aspects of Condorcet's ideas that seem to have been overlooked or misunderstood.

¹ I would like to thank, Eric Brian, Iain McLean, Bernard Montjardet and Peyton Young for their comments on an earlier draft of this paper presented at the Colloque Condorcet, Paris, November, 2007.

² Stevens Institute of Technology, Castle Point on the Hudson, Hoboken, New Jersey 07030, aurken@stevens.edu

To introduce this review of the *Essai*, I have used the word “grok” to draw attention to the different ways in which the 1785 *Essai* deals with systems for processing information, a strikingly modern aspect of the work. “Grok” refers to the “grammatical representation of objective knowledge” that computer scientists use to describe the semantic and syntactical attributes of the systems used to construct sets of instructions that operate in computer systems. The semantics, the meaning of the signals used to communicate, and syntax, the rules for combining the elements of communication into coherent statements, provide a structural basis for a grammar, a system for generating different statements at a higher level of analysis.³

The core meaning of “grok” involves grasping the underlying structure of a system that goes beyond a purely descriptive understanding to internalize the organizational arrangement of subsystems. But grokking is not purely subjective. For example, an associative level of understanding enables a “grokker” to contribute to the evolution of a system by refining ideas, extending applications to take account of new details, or improving doctrine. So grokking systemic relationships in the UNIX operating system (structured around a “kernel”) makes it easier to develop software. Similarly, developing a way of representing (semantic) expressions and (syntax) communications across computer languages enables a developer to efficiently orchestrate programs across computer systems that make use of different programming languages.⁴

In voting systems, the semantics of allocating a vote can signify the expression of a preference or represent a judgment [Balinski and Laraki, 2007]. Individual communication of preferences and judgments is constrained by rules that determine how many votes can be allocated to communicate a preference or a judgment. Preferences can be based on single or multiple dimensional ratings and may indicate a point or an interval on a rating scale. Simple judgments—found in juries—usually involve a binary choice or a preference between two choices about which one is correct or optimal [Urken and Traflet, 1988] Whether a choice is viewed as a preference or judgment, binary choices can communicate rating information about entire sets of choices so that a single vote can be cast for one vote and zero votes allocated to all of the other choices. If the semantic rules of a voting system only allow the use of a single vote to express a preference, a voter whose preference for A and B were tied would be prevented from accurately articulating this information. In any voting system, once votes have been allocated, voting system syntax aggregates the information to produce a collective outcome, which provides a complete grammatical statement relating information about a set of voters to a group decision.

Before voting systems were studied mathematically in the 18th century French Academy of Sciences, theorists had discovered some of the properties of voting system semantics and syntax, but none of them formulated a general theoretical framework

³ In Scottish juries, however, a single vote can be cast for one of three verdict choices: guilty, not guilty or not proven. See Urken and Traflet, 1988.

⁴ The origin of “grok,” in Robert Heinlein’s 1939 novel, imaginatively predates all of these ideas.

within which cumulative knowledge about the voting grammar could grow. This way of looking at voting processes suggests that voting systems, like computers, take input data and process it through voting semantics and syntax to produce new information.

To highlight the place of Condorcet's 1785 *Essai* in the development of voting grammar, this review begins by characterizing Condorcet's theoretical framework as a "metaphysical research program" (MRP) [Popper, 1963]. This Popperian view serves as a basis for a means of relating historical interpretations of *Essai* contributed by grokkers in philosophy and voting theory. The first category includes perspectives from the work of Baker [1975, 1976, 1984] and Daston [1995] while the second category reveals insights from the analyses of Young [1988], McLean [2006], and Schofield [2006]. Although analyses of Condorcet's ideas by voting theorists such as Grofman [1978], Owen [Grofman and Owen, 1985] and Feld Grofman and Feld, 1988], List [2006], and philosophers such as Estlund [2007], and others have contributed significantly to our understanding of Condorcet's theories, the space limitations of this paper make it necessary to limit the discussion.

2. The Condorcet Metaphysical Research Program

Condorcet's analysis of voting processes gained its classic status because it established a grammar, a broad, logical framework for thinking about the act of voting as a collective choice process. Grokking the Marquis' "metaphysical research program" reveals his mathematical, hypothetico-deductive approach to theorizing about voting processes [Popper, 1963]. This Popperian conception of a theoretical framework is important because it considers "metaphysical" statements as part of the creative exercise of the imagination that occurs when our deductive and empirical knowledge does not explain what we want to know. Metaphysical statements, which literally refer to phenomena that cannot be immediately or directly observed, are far from being "meaningless." Rather, they provide an abstract means of organizing our conjectures into statements that can be tested and refined to demarcate the difference between conjecture and scientific knowledge. These tests subject theories to rigorous experiments that gauge the mettle of a theory by seeking to refute predictions deduced from the theory. When theories fail, we are presented with opportunities to improve our models by explicating experimental results to build models that yield better predictions. The goal of such theorizing is not epistemological certainty, but the growth of knowledge that is derived from exercising our imagination and creativity to create new conjectures to develop better theories. In Popperian terms, if we learn from our mistakes before making irreversible errors, mankind can survive and progress.⁵

Condorcet's theoretical framework is Popperian and fundamentally optimistic about the growth of knowledge in general and social mathematics, including voting systems. Condorcet realizes that humans are fallible, but seeks to build theoretical systems of voting that minimize error while producing collective outcomes that maximize the probability of producing a correct collective choice. He also seeks to minimize the

probability of producing no plurality winner, a necessary, but not sufficient condition for maximizing group competence and minimizing collective incompetence.

It is remarkable that Condorcet develops what a modern systems theorist would recognize as a multi-objective decision making framework, explicitly presented in the Preliminary Discourse and the main body of the *Essai*. Yet this approach to regulating a complex decision system—only partially developed in the *Essai*—has not received much attention from analysts of Condorcet’s theory, whether they grok the *Essai* philosophically or vote-theoretically. Nevertheless, since the *Essai* is a complex work, the ideas of philosophical and vote-theoretic grokkers are valuable because they direct our attention to dimensions of Condorcet’s ideas that might otherwise elude us. Unfortunately, there is still no English or bilingual edition of the *Essai* to make it easier for modern analysts to make use of these potential Condorcetian intellectual take-off points in their own theoretical and empirical work.

3. Baker’s Perspective

Keith Baker’s work on Condorcet’s theories explicates enlightenment cognitive political logic that has been missed by later “social choice” theorists who, with significant exceptions, have treated Condorcet as a voting theorist seeking to maximize collective voter utility. For these modern utilitarians, Condorcet is famous for discovering that majority rule does not always produce a transitive collective preference, something that Kenneth Arrow independently discovered as a “paradox” approximately some 170 years later, axiomatized in his famous impossibility theorem, and, in part, won him a Nobel prize. As Baker explains [2], Condorcet was interested in preference intransitivity only in so far as it prevented a collective choice process from producing a “correct” collective choice. For Condorcet, it was rational for an individual to accept state authority only if the individual’s competence was less than probability of correctness of the collective judgment of the community. For this reason, throughout the 1785 *Essai*, Condorcet repeatedly says that v , the competence or enlightenment of decision makers is more important than any other structural factor in voting processes.

Baker’s analysis reminds us that although Condorcet discovered collective intransitivity, he considered it to be an “effect,” not a paradox, as scholars such as Guilbaud and Granger had pointed out [13,14]. Moreover, Arrow—not Condorcet— invented the term “social choice” which has become standard terminology for social scientists, mathematicians, and others interested in voting theory. It is worth noting, however, that although Baker’s translation of Preliminary Discourse (PD) of the 1785 *Essai* [3] introduces students to the broad scope of Condorcet’s work, it is—for marketing reasons—selective in describing the contextual significance Condorcet’s argument. Baker does not translate the entire PD and clearly indicates which sections he has redacted out of his translation. On pages 50 and 52, for example, Baker summarizes parts of the redacted line of reasoning that are not necessary to read in verbose form to follow the logic of Condorcet’s mathematical argument. Similarly, on page 57, Baker explicitly redacts part of the beginning of Marquis’s summary of Part III, where Condorcet analyzes the problem of determining the degree of assurance of the truth of a

decision that will be sufficient to oblige acceptance of the collective decision by those “who have not directly participated in making it.” Again, at the beginning of Condorcet’s summary of Part V, in which the Marquis addresses the problem of “numerous” assemblies, Baker explicitly removes introductory text that frames the argument. Then Baker redacts—without comment—the entire 28 pages of the Marquis’s summary of Part IV, where Condorcet discusses ways of taking account of ‘considerations’ that must be part of any attempt to apply his model and obtain precise results. This discussion addresses the following questions:

- How to take account of situations in which a set of voters has different probabilities of making a correct choice for different decisions
- How, in a single decision, to model differences in voter probabilities of making a correct choice
- How assembly members can influence each other’s votes
- How to evaluate the influence of bad faith on collective judgments
- How to deal with cases in which assembly rules require a unanimous vote
- How to deal with the practice of treating the plurality vote of a set of voters related by kinship as if it were one vote.⁶

Given that Baker’s PD translation is part of a set of introductory Condorcet writings selected for students, his decision to redact these sections seems reasonable. Indeed, Baker focused on the non-technical aspects of the *Essai*, leaving the mathematical analysis to voting theorists (like Black [1958])⁷. even though he criticizes modern social choice theorists for being out of touch with Condorcet’s perspective [Baker, 1984]. Nevertheless, some of these redactions, particularly Condorcet’s entire summary of Part IV, unintentionally prevent us from grokking more deeply. For example, Part IV includes some interesting and challenging ideas about how to pursue the multi-objective decision making goal that motivates the *Essai*. These ideas demonstrate an imaginative combination of speculative and applied argumentation that forces us to think differently about the science of designing institutions for making collective decisions. Moreover, the PD summary of Part IV helps counteract the familiar stereotype of Condorcet as an impractical dreamer⁸ rather than as a scientist who tried to understand social processes to design systems that would work.

Indeed, throughout the *Essai*, Condorcet talks about experiments and applications, but avoids talking about experimental design because he says that the experience could be embarrassing for voting and non-voting members of selected organizations. So the goal of the *Essai* is to rough out (*ébaucher*) a framework for empirical research that can be done by others. Condorcet’s conception of experiments seems predicated on the development of counterintuitive predictions deduced from a theory rather than what he called *physicaille*, or trivial experiments based on induction.⁹ But Condorcet realized that non-mathematical and mathematical readers, alike, needed to

⁶ Condorcet, 1785, *cxviiij*.

⁷ See Baker, 1976, 238-40, which replicates Black.

⁸ This characterization can be found in Sabine, 1961.

⁹ Condorcet attacks Borda for this in a letter to Turgot, quoted by McLean and Urken, 1995, p. 25.

be motivated to consider the implications of the predominantly mathematical argumentation of the 304 pages of the main body of the Essai. For this reason, he wrote a 191-page Preliminary Discourse, an extraordinary introduction, to raise interest in and awareness of the issues. Quite humbly, he says that the mathematical analysis is not so novel.¹⁰

Baker's grokking of the Essai helps us understand the complexity and subtlety of the semantics in Condorcet's voting grammar. For Condorcet, the act of voting communicates information about preferences or judgments—or both. Voters can prefer one jury verdict alternative to another. Voter behavior can also be modeled so that preferences are a random variable in a voting process and the logic of the voting grammar maps voter competence, an independent variable, to the dependent variable, the probability that the group renders a correct collective choice.

4. Daston's Point of View

If Baker's work teaches us about logical misconceptions of the Essai's voting semantics, Daston [8]. helps us understand the intellectual and cultural complexity of the conception of probability that underlies the semantics and syntax in Condorcet's voting grammar. Daston, like Baker, does not explore the detailed mechanics of voting processes presented in the Essai. While Daston does not analyze the development of social mathematics in the Essai, she links the Essai as a thematic work to the literature on the probability of witnesses,¹¹ a subject that died out after Condorcet's death, when the center of scientific work in the generalist culture of the French Academy of Sciences (FAS) was replaced by the Institute of France, where disciplinary specialization—already growing before the Revolution—thrived and scholarly research that had not put down roots in research groups outside the FAS before the Revolution did not grow under the auspices of the Institute of France [7].¹²

While Baker concentrates on the Essai's PD, Daston briefly describes how the major parts of the main body of the Essai are connected to the classic theory of probability in the 18th century and briefly describes Condorcet's *analyse* of the relationships among v , the probability of making a true decision, e , the probability of making a false decision, n , the number of voters, m , the plurality rule, and the probability of making a correct choice. It is these aspects of the Essai that fit the academic conception of *analyse* which explores mathematical systems to determine if and how changes in certain factors are related to other factors in a model.

Daston's work teaches us about intricacies of the concept of probability underlying the mathematical models Condorcet's Essai. Daston unravels complications

¹⁰ It is remarkable that there are only 12 errors in mathematical notation in the entire work.

¹¹ Nicolas Collin, a member of the American Philosophical Society (APS) in the early 1800's, completed a dissertation in Sweden on probability theory that continued this tradition. Collin gave a talk about the 1785 Essai to the APS in 1826. See [Urken and McLean, 2007].

¹² See Crosland, 2002, for a discussion of the growth of science in the Institute of France.

associated with shifts between theoretical and naturalistic conceptions of probability [23]. In this regard, the Marquis himself admits that

Almost all of the results [of the *Essai*] will be found to conform to that which the simplest reason would have dictated; but it is so easy to obscure reason by sophistry and vain subtleties that I thought myself fortunate to have been able to support [even] a single useful truth with the authority of a mathematical demonstration.¹³

Daston's analysis of Condorcet's ideas considers both the PD and the main body of the *Essai*, which consists of an exploration of eleven *hypotheses* (hypothetical situations)—not proofs—followed by a consideration of problems and questions. While Daston does not explore the implications of the vote-theoretic logic of the *Essai*, her account of the difficulties with the classical concept of probability highlights the challenges that Condorcet faced in presenting his mathematical models in the French Academy of Sciences (FAS), as well as outside of this context, where Condorcet applies the 1785 mathematical argument in the context of post-Revolutionary politics.

In Daston's view, the ambivalence created by shifts between theoretical and naturalistic argumentation, endemic in the classical theory of probability, created a sense of uncertainty that hindered the development of applications of probability in scientific work. In the FAS, itself, members addressed the problem of choosing voting systems to elect new members and promote existing members. The problem was complicated by the fact that although scientists could make their own rules, the context of the discussion included a subtextual ideological conflict between modernists (such as Condorcet) who wanted to use science to reform France's constitutional structure and traditionalists (such as Borda) who supported regal absolutism. Since 1699, when the Academy first touched on voting syntax, [27] the problem of producing a majority consensus, it appointed commissions to study the system, a practice that Condorcet advocates in the *Essai* to draw on the benefits of "enlightened" opinion. By the time that Condorcet became Secretary, the FAS normally voted to produce a set of ranked recommendations for new members that was sent to the King. However the King was not necessarily bound by the ranked recommendations. Occasionally, the King would not choose the members' most preferred choice or even select someone who was not on the list of recommended candidates [21].

In 1770, Borda presented a paper showing that plurality voting, the existing Académie voting system, might not select the strongest choice. His example shows that plurality voting could produce a winner who would not have won in pairwise contests against every other candidate. Although the 1785 mentions Borda's work—though not by name—and discusses it very briefly, the Marquis does not refer to Borda's paper or the broader organizational context and significance of Borda's critique. This treatment stands out given the trend toward peer review of publications in the French Academy of Sciences (FAS). According to McClellan [16], by 1785, the FAS Comité de Librairie

¹³ Condorcet, 1785, ii.

had established Publication Commissions that articulated and upheld principles for recognizing priority in scientific work, though citing prior research was still not necessarily the norm when Condorcet served as Secretary and published the *Essai*. Acknowledgments were not automatic and the Comité de Librairie became involved in resolving disputes privately to avoid institutional embarrassment.

That said, it is interesting that Condorcet and Borda both used what is now known as the “Condorcet criterion” in evaluating the collective outcome of a voting system. While this criterion is a “natural” algorithm that was not in any sense “owned” by Borda, it seems disingenuous of Condorcet not to have acknowledged its use by a colleague, particularly if he wanted to encourage awareness of voting problems among mathematical and non-mathematical colleagues. (Perhaps Borda enthusiasts would argue that the convention of attributing the pairwise scoring method to Condorcet rather than Borda should be reexamined.)

This impression is reinforced by the fact Condorcet, as Secretary of the Academy, had a potential role to play in the fourteen-year delay in publishing Borda’s paper. Condorcet had little personal regard for Borda’s scientific work, so the Marquis’ motives are understandable. But if Condorcet used his power to suppress publication, the traditional or monarchist wing of the Académie may have overcome the Marquis’ influence when Borda was elected to the Publications Committee, which coincided with expedited publication of Borda’s *Mémoire*.¹⁴ Or perhaps, as McClellan’s analysis suggests, the Comité de Librairie found it increasingly difficult to maintain production of *Mémoires* and found it convenient—regardless of the Borda-Condorcet ideological rivalry—to publish the Chevalier’s 1770 presentation.

The details of the interaction between Condorcet and Borda (and/or their confederates) in the Comité de Librairie and its commissions constitute a story waiting to be told. Brian [1994] explains the system of academic obstacles that obliged Condorcet to publish Borda’s 1770 presentation to gain the approval of the Academy for his 1785 *Essai*. But we still do not know the details of the processes that led to this compromise between Borda and Condorcet. Still, it seems that the Publication Commissions did not raise their hands or mark ballots to indicate their support or opposition to publishing scientific works. Rather, they ruled by consensus so that after reviews were presented, a member of the commission might voice support for publication and other members would mimic the lead utterance to indicate that a consensus had been reached. In such “voting by consensus,” the will of majority is not always clear. In the 1785 *Essai*, Condorcet touts the superiority of voting by ballot over traditional voice voting that was used in elections in classical cultures, though he does not explicitly compare the attributes of voice and ballot voting. In other writings, Condorcet says that a drawback of voice

¹⁴ I would like to thank my colleague, James McClellan, for providing database records that revealed this coincidence. I have not investigated FAS records of Borda’s election and the Publication Committee’s decision to clarify this pattern to search for correlations or other evidence of influence. Borda served on the Comité de Librairie from 1773 until 1790, but did not become a permanent member until 1784, when his 1770 presentation was published expeditiously.

voting is that it can be difficult to gauge a majority consensus due the noise associated with the communications process.

Although the apparent absence of open, scientific debate about the choice of a voting method in the FAS stifled the growth of Condorcet's metaphysical research paradigm, scientists were not able to distinguish and analyze the dualistic semantics and syntax associated with talking about voting in the FAS. Although lobbying in elections was common, members described their favorites as "meritorious choices" without representation or discussion of preferences that could have led back to the problem raised by Borda in 1770. This linguistic subtext only enhanced the taboo of openly debating the FAS election process.

In broader organizational context, the publication of the 1785 Essai can be considered in connection with the concurrent FAS organizational reform,¹⁵ led by Lavoisier. From 1716 to 1785, while the ranks and rules governing membership did not change, there was a commonly-recognized (and accepted) ambivalent relationship between the most meritorious (or theoretically "correct choice") and the plurality winner (the "naturally" occurring outcome) "engineered" in Academy voting processes [Rappaport, 1981].

5. Condorcet and Traditional Voting

In the 1785 Essai, Condorcet refers to the limitations the ways that the ancients conducted elections without being very specific. He refers to Papal tribunals, but not to procedures for electing the Pope, which traditionally involve each Cardinal praying for help in making a correct choice before casting a ballot. (Perhaps Condorcet, the atheist, assimilated the "naturalness" of this customary probability connection as a standard of confidence in voting processes.)

Condorcet criticizes elections conducted by voice votes because they do not scrutinize the processing of voting information. Condorcet, who still uses the term "voix" for votes in the Essai and who uses *pluralité*, not *majorité*, in talking about voting syntax, talks as if marking ballots were a straightforward process—something we know to be not true from the US 2000 presidential elections.

In 18th century France, marking ballots was a relatively "new" technology for representing and communicating preferences and judgments. Condorcet and his contemporaries—like Borda—take it for granted that traditional practices have lost their validity and legitimacy without explaining why. In fact, we know that voice voting and division of the whole—despite their imprecision—work well as analog

¹⁵ Although [Schandeler and Crépel (eds.), 2004] has revealed the long genesis of the Condorcet's Esquisse, there has been no search for fragments or other precursor works related to the 1785 Essai and to the genesis of organizational reform in the Académie.

measures of voting behavior under certain conditions, particularly binary choices. And parliamentary norms (in legislatures and in Roberts Rules of Order—the manual compiled in the 19th century) allow “noisy” or unclear voice votes to be scrutinized by using techniques such as a show of hands—which offers analog as well as digital counting of votes. But in the *Essai*, Condorcet seems unaware of these issues and practices.

However Condorcet was quite knowledgeable about the evolution of politics even though the discussion of historical voting practices in the *Essai* does not draw on the rich and detailed knowledge of voting demonstrated in the extraordinary rendition of *Tableau Historique* [Schandeler and Crépel (eds.), 2004]. This extraordinary scholarly work shows that Condorcet did studies for the *Sketch* from 1772 to 1794, when the *Esquisse* was published. In the *Tableau Historique*, Condorcet demonstrates broad and detailed knowledge of classical ideas about constitutions and stability. In the *Essai*, Condorcet acknowledges that in some cases, a single “enlightened” leader can make decisions that will be as good as—if not better than—the collective decision of a group of sagacious leaders. But in the *Tableau Historique*, the Marquis writes as if he had a more complex appreciation of Aristotle’s conception of a polity, a mixed system of government combining the best elements of monarchical, elite, and democratic rule. He recognizes that different systems may be meritorious if the enlightenment of the leaders is high enough. But he does not explicitly mention or discuss the classical arguments about politics being most stable both in the sense of persistence and adaptability. This is not surprising because Plato and Aristotle did not write about the possibility of engineering social systems by designing rules for voting decisions. In their models, slavery could be justified if people were not enlightened enough to rule themselves—much less others. And politics worked best when qualified enlightened men and random selection of leaders from competent citizens made Condorcetian voting semantics and syntax less important.

If Condorcet had promoted the analysis of voting systems as a purely scientific problem in which there is a consensus on objectives (search for the truth), could the modernists have prevented 1785 organizational reform by transforming a political problem (involving disagreement about fundamental divergent objectives such as absolute monarchy and modernization of the polity) into a common challenge. Within Condorcet’s metaphysical research program, there is no clear-cut definition of the relation between voter preference and competence. So it is not clear what happens if preferences and competencies are no longer independent variables in Condorcet’s models. Does voter competence reduce to voter preference or vice versa? Or are these variables interdependent so that there is a set of conditions that regulate the relationship between competence and preferences?

Although the 1785 *Essai* repeatedly refers to the harmful effects of manipulating votes on collective outcomes, Condorcet does not investigate the production of manipulations as part of individual decision making, an idea that has

been pursued experimentally in contemporary social choice literature. Rather he focuses on group effects and how they might be counterbalanced by increasing the plurality requirement to assure that if manipulations are successful, the minimum probability of producing a correct choice would not drop below an imprudent level. Recall that Condorcet was not unfamiliar with the use of manipulation in his own organizational experience. He probably realized that his own election as FAS Secretary, engineered under plurality voting, where only one's most preferred choice must be known, would have been much more difficult to carry out under Borda voting, where more complex information about individual rank-orderings would have to be known to attempt to manipulate collective outcomes to achieve political advantage. Like Napoleon, who, after the Revolution, changed the Institute of France's voting system back to plurality voting, Condorcet appreciated manipulation as a practitioner and analyst [Urken, 1991].

The Borda voting proposal in Lavoisier's plan probably had broad appeal. It might have strengthened the "democratic" move in the Academy associated with subsuming adjunct members into the associate class and ranking them all as equals. And it could have been perceived as supporting resistance to royal political pressures by providing a simple, ostensibly "scientific" representation of the will of the membership. (In Borda's procedure, voters simply write down their preference order and, predictably, points are assigned based on their rank-orderings. But in Condorcet's (pairwise) method, the point value of individual voter rankings may seem more uncertain because it depends on collective comparisons.) For these reasons, Borda's method may have been seen as a more straightforward, concrete, and disinterested means of differentiating "meritorious" choices. At the same time, in secret votes, voters could have benefited by colluding to give lower rankings to former adjuncts to protect their own chances for advancement. For these reasons, Borda voting was probably regarded as a way of reasserting professional autonomy of the Académie against the crown while it fused the accepted, ambivalent voting practices of scientists.

From the perspective of these conjectures, perhaps Condorcet made a tactical or strategic mistake by not addressing FAS voting procedures in the *Essai*. At several points, Condorcet refers to electoral institutions in religious culture as well as contemporary and traditional tribunals, examples that may suggest a vague indirect reference to the FAS. So modern readers may wonder why Condorcet did not describe FAS voting processes. Perhaps Condorcet did not want to confront the "natural" and dualistic appreciation of the roles of "tribunals" (engaged in rendering correct choices) and "legislative" institutions (involved in reaching consensus about divergent policy choices.) This dualism mirrors the social practices of his time and earlier traditions, in which legislators often doubled as jurors. This subtext duality is obliquely visible whenever Condorcet mentions examples, particularly when he talks about the possibility of carrying out experiments. But any potential connection to experimentation is immediately closed off when Condorcet notes the potential embarrassment caused by experiments.

If Condorcet had exposed the inherent ambivalence of classical probability theory in his MRP would have required resolving cultural and intellectual practices that helped his own argument. This tension ultimately doomed Condorcet's MRP to ambiguity, undermined the Marquis's dream, and hindered the demarcation of science and metaphysics in the grammar of voting. Yet it seems unreasonable to expect Condorcet to have unilaterally challenged or changed the classical theory of probability. His consistent cognitivist orientation was central to his belief in education and the perfectibility of mankind. So if he had admitted that individual choices depended on luck or chance, he might have undermined his models of collective choice. For example, including the possibility of making a correct choice by chance would have raised doubts about "natural" examples of the "wisdom" and "acumen" of elites or wise men used in the *Essai's* arguments.

Although Condorcet makes use of theoretical arguments from the *Essai* in post-Revolutionary writings, the connections are not so obvious in Condorcet's "practical" (Girondin) plan for a post-revolutionary French constitution and his design for a jury to try the King of France. Condorcet's constitutional argument is not framed in a mathematical explanation. In his plan, no legislature would determine its own agenda and agendas would always be composed of binary choices set by a higher authority. Scholars such as Baker have been puzzled about the bizarre complexity of this plan, but Condorcet probably felt quite "naturally" that hierarchical control of binary agendas would provide more stable solutions for maximizing competence—for collective-outcome production as well as for minimum level of performance—and for minimizing the probability of producing no decision.

In contrast, Condorcet's *Opinion on the Trial of Louis XVI* includes a two-page mathematical analysis and discussion of the design of a jury that could have been extracted verbatim from the 1785 *Essai's* discussion of tribunal design. Condorcet talks about determining the size and selection of jurors to maximize the probability that the jury will render a correct verdict [Urken, 1991]. Yet he does not explain the derivation or logic of the mathematics for his public audience. By not addressing the dualism and complexity of his constitutional design, he remained faithful to "naturalistic" argument. Daston and others have shown that naturalism in science was celebrated in enlightenment culture, so Condorcet's presentation of his jury design as if it would be obvious to non-academicians was not abnormal. But what seemed obvious to Condorcet and others comfortable with probabilistic argument may have been insufficient for intellectuals outside the Académie to grasp in a way that would lead to substantive debate and argument. Perhaps Condorcet was relying on an ostensible acceptance of his theory expressed in informal polite words and gesture in the Marquis' salon and political club associates. This level of understanding did not promote criticism and the nurturing of ideas. Or possibly Condorcet felt that it was simply unrealistic to divulge the complexity of his ideas because they could be politically explosive and/or divert attention from his practical proposals. (Is this ambiguity trumping science redux?)

6. Young and McLean

While the philosophical grokkers lead us to explore the implications of textual and contextual ideas for Condorcet's voting semantics and syntax, the grokings of Young and Mclean are distinctive because they discuss the logic of Condorcet's semantics and syntax within a textual framework of the *Essai* itself or a broader intellectual context.

Young and Mclean both follow Black's interpretation of Condorcet's work that is critiqued by Baker [1984] as misconstruing the Marquis' theoretical framework as a purely utilitarian. But Baker's critique does not examine the logic of Black's argument for distinguishing preference aggregation and competence in Condorcet's models. Unfortunately, Baker's critique does not get to the point of actually saying that the "jury theorem," the label invented by Black, is a misnomer.

Young's [1988] goal is to help us understand Condorcet's theory of voting as a coherent system that identifies important properties of voting logic such as the "independence of irrelevant alternatives," which directs our attention to the stability of collective outcomes under Condorcet scoring. Young frames his presentation—without further explanation—as related to the 'jury theorems' that make up the body of the *Essai*. Since Young's focus is on the properties of Condorcet's theory, it is not surprising that, given the voting-theoretic orientation of the paper, that the theory is not couched in terms of the broader issues in the *Essai* identified by Baker and Daston. Nevertheless, Young helps readers understand that there is more to the story of Condorcet's theory even if his picture of the *Essai* is limited. At least Young acknowledges that there is a broader textual framework in the *Essai* that interested readers should know about.

McLean [2006] considers the *Essai* as part of an overview of what he calls the "golden age" of social choice. He uses this label to highlight the fact that—in terms developed in this paper—Condorcet and his contemporaries were grappling with the same problems and ideas that emerged in Condorcet's metaphysical research program and are still facing us today. A lesson that McLean draws from this 18th century struggle with the analysis of voting systems is that voting theorists do not—then and now—talk to each other and to users of their ideas. This paper has argued that there were sociological and epistemological reasons for the lack of such conversations in Condorcet's time. Today, conversations about the choice of "alternative" voting systems are still rare and marginalized.

The experience of voting in the FAS has little to say about contemporary concern about reliable collection and counting of votes. For although Condorcet and his contemporaries disagreed about many issues, they all assumed that votes would be collected and processed reliably—assumptions that have been challenged for more than a century and are now being challenged by the uncertainties associated with the use of electronic voting machines.

The divide between voting theory and practice today is exacerbated by continued use of descriptors such as “social choice theory”—which is merely one aspect of a theoretical study of voting—instead of “voting theory,” which seems more understandable to educated citizens and fellow scientists. This terminology reinforces the perception that voting theory actually is arcane and irrelevant except to erudite scholars.

7. Schofield

Although Norman Schofield’s [2006] imaginative interpretation of Condorcet’s 1785 *Essai* deals mostly with the interpretation of Condorcet’s ideas rather than the *Essai* itself, his grokking suggests that the *Essai* includes insights into constitutional design and scientific change that have not been previously recognized. Condorcet repeatedly refers to “systems” at different levels of analysis in different temporal, cultural, and geographical contexts. His underlying theme is that social systems can be structured to control their functionality and regulate social change. There are multiple constitutional solutions—including epistemic democracy or “polity”—that Condorcet describes that show his appreciation of the variety of social structures that can be adaptive and stable. Structuring the voting process to produce correct or valid choices is simply one aspect of system design.

Although Schofield follows the preference aggregationalist canon of Condorcet’s theory of voting, he recognizes the dualistic tension between what is most preferred and what is correct or “fit” that is a generic aspect of social systems that depend on elections to gain legitimacy. This tension can be managed by inventing new structures, including those socio-economic systems that heresthetically frame a debate or issue to manipulate coalition formation to engineer electoral victory—and social acceptance—for one’s preferences. Schofield’s grokking leads us to see that the *Essai* addresses decision making under uncertainty by introducing social structures to manage risk and provide adaptive, but persistent governance.

If Schofield had explained his interpretation in terms of examples from the *Essai*, he might have seen the connection between Condorcet’s pre-revolutionary theorizing and the post-revolutionary Girondin constitutional design (i.e., that the

binary hierarchical agendas are based on an implicit reference to the probabilistic logic of the 1785 Essai). Nevertheless, Schofield grasps the Popperian logic of conjecture and refutation that motivates Condorcet's efforts to grow our knowledge about rule-based governance structures—constitutions and voting systems.

8. Conclusion

The grokking-theoretic review of selected philosophical and vote-theoretic interpreters of the 1785 Essai has highlighted the complexity of Condorcet's metaphysical research program (MRP). In this framework, we considered different ways in which the language of voting analysis, based on semantic and syntactical models, has been defined to provide a standard for interpreting the processing of information about individual and collective choices.

Baker's grokking revealed the misinterpretation of Condorcet's semantics (meaning) and syntax (combining) of voting information in modern social science. Voters can cast votes to express their preferences or to communicate individual judgments about a set of choices. In the first case, the syntax produces a decisive collective outcome, though the result may not be "decisive" or transitive. In the second case, the information is aggregated to render a judgment that ideally has a high probability of being correct. Within the 1785 Essai, the evaluation of system syntax is not always clear. Daston would account for this ambivalence as a consequence of the complexity of the underlying classical theory of probability. Young would explain any ambivalence in Condorcet's theory of voting by pointing out that the Marquis' method is—in modern statistical terms—maximum likelihood technique. This explanation would suggest that the Condorcet "jury theorem" can be considered within a strictly preference aggregation semantics and syntax, an idea which seems to be at odds with Baker's explication of the Marquis' epistemological political theory. Baker does not pursue the analytical implications of Condorcet's mathematical voting models, but he would agree that the notion of a correct collective choice cannot and should not be restricted to voting semantics and syntax based solely on preference information. Instead, if voting outcomes can be correct or incorrect, models based on maximizing competence or preference aggregation can be subjected to experimental falsification in rigorous experiments. Because Condorcet's Essai does not develop experimental ideas, his work leaves us hanging. This suspense is part of the legacy of the golden age of social choice. We see bold, glittering ideas that must be clarified by striking a better balance between theoretical and practical analysis. While Young, McLean, and Schofield continue and refine the "social choice" canon defined by Black's inability to link correct or optimal choices to politics. They do not positively incorporate the ambivalence of the 1785 Essai as a positive force in the growth of knowledge about voting and constitutional structures.

Condorcet's metaphysical research program (MRP) can be seen as a quintessential expression of the classic liberal dualism between fact and value that

Popper and others have associated with the idea of an open society [Popper, 1945]. Despite the ambivalence that Daston identifies in Condorcet's MRP infrastructure and despite the fact that ambiguity seems to have stifled the growth of Condorcet's theories during and after his academic and post-revolutionary work, the intellectual competition between facts and values is healthy for the evolution of voting theory. Asking factual questions about values and value questions about facts is a way of continuing the conditionally normative tradition of argument that has customarily informed work on voting theory. But we should pay more attention to Baker's warning about subsuming and stifling voting theory under a dominant rubric of preference semantics and syntax. Correctness or truth is a property of the relationship between our statements—including those produced by voting grammar—and the world. A deeper understanding of the 1785 *Essai*, itself, and may help revive a more complex appreciation of Condorcet's metaphysical research program.

References

- Baker K. M. (1975): *Condorcet: from natural philosophy to social mathematics*, Chicago: University of Chicago Press.
- Baker K. M. (ed.) (1976): *Condorcet: selected writings*. Indianapolis: The Bobbs Merrill.
- Baker K. M. (1984): Condorcet: a note on the problem of the randomness of ends, in L.C.Rosenfeld (Ed.), *Condorcet studies I*. Atlantic Highlands, NJ: Humanities Press.
- Balinski, M. and Laraki, R. (2007): a theory of measuring, electing and ranking, Proceedings of the National Academy of Sciences of the USA.
- Black, D. (1958): the theory of committees and elections. Cambridge: Cambridge University Press
- Brian É (1994): la mesure de l'état : administrateurs et géomètres au xviii^e siècle, Paris: Albin Michel.
- Condorcet, M.J.A de (1785): *essai sur l'application de l'analyse à la probabilité des décisions rendues à la pluralité des voix*. Paris: l'Imprimerie Royale [fascimile edition New York: Chelsea, 1972].
- Crosland, M. (2002): *science under control: the French academy of sciences 1795-1914*, Cambridge: Cambridge University Press.
- Daston, L. (1995) *classical probability in the enlightenment*, Princeton: Princeton University Press.
- Estlund, D.M. (2007) *democratic authority: a philosophical framework*, Princeton: Princeton University Press.

- Grofman, B. and Feld, S.L. (1988): Rousseau's general will: a Condorcetian perspective, *American political science review*.
- Grofman, B. and Owen, G. (1985): thirteen theorems in search of truth, *Theory and decision*.
- Grofman, B. (1978): judgmental competence of individuals and groups in a dichotomous choice situation: is a majority of heads better than one? *Journal of mathematical sociology*, 6, 1.
- Granger, G.G. (1956): *la mathématique sociale du Marquis de Condorcet*. Paris.
- Guilbaud, G.Th. (1952): les théories de l'intérêt général et le problème logique de l'agrégation», *Économie appliquée*, 5, 501-55, 1952. (partial translation: Theories of the general interest and the logical problem of aggregation, in *Readings in Mathematical Social Sciences*, Lazarsfeld et Henry, (eds.) Science Research Associates, Chicago, 1966).
- List. C. (2006): the discursive dilemma and public reason. *Philosophy & public affairs* vol. 116 (January): 362-402.
- McClellan, J. (2003): specialist control: the publications committee of the académie royale des sciences (Paris, 1700-1793), Philadelphia: American Philosophical Society.
- McLean, I. (2006): the first golden age of social choice, 1784-1803, in Barnett, W., Salles, M., N. Schofield, and Moulin, H. (eds.), *Social choice, welfare, and ethics: proceedings of the eighth international symposium in economic theory and econometrics*.
- McLean, I. and Urken, A.B. (eds.) (1995): *classics of social choice*, Ann Arbor: University of Michigan Press.
- Popper, K. (1945): *the open society and its enemies*, London: Routledge.
- Popper, K. (1963): *conjectures and refutations*, London: Routledge and Kegan Paul.
- Rappaport, R. (1981): the liberties of the Paris academy of sciences, 1716-1785. In Henry Woolf (Ed.), *The analytic spirit: Essays in honor of Henry Guerlac*. Ithaca: Cornell University Press.
- Richards, J. (2005): *mathematics and narrative: natural mathematics in the French eighteenth century*.

Sabine, G.H. (1961): a history of political theory, New York: Holt, Rinehart and Winston.

Schofield, N. (2006): architects of political change: constitutional quandaries and social choice theory, New York: Cambridge University Press.

Schandeler, J.-P. et Crépel, P. (eds.) (2004): tableau historique des progrès de l'esprit humain: projets, esquisse, fragments et notes, 1772-1794, édité sous la direction de, (Paris à L'institut National d'études démographique).

Urken, A.B. and Iain McLean, I. (2007): Nicholas Collin and the dissemination of Condorcet in the United States, *Science in Context*, 20(1), 125–133.

Urken, A.B. and Stephen Traflet (1988): optimal jury design, *Jurimetrics*.

Urken, A.B. (1991): the Condorcet-Jefferson connection and the origins of social choice theory, *Public choice*, 72: 213-236.

Urken, A.B. (1994): voting methods in context: the development of a science of voting in French scientific institutions, 1699-1803, Rochester: International Conference on Social Choice and Welfare.

Young, H.P. (1988): Condorcet's theory of voting, *American Political Science Review*, 82, 1231-1234.