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THE POLITICS OF FORMALIZATION: LIBERATION OR OPPRESSION?

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Abstract. Techniques of formalization are widely used in philosophy and other disciplines as tools for analysis and research. While epistemological and methodological aspects of formalization have received quite some attention in the meta-philosophical literature, the *politics* of formalization—the entanglements of formalization with power relations, and in particular the impact of formalization for projects of *liberation* or *oppression*—has received comparatively little attention. To discuss the politics of formalization, my starting point in this paper is the idea that formalization can be understood as a *technology*; as such, the existing literature on the political import of technologies (from philosophy of technology and science and technology studies) can suitably inform an analysis of the politics of formalization. I then discuss different views on the politics of formalization: as instruments for liberation (Neurath, Carnap) or as tools of oppression (Horkheimer and Adorno, Nye). Next, I argue that the social and political conditions under which formalization has acquired the outlines now familiar to us—namely, Enlightenment movements, the European colonial expansion, and the birth of capitalist societies—invite a reflection on how this historical background may have affected the development of formalization techniques in the 19th and 20th centuries. To conclude, I sketch the contours of a social (and political) history of formalization against the background of the pervasiveness of algorithmic rules in the past centuries, drawing in particular on the work of Lorraine Daston.

Keywords: formalization • technology • Enlightenment • feminism • logic

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Introduction

Techniques of formalization, understood as the regimentation of concepts, arguments, theoretical frameworks etc. into a well-defined formal system (which may or may not rely on specially designed symbols and notations), are ubiquitous in philosophical inquiry across ages and places (and particularly pervasive in the tradition known as 'analytic philosophy' (Pettigrew, Forthcoming)).[1] Recent examples include uses of probability theory in Bayesian epistemology (Lin 2022), uses of decision theory in philosophy of action and ethics (Buchak 2017), and the regimentation of arguments in vernacular languages into logical formalisms (Hansson 2000). Not-so-recent


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examples include Aristotle's syllogistic and medieval theories of supposition (Dutilh Novaes 2015), and the formalization of classical Sanskrit by the ancient Indian grammarian and logician Pāṇini (Staal 2007).[2] 'Formalization' is a term used to refer to a wide range of methods and phenomena, perhaps best understood as an umbrella term.

In the meta-philosophical literature, much attention has been paid to logical, methodological, and epistemological aspects of formalization (Tarski 1956; Carnap 1947; Brun 2008; Dutilh Novaes 2012; Titelbaum 2022; Pettigrew, Forthcoming). By contrast, the *politics* of formalization—the entanglements of formalization with power relations, and in particular the impact of formalization for projects of *liberation* or *oppression*—has received comparatively little attention. (I here focus specifically on liberation and oppression for the sake of tractability; I do not wish to imply that these are the only two relevant political dimensions of formalization.) To be fair, there have been important discussions on the politics of formalization (broadly construed), particularly in connection with feminist critiques of logic (Nye 1990; Plumwood 1993; Saint-Croix & Cook 2024) and some political aspects of the Vienna Circle (Dutilh Novaes 2020a; Carus 2008). But by and large, it remains a scarcely explored topic in the meta-philosophical literature. In view of growing awareness within both philosophy of science and epistemology of the political dimensions of knowledge (Anderson 2011; Kidd et al. 2017), systematic reflections on the politics of formalization are much needed.

As noted, a pressing question for the politics of formalization is how *liberatory* or else *oppressive* formalization can be. Do formalization techniques contribute to projects of liberating us from the shackles of superstition and obscurantism, as Enlightenment optimists would have it? Or do they instead serve the purpose of further oppressing already marginalized groups, as some feminist critics maintain? Yet another option might be that formalization *by itself* is a neutral tool, while different *uses* of the tool may be more or less liberatory or oppressive. This paper explores these different possibilities, taking as its starting point a characterization of formalization as a *technology* (Dutilh Novaes 2012). This move allows for a fruitful engagement with existing literature in philosophy of technology and science and technology studies on the political dimensions of technologies. I argue that, while formalization may well have both liberatory and oppressive uses and implications, the social and political conditions under which formalization has acquired the outlines now familiar to us—namely, its historical concomitance with Enlightenment movements, the European colonial expansion, and the birth of capitalist societies—invite a reflection on how this historical background has affected the development of formalization techniques in the 19th and 20th centuries. I tentatively suggest that formalization is primarily a technology of standardization, centralization, and control.

The paper proceeds as follows. In section 2, I present the idea that formalization is

best understood as a cognitive technology, drawing mainly on my earlier work on the topic (Dutilh Novaes 2012). In section 3, I discuss some of the positive assessments of formalization as a political instrument, especially its potential for liberation, drawing in particular on the Vienna Circle thinkers Otto Neurath and Rudolf Carnap. In section 4, I turn to some of the negative assessments of the politics of formalization, specifically Adorno and Horkheimer's bleak appraisal of Enlightenment ideals, and feminist critiques of formal logic (Saint-Croix & Cook 2024). In section 5, I sketch the contours of a social and political history of formalization against the background of the pervasiveness of algorithmic rules in the past centuries, drawing in particular on the work of Lorraine Daston (Daston, 2022).

1. Formalization as a cognitive technology

In *Formal Languages in Logic* (Dutilh Novaes 2012, henceforth, FLL), I defended the thesis that formal languages are not merely abstract notational systems that represent logical structure, but are best understood as *cognitive technologies*: external tools that genuinely extend and transform human reasoning capacities.[3] The main idea is that, rather than treating formalisms as representations of logical structures or as arbitrary stipulations, we should treat them analogously to how we treat other technologies—such as writing, the abacus, and mathematical notations. Formalisms are *artifacts*, designed (often gradually and collectively) to perform cognitive work that unaided minds would struggle with.[4] They have histories, affordances, and limitations, and their use *transforms* how people reason. FLL thus connects logic to broader histories of literacy, numeracy, and the cumulative cultural evolution of cognitive practices. Situated at the intersection of history and philosophy of logic, philosophy of mind, and cognitive science, this approach rejects both purely representational and purely conventionalist accounts of what formal languages are and do.

Drawing on the framework of extended cognition (Clark & Chalmers, 1998), in FLL I argued that formal languages can be understood as part of a cognitive system that includes the human reasoner, the notations on the page, the manipulating practices that have been mastered through training, and the surrounding community of practices. Thus seen, reasoning with a formalism is not something that happens only 'inside the head'; it is a hybrid activity in which symbols on paper or screen do real cognitive labor by offloading cognitive burden and constraining the moves that a reasoner can legitimately make. Formal languages are engineered artifacts that scaffold and transform human cognition: tools that we have built, and tools that, in turn, partly reconfigure us as reasoners.[5]

This account of formal languages is supported by what formalisms and notations actually accomplish for reasoners. Notations offer externalization and stability

to reasoning processes; they allow for the reasoning to persist in a stable, inspectable form. Steps can be checked, revisited, shared, and, if necessary, criticized by the relevant community. Limitations of working memory are bypassed, allowing for longer, more complex reasoning processes (e.g., complex calculations). Moreover, the symbols in a formalism can be literally 'moved around' according to the explicit rules of transformation of the system. The reasoner does not need to grasp the full meaning of every step; with a suitable formalism, she can simply follow its rules of transformation. Formal languages exploit sensorimotor capacities by inviting manipulation of portions of the environment (the symbols); the notation does some of the work that the reasoner would otherwise have to do unaided. This overall idea is illustrated by a famous passage by logician and philosopher Alfred North Whitehead (Russell's co-author in *Principia Mathematica*), from his 1911 book *An Introduction to Mathematics*:

> By relieving the brain of all unnecessary work, a good notation sets it free to concentrate on more advanced problems, and in effect increases the mental power of the race. In mathematics, granted that we are giving any serious attention to mathematical ideas, the symbolism is invariably an immense simplification. [...] [B]y the aid of symbolism, we can make *transitions in reasoning almost mechanically* by the eye, which otherwise would call into play the higher faculties of the brain. It is a profoundly erroneous truism [...] that we should cultivate the habit of thinking what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them. (Whitehead, 1911, p.43) Reprinted in (Whitehead 2023, emphasis added)

(Note the reference to 'mechanical' reasoning, which will be important later on.) To account for these features of formalisms, in FLL I relied on the concept of *de-semantification*, as formulated by Sybille Krämer: "signs can be manipulated without interpretation" (Krämer, 200, p.532). Essentially, de-semantification entails that steps in the process of reasoning are not guided by the reasoner's intuitions and beliefs that would be activated if she was to reason on the basis of the meanings of the inscriptions in question. Rather, by 'mechanically' applying the rules defined within the formalism, the reasoner not only alleviates the demands on her cognitive resources; she may also effectively block undue interference of external information.

Moreover, thanks to de-semantification, formal languages allow reasoners to reach conclusions that go *against* their natural inferential tendencies. Humans have well-documented cognitive biases: confirmation bias, belief bias, difficulties with conditional and quantified reasoning, and so forth.[6] A properly trained user of a formal system can override these tendencies because the formalism invites inferences that the reasoner may otherwise resist, if they clash with her prior beliefs. This is one of the ways in which formal languages do not just record reasoning; they reshape it. [7]

While the analysis in FLL is framed in terms of formal languages and formalisms, the general idea is also applicable to *formalization*, understood as a process whereby an idea, concept, argument or theoretical framework is recast in an unrelated formal system, with the goal of yielding a gain in precision and rigor. The formal system is often, but need not be, a mathematical framework, such as the application of probability theory to epistemology that results in Bayesian epistemology. A historically important example of formalization is the *Begriffsschrift* (Frege 1967), where Frege formalizes mathematical (arithmetical) reasoning in a tailor-made logical system, with its own special notation. Indeed, a formalization often involves the use of special symbolism and notations, though again this need not be the case (as I argued for medieval theories of supposition (Dutilh Novaes 2015)).

Thus understood, formalization and the uses of formal languages and notations discussed in FLL largely overlap. What matters for present purposes is mainly the idea that the arguments in FLL also support a conceptualization of formalization as a *technology*. Once formalization is recognized as a technology, then questions pertaining to the *impact* of this technology naturally arise, and research on the impact of technologies more generally will offer relevant insights. (In FLL, my engagement with philosophy of technology and science and technologies studies was quite minimal; the present contribution is also an opportunity to remedy this lacuna.) FLL investigates the *cognitive* impact of formal languages\formalization, defending a largely optimistic assessment of this impact (aligned with the overall cheerfulness of the extended mind literature), while also recognizing that there may be losses, risks and pitfalls entailed by formalization. But the book has virtually nothing to say on the *political* impact of formal languages and formalization, reflecting the overall neglect of politics in this literature at the time.

In recent years, however, important contributions to the literature on extended and scaffolded cognition have appeared that address the issue of potential *noxious effects* of cognitive scaffolding, including political implications. Ryan Timms and David Spurrett introduced the concept of *hostile scaffolding*, which they define as "scaffolding which depends on the same capacities of an agent to make cognitive use of external structure as in benign cases [i.e., cases where the interests of the user are served], but which undermines or exploits the user while serving the interests of another agent" (Timms & Spurrett 2023, p.53). They focus specifically on examples from casinos and electronic gambling machines, and argue that these are genuine examples of hostile scaffolding. In a similar vein, Shen-yi Liao and Bryce Huebner introduced the concept of *oppressive things*, which are material artifacts and spatial environments that are in congruence with and further reinforce oppressive systems (Liao & Huebner 2021). Their main examples are material artifacts of visual culture technologies that have a light-skin bias. Finally, Sabrina Coninx focuses on "the dark side of niche construction, that is, the different manners in which organisms may

modify environmental features that are in some way or another harmful to them" (Coninx 2023, p.3003). An example of environmental modification that has been particularly harmful is the use of fossil fuel technologies, which offered short-term advantages but in the long run have engendered the climate crisis that we now find ourselves in.

The next two sections will explore these two 'sides' of formalization (understood as technologies that scaffold reasoning and cognition) in particular regarding its possible *political* impact. As I will show, formalization has been viewed both as having a *liberatory* impact, enhancing the political freedom of its users; and as having an *oppressive* impact, i.e., as providing tools for the oppression of certain groups by other groups.

2. Formalization as liberatory (optimistic views)

The views that formalization can be an instrument for liberation to be discussed here are inscribed in a larger context of overall *Enlightenment optimism*. In 18th century Enlightenment movements, 'enlightenment' was understood as an ongoing process of social and intellectual development: an orientation on how to organize individual and socio-political lives guided by ideals of freedom and (scientific) rationality. At the risk of glossing over important differences, some of the key features of the various Enlightenment movements (in Germany, France, Scotland, and elsewhere) included a rejection of oppressive political systems, especially as represented by absolutist monarchies and by the firm grip of religious (Christian) institutions; and a focus on *knowledge*—especially *scientific* knowledge—as a means for liberation from immaturity, i.e., a means to break free from prejudice and unscientific worldviews (Bristow 2023). The resulting emphasis on intellectual freedom led to exhortations to 'think for oneself' (Kant 1996), denunciations of authority-based epistemic systems (such as medieval scholasticism), and a rejection of religious worldviews of various kinds. Those who embraced Enlightenment ideals saw themselves as enacting autonomous forms of agency by rejecting the obscure, tangled, and confused conceptual systems inherited from their ancestors (hence the focus on en*light*enment against obscurantism), which they associated with an absence of (individual) freedom and a state of immaturity.

Despite a certain amount of backlash (i.e., 'Counter-Enlightenment' movements (Berlin 2013) such as 19th century Romanticism), this overall Enlightenment ethos—a confidence in the liberatory power of knowledge, especially scientific knowledge—was at the heart of the Vienna Circle movement, in the first decades of the 20th century (Galison 1996).[8] The 'scientific world-conception' was presented in its unofficial 1929 manifesto, written primarily by Otto Neurath, Hans Hahn, and Rudolf Carnap

(Uebel 2004b). In particular, as argued by André Carus, Carnap's key method of *explication* is best understood as an instantiation of Enlightenment ideals: "the ambition of shaping individual and social development on the basis of better and more reliable knowledge than the tangled, confused, half-articulate but deeply rooted conceptual systems inherited from our ancestors" (Carus, 2008, p.1).

Throughout his career, Carnap developed various constructed formal systems, starting with *Der logische Aufbau der Welt* (1928) and *Logische Syntax der Sprache* (1934). In his later writings, in particular in *Meaning and Necessity* (1947) and *Logical Foundations of Probability* (1950), the key methodological concept became that of *explication*, which is not exclusively tied to constructed languages and formalization, but often does take the form of applications of artificially constructed languages.[9] Explication is a process whereby a vague, informal concept, either from everyday life or from more regimented contexts such as scientific research (but in earlier stages of development), is given a more exact, often *formalized* formulation.[10]

> The task of making more exact a vague or not quite exact concept used in everyday life or in an earlier stage of scientific or logical development, or rather of replacing it by a newly constructed, more exact concept, belongs among the most important tasks of logical analysis and logical construction. We call this the task of explicating, or of giving an *explication* for, the earlier concept; this earlier concept, or sometimes the term used for it, is called the *explicandum*; and the new concept, or its term, is called an *explicatum* of the old one. (Carnap 1947, p.7-8, emphasis in the original)

How exactly does the method of explication reflect liberatory Enlightenment ideals? Formulations of more explicit political commitments, and particularly of the idea that philosophy was of critical relevance to the project of promoting socialism, are mainly to be found in Carnap's earlier writings (Uebel 2004a). The concept of explication, in turn, was to be fully articulated only in his later writings (after World War II, when he was already in the United States). But granting some degree of methodological continuity between Carnap's earlier and later work and stability in his political commitments,[11] one may conclude that these political commitments remained relevant also for his later work, and for explication in particular.

Indeed, for Carnap, explication embodied the value of intellectual liberation from the shackles of paralyzing traditions. A comment by one of his students, Richard Jeffrey, illustrates this connection:

> Philosophically, Carnap was a social democrat; his ideals were those of the enlightenment. His persistent, central idea was: "It's high time we took charge of our own mental lives" – time to engineer our own conceptual scheme (language, theories) as best we can to serve our own purposes; time to take it back from tradition, time to dismiss Descartes's God as a distracting myth,

> time to accept the fact that there's nobody out there but us, *to choose our purposes and concepts to serve those purposes*, if indeed we are to choose those things and not simply suffer them. [. . .] For Carnap, deliberate choice of the syntax and semantics of our language was more than a possibility – it was a duty we owe ourselves as a corollary of freedom. (Jeffrey 1992, p.28)

Thus seen, explication exemplifies ideals of epistemic autonomy and emancipation, famously encapsulated in Kant's Enlightenment motto: 'Sapere Aude!'[12] Carnap focused primarily on scientific theories and concepts (modality, probability, information), but another prominent member of the Vienna Circle, Otto Neurath, was much more outspoken on the connections between the Circle's logical empiricism and politics (Okruhlik 2004). While most of the Vienna Circle members had a background in the natural and exact sciences, Neurath was primarily interested in the social sciences and political/social phenomena, which he approached through a broadly Marxist lens. His interests were not only theoretical; he was also a committed *activist* for social reform.[13] As such, Neurath was particularly interested in centralized social and economic planning (in his terms, 'social engineering'), which involved the meticulous study through statistics, quantification, and calculation of social and economic processes (Neurath 1983). Neurath's overall position can be described as "technocratic socialism" (Dale 2023), given his emphasis on the role of scientific knowledge and experts for the establishment of centralized economic planning, 'in-kind' (non-monetary) calculation, and full socialization of the economy.

Neurath thus espoused an Enlightenment optimism in quantification, calculation, and standardization, but in his case specifically to further socialist political and economic agendas. "The planned economy would be concerned above all 'with utility,' with the interest of the social collective and providing all citizens with 'housing, food, clothing, health, entertainment, etc.' " (Dale 2023) Neurath was thus also an enthusiast of *formalization*, broadly understood: the precisification, quantification and standardization of social and economic processes, leading to accurate predictions and suitable interventions (more on this broad understanding of formalization in section 5).[14] Indeed, Neurath aimed for formalization not only at a theoretical level (the formalization of theories) but also at the level of the *processes themselves*, which could be optimized by means of extensive knowledge of statistics so as to serve the best interests of the social collective. Hence, for Neurath, formalization has a liberatory effect in the very concrete sense of liberating the masses from poverty and from the "irrationality" of capitalism (Dale, 2023).[15]

Before closing this section on optimistic assessments of formalization, I want to mention one more 20th century author who believed in the liberatory potential of formalization (in this case, specifically of *logic*): Susan Stebbing (1885-1943). Stebbing was a highly influential philosopher in the early days of analytic philosophy in England, but who later became virtually forgotten for decades, until a recent resurgence

of interest in her work (Beaney & Chapman 2026).[16] One of Stebbing's most influential contributions was her book *Thinking to Some Purpose* (Stebbing 1939), a work of what is now described as 'public-facing philosophy' (intended for a broad audience) that became extremely popular at the time.[17] In the book, Stebbing draws on logical concepts and techniques to help the reader improve their reasoning capacities. Written against the background of rising dictatorships and the collapse of democracy in Europe in the 1930s, it offers advice on how to think critically and clearly, how to spot illogical statements and slipshod thinking, and how to rely on reason rather than emotion. "I am convinced of the urgent need for a democratic people to think clearly without the distortions due to unconscious bias and unrecognized ignorance. Our failures in thinking are in part due to faults which we could to some extent overcome were we to see clearly how these faults arise. It is the aim of this book to make a small effort in this direction." (Stebbing 2022) (p.xxix) Thus, for Stebbing, logic can enhance critical thinking, which in turn is essential for a well-functioning democracy.[18]

3. Formalization as oppressive (pessimistic views)

In the 1920s, another influential group of thinkers were articulating a shared intellectual identity in what became known as the *Frankfurt School*, and later the intellectual tradition known as *critical theory*. These thinkers, while also espousing the same broadly socialist sympathies of Carnap and Neurath, were much less optimistic regarding the role of scientific knowledge for social reform. Initially, the two groups (Vienna Circle and Frankfurt School) did not see each other as adversaries (the real adversary of the Vienna Circle being Heidegger (Friedman 2000)), and even had plans to collaborate as they were all forced into exile due to the Nazi ascension to power. But the relations between the two groups soon deteriorated, and the Frankfurt School thinkers, in particular Max Horkheimer and Theodor Adorno, became vocal critics of 'positivism', a position they attributed to the Vienna Circle (Vrahimis 2020).[19] In particular, while the Vienna Circle saw itself as exemplifying the Enlightenment ethos, the (early) Frankfurt School thinkers came to see it as their mission to critique this very ethos (usually referred to with the concept of 'modernity').

Written in exile during World War II and published in 1947, Horkheimer and Adorno's *Dialectic of Enlightenment* (Horkheimer et al. 2002) became itself a kind of 'manifesto' for the critical theory tradition. The book argues that, while the Enlightenment ostensibly pitted reason against authoritarianism and barbarity, the horrors of World War II showed that, in fact, reason *itself* inevitably leads to domination and violence. More specifically, they viewed fascism as the logical consequence of a process of *over-rationalization* set in motion by the Enlightenment and (what they per-

ceived as) a merely instrumental, result-oriented conception of rationality. According to Horkheimer and Adorno, and crucial for our purposes, formal logic epitomizes the calculating, oppressive face of reason: "The expulsion of thought from logic ratifies in the lecture hall the reification of human beings in factory and office." (Horkheimer et al. 2002, p.24)

> Formal logic was the high school of unification. It offered Enlightenment thinkers a schema for making the world calculable. [...] The same equations govern bourgeois justice and commodity exchange. [...] For the Enlightenment, anything which cannot be resolved into numbers, and ultimately into one, is illusion... (Horkheimer et al. 2002, p.4)

Hence, for Horkheimer and Adorno, the same features of formalization that are for Neurath tools for liberation—quantification, calculation—are instead instruments of (capitalist) oppression. Formal logic is for them the prime example of a rationality that only cares about efficiency: a mechanism of domination that reduces complex realities to standardized units, thus reinforcing the status quo. (The point generalizes to other formalistic approaches to substantive value questions, e.g., decision theory or game theory.[20]) For Horkheimer and Adorno, formal logic assumes that everything can be categorized and computed, and this 'mechanical' approach to reasoning mirrors the impersonal industrial production of capitalist systems.

Writing four decades later, Andrea Nye developed a similar criticism of logic, this time viewed as an instrument of patriarchal oppression, in her book *Words of Power: A Feminist Reading of the History of Logic* (Nye 1990).[21] While her critique is levelled specifically against logic, the gist of it generalizes to formalization and modeling more broadly (Saint-Croix 2026).[22] Essentially, Nye reads the history of logic as embedded in a history of male dominance and patriarchy, and views logic as one of the instruments that (some) men have used to subordinate and exclude others.[23] "Logic was the prerogative of those in power who would use it as the tool for correct rule." (p.170) "The arena of logic was made by men for men; it was expressly founded on the exclusion of what is not male, as well as what is not Greek, nor Christian, nor Western, nor Aryan." (p.177)

> In my view, there is no one Logic for which such a theory can account, but only men and logics, and the substance of these logics, as of any written or spoken language, are material and historically specific relations between men, between men and women, and between them and objects of human concern. (Nye 1990, p.5)

Despite being historically situated and contingent (just as any human theoretical construct), logic sees itself as pertaining to universal, absolute, immutable truths. "Logic is the form of all knowledge and, therefore, all behavior. A unitary, consistent

Truth, expressed in the clear functional terms of mathematical science, regulates that behavior."[24] (p.163) Nye thus identifies in logic an authoritarian/totalitarian proclivity, as Horkheimer and Adorno had suggested. Her diagnosis of *how* logic serves as an instrument of oppression also echoes some of Horkheimer and Adorno's claims. What logic does is to detach statements from their context and content: "logic teaches us to ignore the circumstances in which something is said" and "to forget who says something and why" (p.183). The decontextualization and depersonalization[25] that logic requires leads to a form of *alienation*, according to Nye:[26]

> The atomized statements that logic reconnects in syllogisms or propositional calculi are themselves spoken, but it is by a certain kind of speaker, a speaker who is alienated from himself, who speaks from no coherent interpersonal experience, from no stable communal reality. (Nye 1990)

One of the facets of this tendency towards alienation is the requirement not to *think* when dealing with logical problems: "The trick is not to think" (p.2); "Forget what is said. Don't think." (p.181). What Nye means by this is that the parameters of a logical problem (in particular the premises) must be taken at face value, no questions asked. Hence, the very same feature of mathematical notations that was commended by Whitehead ("by the aid of symbolism, we can make transitions in reasoning almost mechanically by the eye, which otherwise would call into play the higher faculties of the brain") is now viewed as a source of alienation by Nye. "If truth is more than a sterile formality, more than a *mechanical* semantic matching of formulae with other formulae, we must first know the meaning of the words that we are to judge true or false." (p.174, emphasis added)

It might be thought that Nye's criticism is not of logic and formalization *per se*, but of the history of logic thus far and its entanglement with the patriarchy and gender oppression. If this is so, then there could at least in principle be different ways of doing logic, in particular *feminist* ways. But this is not Nye's view: for her, 'feminist logic' is an oxymoron, an impossibility, as logic itself is an anti-feminist, inherently patriarchal enterprise. This is probably the most controversial aspect of Nye's overall thesis; while readers may be sympathetic to her diagnosis of how logical practices are, as a matter of fact, entangled with gender oppression throughout the history of logic, there is much resistance to her diagnosis of logic as *intrinsically* oppressive (Saint-Croix & Cook 2024; Uckelman 2025). (On the whole, especially in virtue of the intrinsicality claim, Nye's arguments have not been favorably received among logicians, philosophers and historians of logic (Saint-Croix, 2026).)

Logician and philosopher Val Plumwood offered an influential response to Nye, challenging specifically the intrinsicality claim (Plumwood 1993). Plumwood agrees with Nye that, insofar as logical practice has not been properly grounded in careful attention to personal experience, testimony, human interchange etc., the corre-

sponding logical systems can indeed be considered as oppressive and patriarchal. But she believes that *different* approaches to logic, more attuned to feminist values, are possible. In particular, according to Plumwood, the problem lies with *classical* logic (which she describes as "the logic of domination"), and in particular with the classical *negation*, which reinforces a problematic and exclusionary form of dualism ("dualistic otherness"). By contrast, the negation of *relevant* logic, Plumwood claims, is not based on dualistic otherness. According to her, the relevant negation permits a more nuanced relationship where entities are defined positively and can intersect, thus rejecting the classical, binary understanding of the negation: "relevant negation can be interpreted as expressing a notion of otherness as non-hierarchical difference" (Plumwood 1993, p.458). Plumwood thus carves conceptual space for the possibility of a logical system that is not inherently patriarchal and oppressive, and argues that relevant logic may occupy this space.[27]

The negative assessments of the politics of formal logic offered by Horkheimer and Adorno, and later by Nye, are in stark contrast with the Enlightenment optimism of figures such as Neurath, Carnap, and Stebbing. What should we make of this contrast? My own assessment is that Nye is overly critical, especially when claiming that logic is *intrinsically* patriarchal; but the Enlightenment optimism of Carnap and Neurath is also quite naïve, oblivious to the oppressive potential of formalization.

We might be tempted to conclude that formalization is nether *inherently* liberatory nor *inherently* oppressive; as with technologies in general, its impact will depend on the details of specific *uses and applications*. (As gun rights advocates like to say, "Guns don't kill people, people kill people.") However, as argued by philosopher Langdon Winner in his highly influential 1980 article 'Do artifacts have politics?' (Winner 1980), artifacts and technologies are not value-neutral; rather, they are always value-*laden*. "Each technology pushes society in a particular political direction, and these effects are often independent of the intentions of its inventors and users." (Nguyen 2026, p.201) Similarly, the value sensitive design framework (VSD) in philosophy of technology takes as its starting point the idea that technologies will always be infused with values, and recommends that values be explicitly taken into account when designing technologies (Friedman & Hendry 2019). To investigate ways in which formalization is a value-laden technology, the next section places the history of formalization in a broader social and political context.

4. Towards a social (and political) history of formalization

A foundational tenet in science and technology studies (and related fields of inquiry that study technology) is the idea that, to be properly understood, technologies must be studied against the background of the larger social and political contexts of their

emergence, adoption, and uses (Hughes 1993). Technology is as much a *socio-cultural* as it is a *techno-scientific* phenomenon (Bijker et al. 2012). Consider the development of nuclear technology in the 20th century. Imagine a future scholar interested in nuclear technology, who only looks at the physical and technical aspects of these developments and ignores the broader historical and political 20th century context: World War II, the arms race between Nazi Germany and the Allies to develop the atomic bomb, the detonation of atomic bombs in Hiroshima and Nagasaki, the geopolitical role of nuclear technology during the Cold War, and so forth. Clearly, this aspirant scholar would only obtain a very partial, incomplete understanding of nuclear technology if they disregarded the crucial historical and social background.

A similar point can be made for the emergence of technologies of *formalization*. A familiar, somewhat simplified story starts with the development of artificial languages in the 17th century, resulting from the interaction between logic and mathematics (Mugnai 2010), of which Leibniz is the most famous but by no means the only exponent.[28] It then 'jumps' to the 19th century and the so-called 'foundational crisis' in mathematics, which provided the main motivation for projects of axiomatization of portions of mathematics such as arithmetic and geometry (Awodey & Reck 2002). From these axiomatization projects, a meta-mathematical research program emerged, spearheaded by figures such as Gottlob Frege, David Hilbert, and Bertrand Russell (Dutilh Novaes, 2012, Chapter 3), which current formalization techniques can ultimately be traced back to.

This story is not exactly wrong, but it only offers a very partial and limited account of these developments, concentrating exclusively on academic and theoretical elements; a more encompassing social history of formalization must also take into account the broader historical background, just as social histories of nuclear technology do (Trischler & Bud 2018). And while it may seem that the two cases are disanalogous—nuclear technologies have wide societal impact, while techniques of formalization (allegedly) remain confined to narrow academic spaces—they are, or so I will argue, more similar than one might expect. (Given the very large scope of such an investigation, what follows is just a first, tentative sketch of what a social history of formalization might look like.)[29]

In her book *Rules: A Short History of What We Live By*, intellectual historian and philosopher Lorraine Daston presents an ambitious yet accessible history of rules. She argues that, across times and places (but drawing mostly on so-called 'Western' traditions and contexts), there have been three main conceptions of what a rule is. "Since Greco-Roman antiquity, three principal semantic clusters have mapped out the meaning of rules [...]: tools of measurement and calculation; models or paradigms; and laws." (Daston 2022, p.2) Laws (also conceptualized as *principles*) and models require careful judgment in their application; whether a specific law or model is applicable to a particular case is always open to different interpretations, and consid-

erable discretion can be used. By contrast, on the calculative, algorithmic conception of a rule, its application should be purely 'mechanical', with no discretion, ingenuity or judgment involved, no exceptions allowed. One of Daston's main claims is that a significant and fairly recent change regarding the prevalence of each of these three categories took place. Through millennia, rules were primarily interpreted as models or as principles; over the last few centuries, however, rules understood as *algorithms*—mechanical rules akin to calculations—have become more pervasive.

According to Daston, this overall phenomenon occurred in various spheres of life. One of her examples are *cookbooks* (pp.70-76). She notes that, while up to the 17th century, cookbooks were primarily written for fairly experienced cooks (i.e., those who had already received some form of apprenticeship), their 18th century counterparts were primarily pitched at novices. As a result, the earlier books substantially rely on the tacit, prior knowledge of its readers, providing explanations and instructions that are much less explicit than their successors on what exactly needs to be done to cook a particular dish. In turn, the later cookbooks offer a more 'algorithmic' description of cooking procedures, including exact quantities (something usually missing in the earlier cookbooks), such that virtually *anyone*, regardless of their prior cooking abilities, would be able to carry them out. Since the 18th century, cookbooks have become ever more 'algorithmic'. Commenting on Daston's analysis and adding his own experiences with cooking, philosopher C. Thi Nguyen compares two recipes for egg bread:

> The old-school recipe is made up of *principles*, and the new-school recipe is made up of *algorithms*. The old-school recipe requires a bunch of judgment calls to apply, and those calls involve a fair bit of experience with bread [. . .]. The new-school recipe mostly removes judgment calls, substituting various algorithmic rules that can be executed by almost anybody. (Nguyen 2026, p.139-140, emphasis added)

Given their accessibility, it might seem that new-school recipes are *obviously* to be preferred over the cryptic old-school ones; new-school recipes are more *democratic*, as they allow for virtually anyone to cook with them. The same point applies to algorithms for calculation: if all that is required is to follow instructions 'mechanically', with no need for additional judgment, ingenuity or discretion, then anyone can do it, as no substantive prior knowledge and expertise are required. (Daston notes that 'computers' were originally *people* who performed calculations, usually poorly paid workers deemed to be largely unskilled (Daston 2022, p.115).) This democratic import of algorithms echoes Carnap's and Neurath's optimism regarding formalization (broadly understood) as an instrument for liberation and egalitarianism.

But what (if anything,) is lost with new-school, algorithmic cooking recipes? Standardization and quantification make them generalizable and 'portable' through a pro-

cess of abstraction from the peculiarities of particular situations or individuals. And this is exactly their limitation: they do not easily adapt to different circumstances. A new-school recipe to cook a stew will simply state something like '200 gram of diced tomatoes', disregarding the fact that tomatoes can taste very different depending on their kind or provenance: they can be sweeter or more acidic, they can be softer or firmer etc. Old-school recipes contain recommendations on how to adapt to different circumstances (e.g., a sweeter or more acidic tomato), but new-school recipes typically do not (Nguyen 2026, Chap. 11).[30] This means that old-school recipes are in general more 'accurate' in terms of the obtained result – the deliciousness of the dish – since they encourage calibration (including tasting the dish along the way to correct if too acidic or too sweet etc.) and include provisions to deal with widely varying ingredients and circumstances. We are here reminded of Nye's denunciation of logic as teaching us "to ignore the circumstances" (just as new-school recipes do), which according to her leads to alienation and patriarchal oppression.

Nguyen's assessment of the respective advantages and drawbacks of old-school vs. new-school recipes is that neither is inherently 'superior' to the other: "The new-school recipe trades *accuracy* for *accessibility*." (Nguyen 2026, p.143) It is *precisely* what makes new-school recipes accessible that also makes them poorly adaptable, and thus less accurate; it is *precisely* what makes old-school recipes accurate that also makes them inaccessible.[31] This point generalizes to the advantages and drawbacks of formalization, broadly speaking: standardization and quantification offer several advantages in terms of making sense of a vastly complex world (as stressed by Neurath), but they also entail a loss in accuracy when specificities of particular situations are abstracted away (as pointed out by Nye). "Standardized systems work by being rigid across vast scales. This enables frictionless coordination, but with a trade-off: Standardized systems strongly discourage sensitive adaptation to the particular local environment." (Nguyen 2026, p.211)[32] One may think here of the advantages of standardized methods and notations for specific research programs – which allow researchers with different backgrounds to understand each other and compare results – while also recognizing the potential explanatory losses that researchers may incur when adopting a one-fits-all method to explain widely diverse phenomena and contexts. In sum, standardized systems offer *trade-offs*: gains in coordination and accessibility, losses in adaptation to diversity and accuracy (Tanesini 2025, Chapter 3).

But *why* exactly have algorithmic rules become more pervasive in the past centuries, as claimed by Daston? While it is certainly a multi-causal phenomenon (including the increased rationalization of work in industrialized societies), one significant global historical feature of the last centuries has been the European colonial expansion since the 15th century, which, among other things, produced large empires and extensive trading networks. "Not coincidentally, the rise of such ambitious [algorithmic] rules begins with the expansion of trade and empire to global dimensions in the

sixteenth century, which created both the need for and the means to enforce rules that transcended any one locality." (Daston 2022, p.19)

Indeed, algorithmic rules lend themselves to become *tools of empire and state control* (Headrick 1981) by providing procedures to be applied to a wide range of otherwise very dissimilar and locally specific contexts: everything must fit within standardized metrics and rules, even if the (local) fit is poor.[33] Returning to Winner's idea of the politics of artifacts, we may thus tentatively conclude that the value-ladenness of formalization, understood as an artifact, veers toward *centralization and control*, i.e., toward subsuming vastly diverse contexts and situations under standardized rules and procedures.[34] This tendency was openly acknowledged by Neurath, but rather than as an instrument of oppression, he viewed the pull towards centralized control as a solution to the challenge of creating more just, egalitarian societies.[35]

Thus, I submit that a social history of formalization must consider the broader historical context of the European colonial expansion, which non-coincidentally was assisted by scientific knowledge such as mathematical techniques of cartography for exploration and control (Lilley 2020), among others.[36] It is against this general background of Enlightenment scientific optimism on the human ability to *control* (a point also made by Horkheimer and Adorno) that formalization techniques were developed in the 19th century and beyond. To my knowledge, such a social history of formalization and its entanglements with colonial projects is yet to be written. It need not be an exclusively critical, debunking account, and the conclusion will not necessarily be that formalization is inherently an instrument for colonial oppression and must thus be rejected.[37] Broadly understood, formalization has also given us life-saving medical protocols, beneficial public health interventions, optimization of transportation technologies, and similar desirable outcomes. Rather, such a history must recognize the trade-offs involved in developing and adopting technologies of formalization – i.e., both what is gained *and* what is lost – while also openly acknowledging that artifacts do have politics (Winner 1980), and that the politics of formalization lean toward standardization, centralization, and control.

5. Conclusions

As most technologies, techniques of formalization (broadly understood) have desirable as well as undesirable outcomes. In particular, formalization must tread the fine line between establishing illuminating patterns across domains and avoiding the flattening out of important differences and of local, contextual specificities. As a tool for philosophical analysis, formalization has the potential to provide insight and clarity (Pettigrew, Forthcoming), but also poses the risk of creating confusion and alienation. Formalization is ultimately a technology of standardization, centralization, and con-

trol, which in many applications may lead to desirable results (coordination, accessibility, prediction), while at times also oversimplifying an exceedingly complex world and/or supporting oppressive social arrangements.

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Notes

[1]For the purposes of this paper, I am primarily interested in formalization *in philosophy*, and the discussion will draw particularly on what has been said about formalization by means of *logic*, which is arguably the main type of formalization in philosophy, historically speaking. Formalization is a central concept in other areas of inquiry as well, in particular in the social sciences, where it is understood as pertaining to processes of structuring, documenting, or codifying ideas, processes, or relationships into official, standardized formats (Tetrick & Camburn 2004). This sense of formalization will also be relevant here, especially towards the end of the paper.

[2]Formalization as a technology has developed in various intellectual traditions, not only in the so-called 'Western' tradition (Staal 2007). The idea that logical/formal thinking is present only among white Europeans is a colonialist trope, used to justify colonization as a 'civilizing mission' (Ganeri 2001). (See section 5 below).

[3]I adopt a very broad conception of technology, as pertaining to the practical application of scientific and organized knowledge to solve problems, achieve specific goals, or manipulate the human environment. In this sense, it refers to both tangible tools (such as machines and devices, including notational systems) and intangible methods (such as software and engineering systems). (The first person who suggested to me that formal languages can be viewed as technologies was cognitive scientist Rafael Nuñez, who I can't thank enough for such a valuable insight.)

[4]In a similar vein, see (Dos Santos 2026) for an account of logics as cognitive tools.

[5]FLL drew heavily on the extended mind framework, but I now think that the *niche construction/scaffolded cognition framework* offers a more fruitful lens to reflect on technologies in general, and on formal languages and formalization specifically. While the extended mind hypothesis typically includes the idea that bits and pieces of the environment are *constitutive* of human minds, the scaffolded framework emphasizes the role of the environment in supporting and amplifying human cognitive competences without committing to stronger claims of constitutivity. For the purposes of this paper, the details of the extended vs. scaffolded cognition debate will not matter.) See (Sterelny 2010) for a defense of the superiority of the scaffolded framework, and (Tanesini 2025) for a recent and (to my mind) very convincing application of the scaffolded framework to various issues in social epistemology. Chapter 3 of (Tanesini 2025) also discusses issues pertaining to quantification that intersect with the present discussion.

[6]In work with Erich Reck (Dutilh Novaes & Reck 2017), I elaborated further on the debiasing effects of formalisms, referring in particular to statistical prediction rules (SPR) and the work of psychologist Paul Meehl.

[7]Physicist Paul Dirac allegedly stated of what is now known as the 'Dirac equation': "my equation was smarter than I am". He was referring to the fact that the mathematical formalism he was working with predicted the existence of antimatter before it was observed, a result he initially doubted (Wilczek 2004).

[8]The Enlightenment ethos was alive and well also in the 19th century, for example in the positivist philosophy of Auguste Comte, in British utilitarianism, and in various neo-Kantian movements.

[9]"[The theorist engaging in explication] may merely state a few simple rules, or he may prefer a more or less elaborate procedure, and for this he may or may not use an artificial language." (Carnap 1963) (p.936)

[10]See (Dutilh Novaes & Reck 2017) and (Dutilh Novaes 2020a) for more detailed expositions of Carnapian explication.

[11]In his autobiography in the *Living Philosophers* volume, Carnap explicitly noted that he continued to subscribe to the political views first articulated in Vienna. Moreover, he remained engaged in political activism after moving to the USA (Reisch 2005, pp.47-53). But in view of the atmosphere of fear in the 1950s due to McCarthyism and his status as an immigrant, it is conceivable that Carnap felt the need to 'tone down' expressions of his political views.

[12]However, it is worth noting that Carnap's blend of Enlightenment is more self-reflective than a number of other versions, in particular because he was an astute reader of Nietzsche (Sachs 2011). His rejection of the idea of morals in logic embodied in the principle of tolerance can be read as an upshot of Nietzsche's critique of morality in general (Mormann 2012, p.74).

[13]One of his enduring legacies is the development of ISOTYPE (International System of Typographical Picture Education), a method of visual education that used very simple abstract symbols to transmit information to people of all ages, regardless of educational limitations or language barriers. He was also deeply involved in social housing movements until the very end of his life (Okruhlik 2004).

[14]A more recent defense of formalization and 'formality' was presented by sociologist Arthur L. Stinchcombe in his book *When Formality Works* (Stinchcombe 2001). Stinchcombe argues that formal, abstract, and bureaucratic structures can be highly efficient and effective, challenging the common view that such systems usually malfunction. See also (Porter 2020) on the history of quantificational systems.

[15]However, in his later work (in the 1940s), Neurath became critical of certain types of formalization, in particular those that tend to reify the formality of thought at the expense of its matter (a tendency that he identified in the logical works of Carnap and Tarski; Burke & Tuboly 2025, Chapter 5). Neurath may have been influenced by Susan Stebbing when developing this critique, as they became frequent interlocutors after Neurah relocated to the UK. (Thanks to an anonymous referee for raising this point.)

[16]Stebbing was an important interlocutor for the Vienna Circle thinkers in Britain, with whom she agreed on many points but whom she also criticized for their failure to acknowledge the ineliminability of metaphysics (Beaney 2017).

[17]It has been recently re-edited, with introductions on the contemporary significance of the book (Stebbing, 2022).

[18]A very recent defense of the liberatory power of logic, framed as a response to Andrea Nye's criticism to be discussed in the next section, was offered by Sara Uckelman (Uckelman

2025, p.161): "...what makes logic a space, a means, and a tool for freeing people rather than oppressing them, [is] by giving them a space to exploit where their natural tendencies and inclinations lie, independent from their gender..." According to Uckelman, Nye's mistake was to take "her [bad] experiences [with logic] as generalizable, and [to] base sweeping conclusions about the gendered nature of logic on them." Indeed, for some women, defying gender expectations by embracing their interest in logic has empowering, liberating implications. (Thanks to Tamara Dobler for the last point.)

[19]'Logical positivism' is one of the labels used to describe the Vienna Circle; 'logical empiricism' is arguably a more accurate description.

[20]Indeed, while logic may not be a particularly conspicuous example of quantification, other formal frameworks often used in philosophy (probability theory, decision theory, game theory etc.) are clearly quantificational systems.

[21]It is surprising that Nye does not engage with *Dialectic of Enlightenment* at all in her book, especially as she extensively discusses the Vienna Circle thinkers as epitomizing the oppressiveness of logic. Insofar as she was inspired by second-wave feminism, Nye shares with Horkheimer and Adorno a broadly Marxist intellectual heritage.

[22]Another strand of related literature is the critique of 'ideal theory' in political philosophy, such as in Charles Mills' influential paper ''Ideal theory' as ideology' (Mills 2005). According to Mills, the idealized assumptions in, for example, John Rawls' theory of justice abstract away features of the relevant phenomena that are crucial to its proper understanding, thus obscuring the realities of injustice.

[23]Another feminist thinker who offers a sweeping critique of formal logic is Luce Irigaray (Hass 2002). More recently, Franci Mangraviti has explored the connections between logic and epistemic injustice (Mangraviti 2024).

[24]Nye attributes this totalitarian conception of logic primarily to Frege; but its more plausible historical origin is Kant's transcendental idealism, which heavily influenced Frege (Steinberger 2017). Moreover, as pointed out by Audrey Yap (Yap, 2010), Carnap's principle of tolerance is very much at odds with Nye's description of logic as authoritarian/totalitarian.

[25]In my genealogical analysis of the dialogical roots of deduction, I also identify this move towards decontextualization and depersonalization as part of the origin story of deductive logic (Dutilh Novaes 2020b) (Chapter 5 and 6). But whether this *necessarily* entails alienation, as Nye claims, is more controversial.

[26]Nye's use of the concept of alienation echoes the influence of Marxism for second-wave feminism. In a recent paper, Catherine Saint-Croix identifies a fear of alienation as the central motive in Nye's book: "The fear that logic and formalization detach us from what is human. The fear that formalization is some alienation brought down upon us by Men, The West, or whatever target tyrant one prefers." (Saint-Croix, 2026, p.7) Strawson's influential criticism of Carnapian explication as 'changing the subject' can also be read as an instantiation of the alienation worry: "to offer formal explanations of key terms of scientific theories to one who seeks philosophical illumination of essential concepts of non-scientific discourse, is to do something utterly irrelevant—is a sheer misunderstanding, like offering a text-book on physiology to someone who says (with a sigh) that he wished he understood the workings of the human heart." (Strawson, 1963, p.504–505)

[27]See also (Ficara 2024) for a discussion of Plumwood's article in connection with the concept of discrimination.

[28]Of course, the story can also start much earlier and cover the development of formalization in Aristotelian syllogistic, Arabic and Latin medieval logic, the emergence of new notation techniques in pan-Mediterranean trading practices which eventually led to the algebraic notations introduced by Viète and Descartes etc. (Dutilh Novaes 2012, Chapter 3).

[29]My history of formalization in Chapter 3 of (Dutilh Novaes 2012) does contain some elements that go beyond purely theoretical, academic spheres (for example, a discussion of the Mediterranean 'schools of commerce' in the later Middle Ages), but on the whole it largely falls short of adopting the broader social and political perspective that I now think is required. My work on the dialogical roots of deduction (Dutilh Novaes 2020b) can also be read as an attempt at social history, but it is insufficiently attentive to politics and power relations. For a 'social history' of the development of mechanized proof in the 20th century, see (MacKenzie 2004).

[30]Daston (Daston 2022) also introduces the distinction between *thick* and *thin* rules: thick rules are context-sensitive, require judgment, and are filled with exceptions; thin rules are algorithmic, explicit, uniform. Thick rules allow for flexibility, whereas thin rules seek, often unsuccessfully, to eliminate human discretion. The algorithmic rules that became more pervasive in the last centuries, according to Daston, are typically thin rules. In Nguyen's terminology, old-school recipes are *thick*, while new-school recipes are *thin*.

[31]There is an important disanalogy here with respect to formalization in philosophy. One of the concerns of critics of formalization is that, to understand a particular formalization, a reader must first become acquainted with a specific formal theory, which poses entry costs for the non-expert. It is not always clear that this investment is justified, especially if the philosophical analysis in question could also be formulated in 'plain words' with no significant loss of insight. Strawson's critique of Carnapian explication echoes some of these concerns (Strawson 1963).

[32]In Chapter 28 of (Nguyen 2026), Nguyen tells the story of his child's hospitalization to illustrate the beneficial (indeed, sometimes life-saving) effects of standardization. The child was treated by various nurses and medical doctors, all of whom were following (though not purely 'mechanically') a protocol to treat the child's severe asthma. The protocol ensured consistency and continuity in the treatment, while still leaving some room for discretion.

[33]Nguyen (Nguyen 2026) (Chap. 20) discusses this feature of algorithmic rules in connection with the work of political scientist James C. Scott. In *Seeing Like a State* (Scott 2020), Scott criticizes governments' overconfidence in the ability to design and operate societies in accordance with purported scientific laws. But note that this kind of standardization is not unique to the modern era: ancient empires, such as the Roman or the Persian empires, also relied on extensive networks of standardized metrics, rules, and procedures to rule over a wide range of deeply dissimilar local contexts. In recent years, the development of generative AI has also been displaying 'imperialistic' traits, in the form of mathematical tools developed for control and extractivist practices (Mejias & Couldry 2024; Hao 2025).

[34]But at least *some* exercises of formalization come closer to Daston's thick rules than to algorithmic rules. For example, permissivist Bayesian epistemology (Pettigrew 2022) lays down certain general rules for epistemic agents, but those rules do not uniquely determine what an agent should believe; the rules still leave several options open, and thus allow for discretion. (Thanks to Richard Pettigrew for this point.)

[35]Of course, as we now know, "technocratic socialism" was taken to its limit with Stalinism,

leading to horrific consequences.

[36]A telling example of uses of logic to further European colonial projects is a bilingual (English and Massachusett) logical textbook, *Logick Primer*, written by the English Puritan educator and missionary John Eliot and published in 1672 (Uckelman 2024). The goal of the textbook was to teach logic to the Indigenous population so as to facilitate their conversion to Christianity.

[37]Andrea Nye's book can be read as presenting a social history of logic from a feminist perspective. While the project itself is worth pursuing, the details of Nye's analysis have mostly been found to be unconvincing (as noted previously), so more work on the topic is needed. A social history of formalization would focus on how power relations (particularly as based on gender, race, or other social categories) have motivated and shaped the development of techniques of formalization.

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