Computer Ethics - Philosophical Enquiry (CEPE) Proceedings

Volume 2019 *CEPE 2019: Risk & Cybersecurity* Article 14

5-29-2019

Rethinking Algorithmic Bias Through Phenomenology and Pragmatism

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Abstract

In 2017, Amazon discontinued an attempt at developing a hiring algorithm which would enable the company to streamline its hiring processes due to apparent gender discrimination. Specifically, the algorithm, trained on over a decade's worth of resumes submitted to Amazon, learned to penalize applications that contained references to women, that indicated graduation from all women's colleges, or otherwise indicated that an applicant was not male. Amazon's algorithm took up the history of Amazon's applicant pool and integrated it into its present "problematic situation," for the purposes of future action. Consequently, Amazon declared the project a failure: even after attempting to edit the algorithm to ensure neutrality to terms like "women," Amazon executives were not convinced that the algorithm would not engage in biased sorting of applicants. While the incident was held up as yet another way in which bias derailed an application of machine learning, this paper contends that the "failure," viewed phenomenologically and pragmatically, could be articulated as a success. Specifically, this paper contends that if we view the algorithm's bias as making present that which is habitual, or that which fades into the social background, these failures could be valuable tools for evaluating current social and cultural practices. Thus, this paper contends that, rather than treating biased algorithms as "failures," it may be more productive to view algorithmic bias as demonstrative of a social or cultural organization that gives rise to bias. These biased algorithms, therefore, function as modes of diagnosing the ways in which inequalities are institutionalized and replicated within organizations. They are, for John Dewey, forms of technology, insofar as technology refers to the methods of inquiry into problematic situations, which serve to make clear the organization of our society. This paper argues that we should take seriously the results of biased algorithms, not as the projected completion of action, but as processes of inquiry that indicate the ways in which our society is organized to replicate inequality.

Kewords: machine learning, algorithmic bias, pragmatism, naturalism, naturalistic technology

Naturalistic metaphysics

The starting point for John Dewey's naturalistic metaphysics, like Dewey's overall philosophy, is experience. Experience, for Dewey, was not simply the activities of the mind or the processing of our sense experience by our brains: experience referred to the myriad ways that humans exist in nature through culture. In this context, humans are "in nature" in a similar way as a fish is "in water:" nature forms the environmental context and provides the means whereby human life can be human life. To that end, we

are “in nature through culture” insofar as culture provides the ground we can have a “world” and not simply a bio-physical environment. To this end, for Dewey, experience “includes what men do and suffer, what they strive for, love, believe and endure, and also how men act and are acted upon, the ways in which they do and suffer, desire and enjoy, see, believe, imagine—in short, processes of experiencing.” (LW1: 18-19) Additionally, experience includes processes that we would consider “natural,” but are experienced by humanity. In *Experience and Nature*, Dewey indicates “the reaped harvests, the changes of night and day, spring and autumn, wet and dry, heat and cold, that are observed, feared, longed for,” (LW1: 18-19) as part of what is included within the ambit of experience, and all of which take on distinct meanings under the pressures of culture. On this understanding, without culture, there would be no experience of natural phenomena to speak of, as culture provides the ways in which we relate these experiences to ourselves and one another.

Alexander (2013, 4-5) articulates this position succinctly by describing experience as the meaningful ways in which we inhabit the world which form our culture. To this end, we are in nature through culture insofar as culture supplies the ways that we are fully within nature such that the environment is transformed into a locus of meaning. Moreover, culture makes possible the ways whereby we make actual some possibilities of nature, through our transaction with nature as mediated by culture. Dewey expands upon this point by stating “the word ‘experience’ is here taken non-technically. Its nearest equivalents are such words as ‘life,’ ‘history,’ ‘culture’ (in its anthropological use. It does not mean processes and modes of experiencing apart from what is experienced and the way it is experienced, a totality which is broken up and referred to only in ready-made distinctions or by such words as ‘world,’ ‘things,’ ‘objects’ on the one hand, and ‘mind,’ ‘subject,’ ‘person,’ and ‘consciousness’ on the other” (1922, MW 13:351). Here, Dewey is recalling his “Postulate of Immediate Empiricism.” For Dewey, “Immediate empiricism postulates that things—anything, everything, in the ordinary or non-technical use of the term ‘thing’—are what they are experienced as” (MW3:158). Within immediate empiricism, the “reality” of an object is grounded in the situation and the transactions of the individual with the object as denoted within that situation. Dewey uses the example of a horse to demonstrate his claim that if we wish to describe an object, we must describe it as experience by an individual within a situation: for a jockey, the horse is experience in terms of its suitability for riding, and the in terms of the kind of riding to be done; for the zoologist, the horse is experience in terms of its taxonomic classification, and then in terms of the location of that classification within the wider organization of natural organisms; for the child, first encountering it beyond the pages of a picture book, the horse is an object of wonder, of fascination and delight. Within immediate empiricism, the distinction between the accounts of the horse do not point to an absolutely real horse which grounds all other horses; rather, “what is experienced will manifest that it is the account of the horse-dealer, or of the zoologist, etc., and hence will give the conditions requisite for understanding the differences as well as the agreements” (MW3:158), or the unique ways in which the natural history of the horse is organized in the experiences of the different individuals as what gives rise to the multiple ways of experience the horse as real.

It should be noted that Dewey does not articulate the horse as “known” to an experiencer in the examples provided. The postulate does not treat reality as grounded

in or identical with the object of knowledge; rather, on this view knowledge is just one type of experience which does not claim priority over other ways of experiencing the world. Insofar as the postulate presents experience in its myriad forms as primary, Dewey rejects the assertion that all instances of experiencing are at once instances of knowing or knowledge generation. Put another way, experiencing the sweetness of an apple is not identical with knowing the apple is sweet or knowing the sweetness of an apple is characteristic of apples; instead, an apple is experiences as a sweet apple in the moment of an interaction with the apple through biting into it. It is an experience of tasting the sweetness of an apple, as opposed to *knowing* the apple tastes sweet which only occurs through a process of inquiry that serves to reorganize the indeterminate situation of what the apple tastes like into a more determinate situation that consummates in knowing the sweetness of an apple as a quality of apples. To be clear, biting into the apple may be such a process of inquiry that consummates in understanding or knowing the apple as sweet, however, such a process is directed by interest in resolving the problematic situation of not knowing what the apple tastes like. The activity of biting into the apple as a process of inquiry reorganizes the problematic situation through our transaction with the apple and allows use to denote the sweetness of the apple in the experience of biting into the apple, however, the reality of the apple and the experience of the apple and its sweetness far exceeds the knowing of the apple as sweet. The reality of the apple includes the conditions whereby we come to know the flavor experienced as sweetness, but sweetness distinct from a pear or a tangerine. In short, the reality of the apple is inclusive of all the ways that the apple may be experience, how it is experienced, and in what contexts the apples is experienced. It is the latter that will have bearing on Dewey's naturalistic metaphysics, specifically insofar as it seeks a descriptive end which includes the immanent possibilities in situations as opposed to a search for Aristotelian "first principles" as characterizes much of western metaphysics. In contrast, Dewey's naturalism returns not just to the processes of reflection and contemplation of absolute causes, as prescribed in Aristotle's metaphysics as first principles, but to the activities within situations presupposed in the foregoing discussion of experience and the postulate of immediate empiricism. Activity, or transaction, with the world is thus the kernel of experience as explained by Alexander "by the Postulate of Immediate Empiricism, "reality" (existence or nature) is revealed just as much in practical action as in contemplation. Insofar as practical conduct has been ignored or devalued compared with theoretical insight, it has not been given serious ontological status either. Indeed, knowing is part of the practical world of action; it seeks to make a difference in conduct" (Alexander 2018, 6). Conduct, for Dewey, always takes place in a situation, which Dewey describes as "the primary realities," or the contexts in which experience occurs and is discriminated from other experiences. To this end, "it is the situation that is doubtful or consummatory, not some subjective mental "idea." Doubt is in the situation before it can be assigned either to an object or a subject," (Alexander 2018, 6) which is to say that all the qualities of experience articulated previously are qualities of situations immanent in the situation and made actual through activity within that situation. It is only through reflection upon the experience after it has been undergone and consummated that we may identify the salient features of the situation as qualities of our ongoing experiences.

Situations, as Dewey's "primary realities" are the point from which experience unfolds as well as the context in which experience occurs. As such, situations are "primarily organized, active, lived experiences unified by a prelogical or pre-analytical qualitative unity which gives them their continuity and sense," (Alexander 1987, 105) which is to say that a situation has a defining quality that unites all elements of the situation into a continuous, developing whole which is made determinate through the processes of inquiry that enter into the situation as it is experienced. Further, situations "are "about" a subject matter and they have a teleological focus, an "intentional" dimension, i.e., something toward which they are oriented dynamically" (Alexander 1987, 105). Situations are always towards or about some subject or issue that has meaning for the individual involved: it is this "aboutness" that serves to direct the processes of inquiry that resolve the situation, as well as what becomes noted as the pervading quality of the situation upon reflection. This "aboutness," while sensed pre-reflectively, is made clear through the organization of the situation into a dramatic structure, or to recognize the temporal continuity of the situation as developmental and not simply sequential: a situation grows through time as the situation is rendered determinate through our transactions within it and with the environment that it interpenetrates. Situations, therefore, may be composed of multiple aspects that are integrated together temporally or dramatically through processes of inquiry which enable the situation to more from indeterminacy to clarity. In other words, "the unity of a plurality of events or interactions mark it out as an affair or "event." The various "parts" become aspects of a certain subject, organized so that they cooperate to realize an end – they become parts. In conscious experience, this unity is qualitatively apprehended in a prereflective manner." (Alexander, 1987, 104) This qualitative unity is, in short, what we ask about when we are struck by an object, when we ask "what happened," or "what's going on," or "how did this happen," all of which are the starting points for the reconstruction of experience through consciousness as it deploys processes of inquiry which consummate in the meaning of the situation and the qualitative unity that emerges as the situation is reconstructed.

The need for reconstruction of the situation is implicit in the very organization of the situation as "situations have an indefinite "horizon" with a defining pervasive quality; they also have a "focus," a vortex of transformation which manifests itself in human experience as the "tensive" or "problematic." Around this focus is the "context" that includes variously discriminated objects, functions, and values that can be denoted" (Alexander, 2013, 110). While the horizon of the situation is the source of the quality that makes a situation as unique, it is the problematic that we most often consciously encounter in our ongoing experience in the world. For Dewey, every situation has a fundamental tension between the stable and the precarious which is reflected in and continuous with an organism's transactions with the environment. An organism seeks to maintain an equilibrium between the sable and precarious elements within its environment by mediating the two poles of the stable and the precarious through transactions with the environment which seek to maintain this equilibrium. When the organism's equilibrium is disrupted, perhaps in the case of a loud noise which causes us to ask "what was that," the situation of the organism tends towards the problematic: it is this disruption in the environment which pushes the organism to engage in processes of inquiry, in this case identifying the source of the sound, to resolve the problematic

situation through taking action within that situation. This action is also a *transaction* with the environment which consummates in a changed relationship between the organism and the environment such that both the organism and the environment attain a new equilibrium. In the case of the loud noise, the process of inquiry may terminate in the slamming of a door, the banging of a branch against a window, or the backfire of an engine all of which reorient the organism towards the environment. It is in the process of this transactional relation that some possibilities immanent in the "horizon" of the situation are made actual through the transformation of the situation such that new meanings emerge because of the resolution of the situation. This process of transaction does not happen in a vacuum: the ways in which we are in nature through culture, and culture as supplying the modes whereby we make sense of a situation, ultimately narrow the range of possibilities that can be made actual through transaction with the environment in the situation. This is not to say that these possibilities are solely determined by culture, but that because culture transforms a bio-physical environment into a "world," culture structures much of the modes through which we transact with the environment and the ways in which we can have experience. To this end, as with the apple in the example above, the cultural history and the history of the individual enter into a situation to structure the possibilities of nature that can be actualized. "And it is to this localized field of history and possibility that Dewey gives the technical term "situation." A situation includes involves human involvement insofar as human beings have learned to respond to present events in terms of their possibilities and their histories, thereby making these features part of the meaning of the present as a field of activity" (Alexander 2018, 8).

The foregoing articulation of experience and situations sets forth the context for Dewey's naturalistic metaphysics. Taking experience and the way that it reveals and makes actual the possibilities of nature through the transaction between the organism and the environment as his starting point, Dewey's naturalistic metaphysics is not concerned with the search for Aristotelian "first principles," or ultimate causes, as stated previously. Instead, metaphysics would begin by noting empirically the existence of a phenomena within nature as an actualization of a possibility of nature and then proceed to indicate the conditions under which such a possibility becomes an actuality. In so doing, this metaphysics would seek to establish a continuity, not identity, of the present more complex processes with the less complex processes out of which they grow: it would seek to establish a history of the phenomena and then seek to situate this history within a wider universe that makes possible both the history and the fully mature phenomena in question. With regards to the development of this history as part of the project of metaphysics, Dewey states "In each case we may trace its history to an earlier state of things. But in each case, its history is what we trace, and the history always lands us at some state of things in the past, regarding which the same question might be asked" (MW8:5). History, here, is not an attempt to give a causal account of the occurrence of the phenomena, rather; tracing the history of the phenomena seeks to describe the temporal processes whereby the current phenomena under consideration comes to exist within a wider universe that makes possible such an existence. Alexander, in his discussion of eco-ontology which builds upon Dewey's naturalistic metaphysics, describes Dewey's position thusly: "history necessarily includes a narrative of how various potentialities are actualized and come to constitute the factical

history of that being. We understand "what" the thing is in terms of seeing the world it comes from and how it functioned within it." (Alexander 2013, 96) Function, in the preceding, should be understood as referring to the ways in which the thing, object, or event transacts with the environment such that the thing and the environment are transformed, more specifically, for Dewey, function is related to his understanding of "process" and "structure." Dewey states, "[b]y process is meant the manifestation of energy in a change; by structure the arrangement of energies in a relatively static or enduring form; by function, the consequences that give meaning or significance to processes and structures…. Processes refer to the (relatively) dynamic factor; structure to the (relatively) static, and function to the 'ends' maintained and subserved–the phase of use and purpose" (MW15:247), which is to say that an entity will be understood in terms of seeing the world it comes from and the overall effect that the entity has upon the total system of relations in which it is embedded, or the meaning of the thing as it transacts with the world it comes from.

This method of metaphysics, within Dewey's overall philosophy, is referred to the "empirical-denotative method," which Alexander, in his eco-ontology, articulates as the method whereby we understand an object according to its "natural history,"

> An event will be understood—always provisionally—in terms of the situational interactions that constitute its history and its contemporary potentialities. "Natural history" designates the account of how a thing comes to be within its situated contexts. This is an environmental concept, since it locates any individual within its ambit and understands it in terms of interacting with the actualities and potentialities of that ambit. To be is to be the product of a history. (Alexander, 2013, 96)

Metaphysics, for Dewey is a historical, narrative project that seeks to describe how an entity comes to be within a universe that makes possible the existence of the entity. This metaphysics concerns itself with describing the kind of world that makes possible such an entity, through locating the history of that entity within the world from which it emerged. This emphasis upon the world from which an entity emerged is crucial for understanding Dewey's naturalistic metaphysics: as no event, culture, organism, or individual can exist except through transaction with an environment, or a world, the project of metaphysics must undertake the consideration of the world that makes possible and existence and not simply the "first causes." Moreover, under this metaphysics, even the "first principles" that are the object of traditional metaphysical inquiry can only be denoted within a world or a situation and then only as part of the historical narrative that establishes how the entity came to be within this world. To this end, "first causes," if such things are to be denoted, are taken not as the end of the object's history, but as one element in the narrative that accounts for its origin within the world. To this end, the above roots Dewey's naturalistic metaphysics in the world, as opposed to treating metaphysics as separate from the world of experience, through the emphasis on understanding an object *within* its situated context, or within nature itself. To understand a thing in terms of its natural history it to understand it within the world and as part of the world, and not as the result of forces "beyond" the world or outside of nature. Indeed, Dewey's naturalistic metaphysics insists on the continuity of things and

the world, of the lesser with the more complex as a process of growth and development from. To this end, “Metaphysics for him is a prolonged meditation on how human history has engaged Nature so that its pervasive, diverse features, its “ways,” can be gradually discerned, articulated, and become recognized in the array of our experiences. Metaphysics reveals continuities.” (Alexander, 2013, 109)

The return of metaphysics to experience is crucial given Dewey’s identification of experience and culture. As “metaphysics deals with how Nature reveals itself throughout the range of human existence,” (Alexander 2013, 108), metaphysics also indicates the continuity of nature with culture insofar as culture allows us to make sense of the world through the ways that cultures, as creative responses to the world, transform bio-physical environments into “worlds” of meaning and value for humans (Alexander 2013). Metaphysics, as a cultural project which locates things within the world as continuous with the world from which they emerge, is also a project that seeks to articulate the ways in which nature is made manifest in the worlds established by cultures in their transformation of environments into worlds of meaning and value. To this end, not only does metaphysics establish the continuities of things with nature, it also establishes the continuities of things with culture as things are experienced as possibilities of nature made actual through culture. Naturalistic metaphysics, therefore, not only reveals the ways of nature, the ways that things are in nature through their transformation of their environments, it interrogates the kinds of worlds necessary for the ways of nature to be as they are, to make actual some possibilities of nature and not others. Thus, “metaphysics would raise the question of the sort of world which has such an evolution, not the sort of world which causes it.” (MW8:4)

Naturalistic technology

To date, Larry Hickman has provided one of the most systematic accounts of John Dewey’s theory of technology in his book *John Dewey’s Pragmatic Technology*. As such, our articulation of a naturalistic theory of technology through Dewey will take Hickman’s work at its starting point, beginning with his thesis that “inquiry within technological fields, among which he included science as well as the fine and the vernacular arts, formed the basis of and provided the models for Dewey's larger project: his analysis and critique of the meanings of human experience” (Hickman 1990, 1). Dewey’s use of the word “technology,” like “experience” and “culture” is not restricted to the common understanding of technology which Dewey took to be grounded in the “productive fields” of the physical sciences. Technology, for Dewey, “is systematic inquiry into the invention, development, and production of tools and other artifacts (conceptual as well as material) as they are cognitively deployed to raw materials and intermediate stock parts (conceptual as well as material) with a view to the resolution of indeterminate or problematic situations” (Hickman 2017, 2). Of note is the inclusion of conceptual as well as material tools in the above definition of technology: for Dewey, the primary distinction between a conceptual tool as technology and a material tool as technology was the raw materials to which the tools are applied in the resolution of a problematic situation, and not their nature as tools. This blurring of the line between the conceptual tool and the material tool is a point to which we will return, however, it

stands to reason that if technology is to be applied in the resolution of a problematic situation, not all examples of technology will be material as not all problematic situations require a material solution.

For Dewey, the process of resolving a problematic situation required experimentation: the testing out in experience of a variety of means to resolve problematic situation through the deployment of tools to control the outcome of situations. Elsewhere, Dewey refers to this experimental practice as "dramatic rehearsal," or the activity of trying out courses of action in imagination before applying them within a problematic situation, which is key to Dewey's theory of communication;[i] however, the outcomes of the two processes are not distinct: the development of methodologies and tools whereby one might resolve a problematic situation. Dewey defines experimentation as "the art of conducting a sequence of observations in which natural conditions are intentionally altered and controlled in ways which will disclose, discover, natural subject-matters which would not otherwise have been noted" (LW 1:339). Tools supply the means whereby "natural conditions are intentionally altered" such that they disclose new possibilities of nature inherent within a situation. While Dewey does not explicitly name situations as the object to which the tool is applied, we may derive this meaning from Dewey's naturalistic metaphysics articulated earlier, specifically his expansive view of nature. To this end, "natural conditions" do not simply refer to the conditions of nature as determined by the natural or physical sciences: "natural conditions" intend the whole of the environment in which an organism is in transaction. In keeping with Dewey's naturalistic metaphysics, "natural conditions" would include all those conditions that make possible a specific phenomenon within a given world, including cultural conditions, and is coextensive with the "natural history" of the phenomena. It is in this vein that Dewey's understanding of meaning becomes valuable for articulating elements of his theory of technology as presented above: "Meaning, fixed as essence in a term of discourse, may be imaginatively administered and manipulated, experimented with. Just as we overtly manipulate things, making new separations and combinations, thereby introducing things into new contexts and environments, so we bring together logical universals in discourse, where they copulate and breed new meanings" (LW 1:152). Taken in the context of experimentation above, conceptual tools allow us to engage in the manipulation of meanings in new and unique combinations, to apply those meanings through controlling the "natural conditions" of the situation in which they are applied, such that new meanings as possibilities of nature emerge. Meanings become technological insofar as they are deployed and produced to make clear the indeterminacy of problematic situations broadly defined. Put another way, we combine and recombine meanings through experimentation to disclose new meanings as possibilities of nature such that they can be deployed in a variety of novels situations as the meaning of the resolution of those situations.

In this context, we might describe this view of meaning as technology as "functional" or "instrumental," in the sense that meaning as technology allows us to control the outcome of a situation such that the articulation of the meaning acts as an "end-in-view" which serves to control and direct the means used to resolve this situation. As such, this view of meaning as technology as "functional" or "instrumental," for Dewey, also indicates the ways in which the values of a culture or an individual are taken up in the development of meanings as tools such that they enable intelligent

organisms to select among competing ends-in-view as the projected completion of action. As action is always taken within a situation and, ideally, leads to a changed relationship between the organism and the environment, these ends-in-view are both the terminus of a specific process of inquiry and the point from which a new process of inquiry begins. As such, ends-in-view are "instrumental" in the sense that an end-in-view is also an instrument, a tool whereby an organism may engage in further inquiry within the new situation of its changed relationship with the environment. (Hickman 2017, 4)

As the projected completion of action which resolves a situation, an end-in-view is thus a conceptual tool not unlike meaning itself. However, while meaning and ends-in-view are both conceptual tools, they are not distinct from physical tools, like a hammer, in their nature as tools: "it is their function in practice and not their structural features that determine them as instruments" (Hickman 2017, 4). To this end, it is not valuable to speak of the essence of a tool or the essence of technology as such; instead, we might consider that something becomes a tool when set to the purposes some aim or end-in-view. Here, we might note a similarity in this articulation of tools and technology to Dewey's postulate of immediate empiricism: where as the postulate presented things as what they are experienced as, this view of technology states that a tool becomes a tool when it is *experienced* as the means of accomplishing some aim or an end-in-view.

The above returns technology not only to nature as a possibility of nature through culture, but as the means whereby such possibilities are disclosed and part of the activities of living organisms in their transactions with the environment. In keeping with the experiential, naturalistic mode of Dewey's philosophy of technology, "a particular object may be a tool in one situation and not in another. Something becomes a tool only when it is used to do some kind of work" (Hickman, 1990, 22). Again, "work," here, is not merely to be thought of in terms of physical or manual labor, but in terms of the ways that the tool resolves the problematic situation within which it is deployed. To this end, the situated nature of the tool comes into focus: a tool becomes a tool when it is deemed appropriate for resolving the problematic situation at hand. A tool that fails to resolve the situation does not cease to be a tool, rather; it is not the appropriate tool for the reorganization of the problematic situation such that it comes to a satisfactory consummation. This tool may resolve the situation in ways that make the situation further problematic, or in ways that require additional application: we might consider the example of the crutch which no longer serves its purpose once the broken leg has healed. In the situation of the broken leg, the tool of the crutch provided essential support and an aide in maintaining mobility. However, once the leg has mended, the crutch was no longer necessary to resolve the problematic situation of impaired mobility and thus became a burden to the user. In this sense, as the situation changed, so too did the nature of the tool: the crutch did not cease to be a tool, it ceased to be a tool appropriate for the situation of the organism. Bearing this in mind, tools are always provisional, always subject to refinement and development, "a tool is in this sense a theory, a proposal, a recommended method or course of action. It is only a proposal and not a solution per se because it must be tested against the problematic material for the sake of which it has been created or selected. Some tools are not appropriate to the settlement of a particular situation, but may be forced upon it in any case" (Hickman, 1990, 22). Tools are only potential modes of resolving a problematic situation and must be tested experimentally against the situation itself to determine their suitability for

application within the situation and future situations. As “the purpose of the tool is to reorganize the experience in some way that will overcome its disparity, its incompatibility, or its inconsistency” (Hickman 1990, 21), we must bear in mind that a tool will only act as a tool within a given situation insofar as it is suitable to the aim of the reorganization of an experience to overcome its problematic nature. However, the suitability of a tool can only be determined experimentally through testing the tool against the “raw material” of the situation: tools disclose their possibilities as tools through their engagement within the situation, through being tried in experience, and not through some means external to the experience of their use.

This point returns us to Hickman’s initial articulation of technology as the development of tools deployed against raw materials to resolve problematic situations. For Dewey, the raw materials of different situations are not just the consequence of the variations among situations: they are the results of the disciplines from which the tools are drawn and the ways that each discipline deploys its tools to resolve problematic situations. This variety of raw materials to which tools are applied is grounded in the fact that, as indicated above, tools are not external to the situation: rather, tools enter into the situation through their selection by means of recognizing their potential application to the situation at hand (Hickman 1990, 23). Here, we may expand upon Hickman’s articulation of Dewey’s theory of technology through the introduction of Alexander’s natural history: how we recognize the suitability of some tools for some situations and not others is not simply through our own experimentation, but through drawing upon the natural history of the tool as a tool, or the ways that it has functioned to resolve similar problematic situation. The tools for art, for example, may be better equipped to resolve the problematic situation of the expression of love between lovers than the tools of science; however, within the domain of art, some forms of technology, some tools may be more suited to the resolution of the problematic situation than others. A sonnet, for example, may be better suited to resolving the problematic situation of expression than an opera, and a song may be better suited than a sonnet depending upon the ways that the tool enters into the situation. However, while each of these tools must be tested for suitability before they can be determined as the appropriate means to resolve the situation, we may provisionally determine that a sonnet may be a more appropriate tool for the expression of love between new lovers than an opera through our understanding of the natural history of both the sonnet and the opera and the ways that this history structures how the sonnet and the opera function within our world.

While understanding tools through their natural history may serve as a guide for their historical and ongoing deployment in situations, tools may still need to be tested against the raw materials of current situations, particularly as situations are in constant development and do not remain static. While this testing of tools against situations is experimental in the sense articulated previously, it is also subject to a process of inquiry that determines the suitability of the tool for the situation. We might state that the process of testing tools against situations, and how that testing is performed, is itself a process of inquiry in keeping with Hickman’s articulation of Dewey’s overall technological project. Technology, therefore is “an active method of generating and testing new skills as well as reconstructing old ones” (Hickman 1990, 20) and as an active method, it requires the direction of intelligence. For Dewey, intelligence is the ability to see the actual in light of the possible, to recognize what is in light of what could

be such that a situation can be directed to make actual some possibilities and not others. Intelligence, in this sense, is implicit in the understanding of technology previously presented: in order to test new skills and reconstruct old skills, the actuality of these skills must be viewed in light of their possible reconstruction or the possible outcomes of their testing. Moreover, this intelligent control over the testing of skills is not distinct from the same intelligent control that deploys tools in the reorganization of situations and is also the sense of intelligence control that is deployed in the remaking of raw material or a medium to create something new. This sense of intelligent control over raw materials, is also the way in which Dewey describes the process of creating art, a point which Hickman emphasizes in an additional expansion of Dewey's view of technology:

> Dewey variously writes of technology as the active use of productive skills; as the most satisfactory method of inquiry; as production within the fine, vernacular, and industrial arts; as what distinguished the scientific revolution of the century of Galileo from the science prior to it; as the general use of tools (including language, which he calls the tool of tools); as industry and commerce; as an essential ingredient in education; and as planning in the various forms in which it corresponds to specific human social and political arrangements. (Hickman 1990, 85)

Here we have an expansive understanding of technology which brings together the multiple ways that technology has been articulated across Dewey's corpus and within the context of this naturalistic theory of technology. Insofar as we are in nature through culture, it is unsurprising that a theory of naturalistic technology would encompass under its ambit a variety of "tools" whereby we resolve problematic situations including those found within the social life of the human organism. Of note, however, is the articulation of technology as a process of inquiry. For Dewey, "Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole" (LW12:108) which places inquiry at the center of the articulation of natural histories and the center of Dewey's project for a naturalistic metaphysics sketched previously. To this end, if technology is the development of tools to resolve problematic situations, then technology is also a methodology whereby situations are made determinate. In short, technology has as one of its aims the improvement and development of those processes of inquiry whereby we render our problematic situations more determinate through their deployment within those situations. Thus, in Hickman's articulation, for Dewey "in at least one important sense technology can be said to be the appropriate transformation of a problematic situation, undertaken by means of the instrumentalities of inquiry, whatever form those instrumentalities may take" (Hickman 1990, 44-45) which is to say that inquiry itself is technological insofar as inquire requires the intelligent manipulation and control over the conditions of nature such that some consequences rather than others are the consummation of the situation as encountered.

There is at least one final element of Dewey's naturalistic philosophy of technology that needs to be explored before we may apply it fully to algorithms and

algorithmic bias: the capacity for technology to be self-correcting in its deployment in human experience. This is not to say that technology will be autonomously self-correcting; rather, as Dewey states in describing two modes of knowledge as technology in *Unmodern Philosophy and Modern Philosophy*:

> The view that, philosophically speaking, knowledge is one form, a central form, of technology does not mean that its subject matter and products are specifically similar to technologies exhibited in production of commonalities and services in the electrical industry or in transportation or application of bio-chemistry in agriculture. It means that knowledge is, first, a form of technology in the methods it employs in producing more knowledge and improving its own methods, and, furthermore, is capable of being a technology in human social guidance of technologies now called such but whose human and social consequences are left a matter of pulling and hauling of conflicting customs and institutions which are hardly touched by effective use of the method of intelligence at work. What I called the first affair constitutes the philosophical problem of knowledge in its narrower sense. The second matter defines the philosophical problem of knowledge in its wider human and moral sense. (Dewey, 2012, 244)

To be clear, for Dewey, knowledge becomes technological when knowledge is treated as the artifact of a process of production, whereby Dewey intends the processes of inquiry that generate the means to control the outcomes of situation. This treatment of processes of inquiry as productive, with knowledge as its artifact, is coextensive with Dewey's understanding of the plurality of technologies that radiate outwards from our transactions with society. However, for the purposes of this outline, I would like to focus on the two modes of technology indicated by Dewey in the above quotation. The first mode of knowledge as technology is that in which knowledge exhibits the capacity to engage in the production and refinement of knowledge in ways that are self-corrective. Recall that technology is itself inquiry into the tools of inquiry and, as such, produces knowledge about these tools. Here, we should bear in mind that technology includes a wide array of activities, the products of which can be deployed upon the raw materials of the methods of inquiry and the knowledge produced by other fields. Knowledge as technology in this mode enables the production of more knowledge as the knowledge produced is used within problematic situations to resolve these situations, including those for which the application is novel or unique. This, then, follows from the working of technology across fields, a mode of trans-action, as opposed to merely limiting technology to application within the productive or technical fields. As knowledge is but one phase of experience, the consummation of knowledge as a phase of experience ultimately returns knowledge to the experience from which it emerged: in so doing, said knowledge serves to enrich and widen the experience through its application in the ongoing situation. Thus, knowledge as technology displays one of the fundamental characteristics of all technology: the capacity for the processes of inquiry which served as its modes of production to be turned back upon the production of knowledge as a tool in order for that tool to be improved in not only its development but in its application to the raw materials of the problematic situations to which it is applied.

The second mode of knowledge as technology, that which “defines the philosophical problem of knowledge in its wider human and moral sense” (Dewey, 2012, 244), structures Dewey’s argument that the failure of technology can only be remedied by the application of more technology, in the mode articulated above, as opposed to abandoning the technology altogether. This is not to say that Dewey was arguing that technological solution to the problems of technology or society, in the sense argued by proponents of an increasingly technologized society, is what is necessary. Rather, Dewey is arguing that more inquiry into the tools and processes of inquiry that developed the failed technologies is necessary to guide the moral use of technology, or what Hickman describes as Dewey’s “humane technology.” Said technology, for Hickman, is human insofar as it takes into account the human context in which the technology failed, and the degree to which technology should be guided by sensitivity to the ways that humans transact with a bio-physical environment given meaning through culture. Thus, for Dewey, the interpenetration of the humanities, the social sciences, the arts with the more productive fields of technology was necessary to address the deployment of technologies throughout the breadth od humane experience. Technological development, particularly in response to technological failure, was not solely the province of the productive fields, nor was it to be assumed that the results of technological development are maximally beneficial to humanity. As Hickman notes, “What is regarded as a technical success can suddenly and inexplicably turn into a situation that is deeply problematic. Unintended and deleterious consequences can, and often do, arise from matters thought satisfactorily settled. Dewey finds the source of difficulties of this type not in "technology," in the sense of the application of technical methods to unsettled situations, but in the very precariousness of existence” (Hickman 1990, 157). That is to say that the very precarious nature of human existence is what grounds the possibility of technology transforming settled situation into situations that become further problematic through the ways that the technology as applied disclose possibilities of nature, consummations of situations, that are not strictly positive. As indicated in the previous discussion, the source of the problem is within the situation itself and it is the application of the technology as tool, as a proves of inquiry, and as an activity that results in the actualization of the situation as problematic. For Dewey, the appropriate result is the deployment of other processes of inquiry, other forms of technology, to resolve the situation through inquiry into the tools or the situation itself.

Algorithms as naturalistic technology and a process of inquiry

In order to rethink algorithmic bias through American Pragmatism, we need to consider algorithms as technology through American Pragmatism. That is, we need to reconsider the ways in which we view algorithms as technology, not in the material since commonly understood, but in the senses articulated above through John Dewey and Larry Hickman: algorithms as a process of inquiry, and a process whereby an artifact is produced. In the mode of the former, what will follow is a straight-forwards application of the theory of naturalistic technology sketched above; in the mode of the latter, the following will only briefly consider the kinds of “artifacts” produced through algorithms as processes of inquiry as articulated above.

Rather than attempting to develop a new definition of algorithms as naturalistic technology, this work will consider several definitions of "algorithms" in use within current discourse on the role of algorithms in society through the lens of the naturalistic philosophy of technology. To begin, Ananny (2016) defines an algorithm by stating the following: "Computer science defines an algorithm as a ''description of the method by which a task is to be accomplished'' (Goffey 2008, 15). Rendered in any programming language and judged according to how quickly and reliably they transform known inputs into desired outcomes, algorithms are generic solutions for well-defined problems" (Ananny 2016, 97). If we are to take Ananny's definition seriously, several parallels with the naturalistic theory of technology above become immediately clear. Specifically, Ananny's treatment of the algorithm as a "description of the method by which a task is to be accomplished" aligns with Dewey's understanding of technology as a process of inquiry and as a mode of production. For Dewey, any technology as process of inquiry provides, as articulated above, a potential course of action to resolve a problematic situation though the engagement of inquiry into the situation itself. Insofar as algorithms describe the method by which a task is to be accomplished, the algorithm organizes and controls the conditions of the situation in favor of some outcomes as revealed as possibilities of the consummation of situation and not others. To this end, that algorithms "transform known inputs into desired outcomes" indicates the ways in which algorithms as tools are deployed against the raw materials of the situation to transform the conditions of the situation, what the quotation describes as "known inputs," into desired outcomes: what is not made clear by the quotation is the process of transforming the conditions of nature into the inputs to be transformed into desired outcomes. However, for Dewey, how the algorithm accomplishes this task should be the subject additional processes of inquiry when the algorithm engages in the reorganization of a problematic situation in such a way as to further make problematic the situation itself. The primary value of this definition of algorithms for this project is to indicate the ways in which algorithms themselves are processes of inquiry whereby natural conditions of situations are manipulated in favor of some outcomes and not others through the control over said natural conditions.

Before proceeding to the next definition of algorithms to be considered, it is necessary to consider Ananny's statement that "algorithms are generic solutions for well defined problems," which seems to contrast with Dewey's understanding of technology as a potential course of action, a potential mode of resolving a problematic situation. To be clear, for Dewey, problems become well defined through the application of processes of inquiry within them: situations do not present themselves as "well defined" in the encounter with them in experience. While a problematic situation might present itself immediately as a question as to how to cross a river, or how to secure food from an environment, these situations are not strictly well defined: as presented above a situation comes with a fringe, a horizon that supplies its quality, which becomes more definite as we transact within the situation. The transaction as the situation develops is what enables the situation to become more well defined, or to become "clear" in the words of Dewey and Alexander. To this end, the definition of algorithms as solutions to problems that are well defined would limit the scope of the application of the algorithm as tool to those situations whose qualitative unity, whose fringe, is defined well enough for application to the situation. In short, this understanding undercuts the "generic"

nature of the applications of algorithms as solution to problems: for Dewey, an algorithm as described is a specific tool to be applied in a situation after the situation has been made minimally determinate. That is, an algorithm is a tool to be applied after the individual in the situation has determined that an algorithm is the means whereby the situation can be fully resolved through the controlling of the conditions of nature such that some outcomes are more likely as possibilities of nature over others. An algorithm under this definition requires other processes of inquiry to have been applied within the situation such that the situation has been rendered determinate enough for its application.

In light of the above, we might reframe Ananny's definition through the rethinking of the ways in which descriptions of methods whereby a task to be accomplished are themselves "generic" insofar as they become solutions when tested against the raw material of the situation. In Dewey's view of technology, technology may furnish potential solutions through processes of inquiry in their application to the raw materials of the situation such that the solutions become apparent as possibilities of nature through the application of technology as tool. Algorithms are "generic" in the sense that any potential tool is "generic" before its application to a specific situation: a tool becomes a tool for the purposes of resolving the situation when it is applied to the raw materials of the situations. Algorithms, therefore, are generic methods whereby a task may be accomplished and furnish solutions only after their application and testing against the raw materials of the situation. To this end, algorithms are not "generic solutions to problems," they are generic methods of disclosing possible solutions to problems through the means whereby they transform the conditions of the situation in question into known inputs such that they can be controlled to furnish desired outcomes as solutions to problems. Algorithms, like all other things, become technological through their application in situations: they are not "technology" or "solutions," in the sense that Dewey intends, prior to their application to the raw materials of the situation in question. Moreover, in Ananny's description, the judgment of an algorithm as better or worse on the basis of how "quickly and reliably" they engage in the transformation of the problematic situation is also in need of revision: speed of resolution may be valuable in some situations, where a range of outcomes is ultimately necessary for immediate actions, however is not a crucial determination of the value of an algorithm. Reliability, on the other hand, may be more valuable for a critique of an algorithm's suitability in the application to the situation. Reframed in Dewey's naturalistic technology, an algorithm is "reliable" insofar as the ways in which it transforms the raw materials of the situation into known inputs which can then be controlled in favor of some outcomes and not others is broadly applicable in a range of situations and provides the outcomes as possibilities of nature. In this reframing, the solutions furnished as possibilities of inquiry are grounded in the ways in which the algorithm transforms the conditions of the situation into known inputs which are then controlled in ways to provide these solutions. Here, for Dewey, we would encounter the limits of the algorithm as tool: the constraints of the kinds of transformations of a situation into "known inputs" an algorithm can engage in are limited by the methods of inquiry the algorithm engages in to transform the natural conditions into "known inputs," which themselves are modes of technology. To this end, if we are to reconsider Ananny's definition of algorithms under Dewey's naturalistic technology, it is not simply than an algorithm is a single process of inquiry that enables the resolution

of a problematic situation, rather; the algorithm is a collection of processes of inquiry that transform the conditions of nature that structure the fringe of the situation into "known inputs" which are then controlled in favor of some solutions or possibilities of nature and not others. However, Dewey would question the understanding of "known inputs" in the operation of algorithms insofar as we must ask "to whom are these inputs known?"

Gillespie, (2014) provides an additional expansion on Ananny's definition as described above, stating, "Algorithms need not be software: in the broadest sense, they are encoded procedures for transforming input data into a desired output, based on specified calculations. The procedures name both a problem and the steps by which it should be solved. Instructions for navigation may be considered an algorithm, or the mathematical formulas required to predict the movement of a celestial body across the sky" (Gillespie 2014, 167). Here, Gillespie expands upon the concept and context of an algorithm in ways that align with Dewey's expansion of technology to include processes of inquiry and production beyond what are considered to be the productive arts. For Gillespie, an algorithm as an "encoded procedure" not only structures the problem but also furnishes a solution through the transformation of "input data into a desired output, based on specified calculations." Gillespie's use of navigation as an example is interesting insofar as navigation uses the input of the positions of stars or other natural conditions as input to furnish a solution to the problem of finding a path to a destination. Insofar as "navigation" presupposes the uses of natural conditions to find a path to a destination, navigation also furnishes the problem to be resolved through navigation as inquiry. In framing algorithms in this way, Gillespie embeds the algorithm within the problematic situation, within nature, rather than treating it something external to the situation which intervenes upon the situation. Further, while Gillespie confines his use of algorithm to the mode of the computational tool, which he acknowledges supplanted similar processes as executed by hand, it is worth noting that a Deweyan expansion of algorithm on the basis of Gillespie's treatment would not confine itself to such limitations: indeed, a Deweyan algorithm would treat algorithms as present in a variety of fields and not simply those amenable to computational analysis.

If we are to expand Gillespie's notion in the sense of Dewey's naturalistic technology, algorithms are found in a variety of fields albeit in unique modes. For example, the process of creating a poem organized through iambic pentameter or hexameter might be considered "algorithmic" insofar as the composition of a poem in this mode would require the deployment of "encoded procedures for transforming input data into a desired output, based on specific calculations" among which we might include the meter of the poem, the content of the poem, and the language in which the poem is written. To this end, the "input data" transformed through the algorithm of poetry would be the experience to which the poem is applied, whereas the problem defined by the poetic algorithm would be the need to relate experience to an audience by a poet. To the degree that the "poetic algorithm" becomes suitable for application to the problematic situation, the poet must test their command over the meter and the language against the raw material of the situation in question, such that the poem secures the desired outcome. In this mode, we might think of poetic styles, literary styles, musical styles as algorithmic in the modes that Gillespie articulates above, thereby demonstrating the ways in which a Deweyan view of naturalistic technology

confirms the expansion of technology as processes of inquiry and means of production as embedded across disciplines, and across experiences. The use of "embedded" or "encoded" in the above should be reconsidered not in the mode of "code" in the digital sense, but "code" in the sense of the ways we structure transactions with the environment through "codes of conduct" or "cultural codes" whereby we engage in our transactions with one another and with the environment. The danger, however, is the ways in which we understand "encoded" and "algorithmic" in the same ways that we understand "technological," as distinct and separate from nature. Instead, we might re-understand these terms in light of their deployment within a naturalistic pragmatic framework which returns them to nature and treats their "outcomes" or "products" as possibilities of nature. To "encode" a piece of music, therefore, would be to organize it according to the logics of a given culture[1] or style such that it can be "decoded" or experienced through those logics[ii], additionally; to treat art or poetry as algorithmic does not imply its reduction to disembodied "data" without connection to its cultural or social context, it is to understand that art and poetry function according to encoded, embedded logics that serve to control their application as processes of inquiry to the raw materials of the problematic situation such that they resolve the situation through the disclosure of possibilities of nature in line with those logics. Thus, for Dewey, Gillespie is correct in his articulation of the use of algorithms and their location beyond the sphere of computation, however, this understanding would require an additional expansion of the ways that we talk and think about algorithms and their functions within experience.

In line with the above, and our consideration of algorithms as naturalistic technology, Beer (2016) strikes at the core of Dewey's self-correcting understanding of technology, specifically where algorithms are concerned. To this end, "here we might wonder how algorithms shape what is encountered, or how algorithms prioritize and make visible. This is to explore how the predictions of algorithmic systems feed into people's lives, shaping what they know, who they know, what they discover, and what they experience. The power of algorithms here is in their ability to make choices, to classify, to sort, to order and to rank. That is, to decide what matters and to decide what should be most visible" (Beer 2016, 10). To this end, a robust treatment of algorithms as a process of inquiry would engage in the investigation of what Beer describes in the above, however, it would do so with an eye towards engaging in the improvement of the algorithm as a tool, as a means of production, and as a process of inquiry. A fully robust treatment of algorithms within Dewey's theory of naturalistic technology would investigate the ways in which other processes of inquiry could be brought to bear upon the algorithm as a process of inquiry to interrogate how the algorithm unites other processes of inquiry in order to produce information as an artifact, moreover; a robust engagement with algorithms as naturalistic technology would interrogate the ways that algorithms transform experience and the natural conditions of problematic situations into "input data," terms used by both Gillespie and Ananny and the conditions out of which the means whereby this data is gathered and transformed as part of the projection of an end in view, or the thing to be produced by the algorithm itself. Thus, we might challenge Beer's assertion that the algorithms make choices: it is not simply the case that the algorithm makes a choice; rather, an algorithm is a tool whereby choices are

made in line with cultural and social logics that are operative within the culture that has produced the algorithm as a tool for application within the problematic situation as encountered. Put another way, the decisions articulated by Beers above as being made by algorithms are the products of the application of the algorithm as technology, as tool within the problematic situation. That is, even the transformation of the natural conditions of the situation to which the algorithm is applied into "input data" is continuous with, and a disclosure of, the possibilities of nature implicit within the problematic situation as structured by the ways in which the algorithm and the individuals responsible for its deployment are in culture through nature, and subject to the organization of that culture and its cultural logics.

It is here that we can turn to algorithmic bias as a possibility of nature. Under a view of an algorithm as naturalistic technology, we can treat algorithmic bias as the disclosure of some possibilities of nature as structured by the cultural logics that organize the processes of inquiry that are collected into the algorithm and then deployed against the raw materials of the problematic situation. To this end, the "problem" of algorithmic bias, under a view of naturalistic technology is not necessarily one of the technology deployed, but the situation in which the technology is deployed and the grounding of experience in the tension between the stable and the precarious. As Hickman noted in the previous section, "What is regarded as a technical success can suddenly and inexplicably turn into a situation that is deeply problematic. Unintended and deleterious consequences can, and often do, arise from matters thought satisfactorily settled" (Hickman 1990, 157), which, in this case is crucial for our understanding of algorithmic bias. In the common understanding, algorithmic bias is an unintended result of what is considered to be a "technical success" insofar as the algorithm manages to engage in the controlling of a situation to propose potential methods for resolving the problematic situation in which it is deployed. However, as a tool, the algorithm may also render additionally problematic the situation through the solutions offered and the methods proposed in its application. Algorithmic bias, as a preference for some conclusions, some possibilities of nature through the deployment of the algorithm and not others is not simply an unintended consequence of a technical success, it arises from the very precarity of the situation in which it is deployed. More specifically, it arises from the ways in which the collection of processes of inquiry deployed in the situation result in a situation being made further precarious through the ways that the algorithm is deployed. On this account, it is the capacity for an algorithm to structure possibilities as possibilities of nature through the deployment of processes of inquiry in problematic situations that results in the biases "discovered" or "made possible" through algorithmic bias.

To conclude the discussion of algorithms as examples of naturalistic technology, we must consider the ways in which algorithms serve as processes of production, the artifacts of which are as various as the raw materials to which the algorithm has been applied. On this point, Gillespie is informative: rather than simply produce knowledge in ways that other technologies do, algorithms also "traffic in calculated publics that they themselves produce. When Amazon recommends a book that "customers like you" bought, it is invoking and claiming to know a public with which we are invited to feel an affinity—though the population on which it bases these recommendations is not transparent, and is certainly not coterminous with its entire customer base" (Gillespie

2014, 188). In the context of a naturalistic theory of technology, one of the products of the process of inquiry and the process of production that are algorithms in deployment, in this case in the mode of predicting the kinds of literature a user might enjoy, is an imagined public with whom the user shares an affinity. This public, in a Deweyan sense, is a public that is produce through the processes of inquiry that seek to resolve the problematic situation of kinds of literature to be enjoyed by organizing an imagined community of shared literature readers. A public, in this sense, is not simply an imagined community of individuals all engaged in similar modes of inquiry which result in the purchasing or enjoying of similar kinds of literature: it is an actual public that emerges through the shared set of actions, the dispositions towards actions, that resulted in the purchasing of the literature on the basis of the recommendations made by the algorithm. Thus, the algorithm produces a public of individuals who are interested in similar literature on the basis of its transformation of the activities of users into "known data" which is used to display a range of possibilities for purchasing literature as possibilities of nature through culture, for actualization. In keeping with Gillespie (2014, 189), this public serves as a product of the algorithm in so far as the algorithm used the raw materials of the purchasing habits of the users of Amazon in order to provide recommended courses of action. In this sense, the products of the algorithm are manifold: not only is this "calculated public" a product of the algorithm as a process of production, knowledge about user transactions with Amazon, of the circulation of literature among a set of users, is also produced. This knowledge itself becomes further raw material for the refinement of the production of this calculated public such that the algorithm can further improve its recommendations, which itself are products of the algorithm as process of inquiry and process of production.

While Gillespie uses the example of Amazon's recommendations as producing one mode of calculated publics, he also provides the example of Twitter's trending topics as well as Facebook's recommendations as other modes of calculated publics, thereby indicating the ubiquity of the ways in which algorithms generate imagined communities, or communities as possibilities of the organization of "data inputs" as raw materials for the production of the artifact. What is also elided in Gillespie's analysis is the creation of knowledge about users as an artifact of the algorithm as process of inquiry and production. The productive mode of this knowledge is best found in the transformation of user habits into "input data" which is then manipulated to generate some outcomes as "solutions" in favor of others. Put another way, in order to engage in the production of the calculated publics about which Gillespie is speaking, the algorithm must transform the habits of the members of that public into "input data" or "known inputs" in the words of Ananny which can be used as raw materials for the production of the public. That is, algorithms engage in a triple form of production: first in the mode of processing the raw materials of user habits into "input data" or "known inputs," and then the shaping of the produced "input data" or "known inputs" as refined materials for use in the production of calculated publics, about which the algorithm claims to product knowledge. The organization of these various forms of knowledge and the calculated publics to which the data is attached is then returned to experience by the algorithm as an aid to user decision-making or to recommend a specific course of action to make possible some possibilities of nature implicit in the situation in which the algorithm is deployed. This tripled production not only reveals the ways in which algorithms are

modes of knowledge production, or processes of production, as described by Dewey, but also the ways in which the algorithm as a process of production functions in line with Dewey's understanding of naturalistic technology.

As a process of production, algorithms are reliant upon the raw materials of the situations in which they are deployed. While we have used "raw materials" as short hand for the conditions of nature to be manipulated such that some possibilities of nature are actualized and others remain potential, the above provides further context for the ways in which the raw materials subject to the processes of production of algorithms are distinct from the raw materials of other similar forms of technology. To be clear, in the majority of our deployments of algorithms, they are applied to natural histories, or "training data" which serve to enable the algorithm to engage in the predictive processes articulated above. Algorithms, on this logic, engage in the production of knowledge through the organization and processing of natural histories in order to generate "input data" or "known inputs" for use in the recommendation of courses of action or resolutions to problematic situations. Thus, in order to fully articulate algorithmic bias within a naturalistic theory of technology, we must turn to the natural history of the situation to which the algorithm is applied.

Training data and databases as "natural history" and algorithmic "bias" as the consummation of a natural history: rethinking algorithmic bias.

Algorithms, unlike most of the technologies under consideration in both Hickman and Dewey's theories of technology, are uniquely subject to natural histories in their deployment as processes of inquiry and modes of production, the artifacts of which as indicated above, are potential courses of action. Put another way, the user data used as raw material for the production of "known inputs" which is then used in the production of calculated publics, constitutes the "natural history" of a given user in their interactions with the situation in which the algorithm is deployed. Recall, for Alexander, "An event will be understood—always provisionally—in terms of the situational interactions that constitute its history and its contemporary potentialities. "Natural history" designates the account of how a thing comes to be within its situated contexts," which is to say that the user data used as raw material in the process of production inherent in the deployment of algorithms is an account of the situated interactions of the user with Amazon, Twitter, or other such platform and the contemporary potentialities of that user in its interactions with the platform itself. The ways in which the algorithm processes and transforms this raw material serve to determine the contemporary potentialities for the user within the context of the platform in question and seek to make actual some possibilities as outcomes of this natural history as opposed to others. To be clear, the centrality of natural histories is not merely unique to algorithms in the ways that they are deployed in the attempt to manipulate user interactions with Amazon or Facebook, but is integral to algorithms as deployed across situations and platforms.

In this vein, for Gillespie, "Algorithms are inert, meaningless machines until paired with databases on which to function" (Gillespie 2014, 169). Here, I would argue that any philosophical inquiry, including those that seek to understand algorithms

through naturalistic technology, must also grapple with the databases to which the algorithm is wedded, specifically insofar as the database provides the raw material that enables the algorithm to engage in a process of production of knowledge and of possibilities for action in situations. Databases, in a naturalistic technological view of algorithms are thus the collections of raw materials to which the algorithm is deployed, much as ore is the raw material to which smelting is deployed such that it becomes ore to be fashioned into parts for technologies. Moreover, an algorithm, as a process of inquiry also determines the kinds of databases necessary to provide the raw materials for the application of the process of inquiry: to the extent that an algorithm is deployed to resolve a given problematic situation, the database, the raw materials must be aligned with the situation to be resolved. In this mode, the raw materials to which the algorithm is applies are within the situation or serve to provide the context whereby the situation becomes problematic. Again, we must bear in mind that the understanding of "problematic" in use here is not in the sense of an undesirable situation, but of a situation wherein the tension between the precarious and the stable has shifted towards the precarious such that a process of inquiry is necessary to restore the equilibrium between the organism and the environment that has been disrupted. To this end, a problematic situation can be anything from enabling a user to determine their next book purchase to determining what tweets are of interest to a user to the promotion of content in the form of advertisements across social media platforms. As such, the databases to which the algorithm is paired must not only be aligned with the situation in which the algorithm is deployed: they comprise the context for the decision-making processes that the algorithms use to project solutions to the problematic situation.

To this end, as databases may be treated as an account of the interactions of organisms with their ongoing environments, the database serves as "natural history" for the users or the institution to which the algorithm is applied. As articulated above, the "natural history" provides an account for the ways in which an event or an organism comes to be in its situated contexts, the database constitutes a record of the interactions of multiple organisms with the environment such that they come to be in their situated contexts. Without such contexts as provided by the databases, the algorithms with which they are paired would be unable to engage in their predictive activities, or in their recommendations for possible courses of actions. However, even the production of a database as Gillespie (2014) notes is not simply a neutral compilation of data: a database is the result of the organization of information in line with cultural and social logics which themselves are continuous with the organization of the societies from which they emerge. As such, databases themselves may be treated as continuous with the natural histories of the cultures from which the data is collected and reflect the mythoi, the organizing narratives of the cultures with which they are continuous. Put another way, databases are not simply subjective by virtue of their modes of information collection and the logics by which they are organized: databases are subjective by virtue of their continuity with the cultures from which they emerge as they reflect the ways in which these cultures transform a bio-physical environment, including the transactions of the humans within it, into a world wherein humans create and make meaning. Thus, a database is an account of the natural history of the culture from which it emerges as well as providing, in a limited sense, an account of the transactions of the individuals captured within the database itself.

The understanding of databases as natural histories which form the raw materials to which the algorithm is applies is important for understanding the nature of algorithmic bias: on this view, algorithmic bias is not the result of a failure of technology, in keeping with Dewey, but a result of the application of the algorithm to the raw materials of the database such that the possibilities disclosed were possibilities structured by the natural histories of the users or the institutions to which the algorithm was applied. As an example, in 2018 Amazon abandoned a multi-year project to develop an artificial intelligence platform for the purposes of determining candidates to automate its recruitment practices. To this end, Amazon's team created over five-hundred computer models which were trained on a decade's worth of past Amazon hires to develop a database of over fifty thousand key terms which it would then match within the resumes of potential applicants. In so doing, Amazon hoped to take much of the unpredictability out of the problematic situation of engaging in hiring top talent through filtering out potential applicants by deploying the algorithm. In essence, the natural history of a decade of Amazon hiring was used as the raw materials to which the algorithm was deployed such that it could produce knowledge about the best applicants for Amazon to hire. The natural history was used to control the conditions of the situation of hiring such that it became less precarious and the outcomes supplied would be those that aligned with the desired outcomes of Amazon's hiring practice. Unfortunately for Amazon, the possible outcomes of the process of inquiry that was Amazon's tested algorithm served to demonstrate results which were accurately called "biased."

This example is valuable insofar as it demonstrates the interrelation between the database as natural history and the production of biased results by the algorithm. To be clear, the purpose of an algorithm is to control the natural conditions of a situation such that some outcomes are more likely than others as the consummation of the situation. On this view, most algorithms engage in a bias towards some outcomes and not others, however; in the case of the Amazon algorithm, the bias that emerged from the deployment of the process of inquiry to resolve the problematic situation of hiring "the best" applicants resulted in making more precarious the situation through the deployment of the algorithm because of the recommended courses of action produced by the algorithm from the raw materials of the database. Specifically, insofar as the raw materials upon which the algorithm was trained was a database of Amazon's hiring that reflected Amazon's predominantly male pool of software engineers, the recommended courses of action produced by the algorithm also reflected the predominantly male pool of software engineers by controlling the natural conditions of the situation such that women's applications were treated as a less optimal resolution to the problematic situation than men's. This control over the natural conditions of the situation manifested in several ways: "the tool disadvantaged candidates who went to certain women's colleges presumably not attended by many existing Amazon engineers. It similarly downgraded resumes that included the word "women's" — as in "women's rugby team." And it privileged resumes with the kinds of verbs that men tend to use, like "executed" and "captured" (Goodman, 2018), all of which ensured that the natural conditions controlled would result in a resolution of the situation that presented men's' applications as the resolution to the problematic situation.

In the above, the limitations of the training data supplied as raw materials for the algorithm resulted in the controlling of the situation of hiring such that women's applications were systemically excluded as ways to resolve the situation of whom Amazon sought to hire, thereby transforming the situation into a significantly more problematic situation, albeit in a way only disclosed through the application of the algorithm. A similar situation can be seen in other kinds of natural histories used as raw materials to which algorithms as processes of inquiry are deployed. In her discussion of implicit bias in algorithms and machine learning, Lee (2018) provides the following:

> In her research on "word embedding," which is commonly used in language translation apps, Joanna Bryson found that this type of bias creates issues for machines that do not have the moral compass of humans when it comes to identifying stereotypical traits (Caliskan et al., 2017). Researchers discovered that words that included "female" and "women" were more likely to be associated with arts and humanities occupations, while "male" and "man" were often correlated with math and engineering jobs, thereby creating false positives and negatives (Caliskan et al., 2017). The same study also surfaced that European American-sounding names were more likely as associated with pleasant word associations, while "black-sounding" names were often associated with unpleasant words (Caliskan et al., 2017). Consequently, stereotypes about African–Americans remain pervasive.

While Bryson's work, as cited in Lee, is not dealing with the explicit construction of a database as natural history, Bryson's work does reveal the ways in which the mythoi which organize our natural histories serve to organize the raw material to which the algorithm is applied in such a way as to result in the production of bias as a result. In the above, it is the organization of the culture to which the algorithm is applied which results in the association of gender with specific occupations through the ways in which our mythoi, as narratives about ourselves, come to organize our perception of the meaning of gender. To be clear, the resulting bias discovered by Bryson's work is implicit in so far as the biases that organize the associations above act unconsciously upon the individuals that hold them, yet in so doing, serve to organize the transactions with the environment that they engage in, including those transactions which result in the making of meaning. As these meanings form part of the mythoi of gender stereotypes, we may view them as continuous with the ways in which bias is expressed in the deployment of the Amazon algorithm upon the decades worth of hiring data used to train the algorithm. In both, the mythoi of gender roles served as part of the natural conditions that structured the "known inputs" that were used as raw materials for the algorithms, resulting in the reproduction of the biases that served to organize the perception of gender.

On the other hand, M. Ali, P. Sapiezynski, M. Bogen, A. Korolova, A. Mislove, and A. Rieke's (2019) study conducted on Facebook's advertising algorithm was determined to engage in similar modes of bias in its display of advertisements based upon identity categories, a result of which was "significant ad delivery skew along racial lines in the delivery of our ads, with certain ads delivering to an audience of over 85% white users while others delivering to an audience of as little as 35% white users," and

“drastic differences in ad delivery across our ads along both racial and gender lines: our five ads for positions in the lumber industry deliver to over 90% men and to over 70% white users in aggregate, while our five ads for janitors deliver to over 65%women and over 75% black users in aggregate.” It is worth noting that Facebook’s advertisement targeting algorithm relies upon the organization of a class of individuals to be targeted by the advertisement, which is, in short, grounded in a natural history of the kinds of engagements a target audience participates in as structured by a natural history that is continuous with the demographic information compiled into the database as natural history. To this end, the advertising algorithm displays advertisements through the production of a calculated public, as articulated above, but a public structured and organized around the natural histories of the culture in question, including those histories that serve to structure our perceptions of the members of our culture. Insofar as databases as natural history are continuous with the natural histories of cultures, including histories of institutional oppression, it is unsurprising that these histories would reflect the biases of the cultures with which they are continuous.

Bearing the above in mind, we can turn to the ways in which institutions have responded the results of their processes of inquiry. In the case of Amazon, rather than alter the training data, the raw materials to which the algorithm is applied, the Amazon engineers sought to alter the algorithm as process of inquiry itself to change the ways that the algorithm controlled the natural conditions of the situation such that additional possibilities of the natural history used were disclosed. Unfortunately, these attempts to alter the algorithm rather than the database ultimately resulted in failure for Amazon, resulting in the scrapping of the algorithm. Here, we can turn back to our understanding of algorithms as naturalistic technology to consider what is produced in both the above examples of algorithms as deployed. In both the “failure” of the Amazon algorithm and the skewed presentation of advertisements on Facebook, and the ways in which algorithms reproduce implicit bias as indicated by Bryson, there exists a tendency in the literature to assign the fault for the biased result to the algorithm itself. This assignment of fault is most clearly indicated in Amazon’s abandoned attempt to restructure the process of inquiry through engaging in a process of inquiry grounded in an engineering standpoint, as if the problematic situation lies with the algorithm. In the context of a naturalistic theory of technology, the Amazon team engaged in a partial move to resolve a situation made further problematic through the introduction of the algorithm: they attended directly to the algorithm as tool, rather than recognizing that the algorithm merely disclosed the results of Amazon’s own process of inquiry to resolve the problematic situation of hiring an applicant. In doing so, Amazon subsequently missed the ways in which the bias of the algorithm was not located in the failure of the algorithm, but in the precarious nature of the situation.

It is in keeping with the failure of institutions like Amazon to recognize the precarious nature of the situation as the source of the failure of the algorithm that the treatment of algorithms as naturalistic technology can provide an intervention on current treatments of algorithms as biased. Insofar as the algorithm discloses a possibility of nature on the basis of the natural history that it takes as raw materials, the algorithm not only produces knowledge about the appropriate course of action to be taken on the basis of that natural history, it produces knowledge about that natural history, or the natural history of the institution in question. Recall that technological development,

particularly in response to technological failure, was not solely the province of the productive fields, nor was it to be assumed that the results of technological development are maximally beneficial to humanity. On this view, the approach to solving the biases of algorithms as grounded in the technological problem of a biased algorithm as overcome through re-engineering the algorithm is an approach that avoids returning the products of the process of inquiry back to the experiences that prompted it. Moreover, it is to fail to recognize the need to develop algorithms as "humane technology" as described by Hickman. Again, recall that "humane technology" is humane insofar as it takes into account the human context in which the technology failed, and the degree to which technology should be guided by sensitivity to the ways that humans transact with a bio-physical environment given meaning through culture. To this end, a treatment of algorithmic bias within a naturalistic theory of technology would seek to determine the meaning of the products of algorithms as processes of production and processes of inquiry for the overall human context to which it is applied. This, then, would require the direction of processes of inquiry towards the raw materials to which the algorithm is applied: the natural history or the training data which served to structure the methods and courses of action recommended by the algorithm through the reorganization of natural conditions whereby some possibilities of nature are disclosed. The biased result produced by the algorithm, while not the result expected by the designers of the algorithm, does not indicate the failure of the algorithm as a tool applied: is a disclosure of the possibilities of nature grounded in the natural history of the institution that the algorithm is applied to. Put in the context of Amazon's hiring AI or Facebook's advertising algorithm, the algorithm produced knowledge about the practices of these institutions and the cultures that they are continuous with which should be taken up and incorporated into further processes of inquiry into those practices such that the natural conditions used as raw materials for subsequent processes of inquiry can be altered to disclose new possibilities of nature.

The above treatment of algorithms within Dewey's naturalistic technology aligns with Dewey's view of technology as self-correcting through further inquiry into the tools and processes of inquiry that developed the failed technologies in order to guide the moral use of technology, or what Hickman describes as Dewey's "humane technology" articulated above. In this context, a naturalistic theory of technology would call upon the individuals developing the algorithm to avoid treating the algorithm as having failed in its application as a process of production or a process of inquiry, but to take seriously the possibilities of nature disclosed or the knowledge as artifact produced by the algorithm as process of inquiry or process of production. Doing so would then require the integration of the knowledge back into the experience or its application as tool against the current practices, the raw materials to which the algorithm was applied. Here, we return to Dewey's location of the failure of the technology not in the tool itself but in the precarious nature of the situation. However, in the context of algorithmic bias, or the production of knowledge that indicates bias in the natural histories supplied as raw materials for the algorithm itself, and consequently in the institutions that the natural history describes. A theory of naturalistic technology would, therefore, recommend against practices that seek to eliminate bias from algorithms as these practices would consequently end inquiry into the production of knowledge or the processes of inquiry: rather, such a theory would demand that we take seriously the results of said algorithms

as knowledge about our processes of inquiry and about the raw materials supplied to those processes as a tool for further inquiry. To this end, we may repeat the guiding principle of Dewey's naturalistic metaphysics in the context of the algorithm: it is not what kind of algorithm produced the biased result, but what kind of world makes it possible for algorithms to produce the biased result or what kind of world is necessary for algorithms as processes of inquiry to demonstrate the biases as knowledge. However, for Dewey, understanding algorithms solely through the lens of the productive technologies would be unable to supply an answer to this question: the interpenetration of the humanities, the social sciences, the arts with the more productive fields of technology was necessary to address the deployment of algorithms as natural technologies throughout the breadth of human experience, and more specifically to adequately understand what these algorithms tell us about that experience.

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[i] It should be noted that Dewey referred to language as the “tool of tools,” so it is unsurprising that a corollary to Dewey’s experimentation would appear in his descriptions of communication.

[ii] Gillespie, to his credit, notes “The algorithmic assessment of information, then, represents a particular knowledge logic, one built on specific presumptions about what knowledge is and how one should identify its most relevant components,” which is a presumption that runs through all of the fields that Dewey argues are culturally organized. Even cultures have their own logics about what counts as knowledge.