Super-Explanatory Essentialism and Modal Epistemology

Shih- Hao Liu[1]

Abstract

According to super-explanatory essentialism, the essences of natural kinds are identified with their core causal properties. Several proponents of this view develop a distinctive form of modal epistemology, maintaining that our modal knowledge about natural kinds can be derived from knowledge of these core causal properties. In this paper, I argue that this epistemological project is explanatorily unsatisfactory since it presupposes pre-existing modal knowledge. My argument unfolds in three steps. First, I highlight that a crucial component—the epistemology of super-explanatory essences—is underdeveloped in the relevant literature. Second, I propose a two-component epistemology of super-explanatory essences that incorporates some interventionist principles and abductive elements as the most promising reconstruction and rationalization which best captures the super-explanatory essentialists' intent. Third, I contend that such an epistemology requires antecedent modal knowledge to get off the ground. As a result, their modal epistemology ceases to be explanatorily self-supporting. The supposed explanatory priority of knowledge of essence thus collapses, leaving the super-explanatory essentialist framework without the epistemic merit it promises. If this is the case, the explanatory ambition of the super-explanatory essentialist's modal epistemology is utterly compromised.

Keywords: Modal Epistemology, Essentialism, Essence, Natural Kinds, Causal Knowledge

Introduction

In philosophical discourses, we often argue with claims about metaphysical modalities like the necessity of water being H2O or the possibility of philosophical zombies. But what is the rational basis for us to know these metaphysical modal claims? Recently, some essentialists maintain that our modal knowledge is primarily derived inferentially from knowledge of essence. Call this view *essence-first modal epistemology*.[i]

[1]**Shi-Hao Liu,** Researcher, Department of Philosophy, University of Miami, U.S.A.

To develop an adequate essence-first modal epistemology, its proponents should further elucidate (1) what essence is, and (2) how we know essences in the first place. Without an answer to (1), essence remains an elusive and mysterious notion. If (2) is left unaddressed, the explanatory task of the essence-first modal epistemology remains incomplete. In previous literature, various versions of the essence-first modal epistemology have been developed, each offering different answers in answer to (1) and (2) (Lowe; Hale; Kment; Jago).

Recently, focusing on natural kinds such as physical, chemical, or biological kinds, several theorists have defended an innovative approach known as *super-explanatory essentialism* to elucidate what the essence of a natural kind is (Godman et al.; Mallozzi). In response to (1), the view holds that the essence of a natural kind is its *super-explanatory property*—the causal property that accounts for most of the typical features shared by all members of the kind. With respect to (2), super-explanatory essentialists, most notably Antonella Mallozzi, argue that our knowledge of a natural kind's super-explanatory property is largely attainable through empirical methods, particularly induction and abduction. (For convenience, I will use "super-explanatory property" and "super-explanatory essence" interchangeably in my later discussion.) Once we know the super-explanatory property of the kind, we thereby know its essence—and can subsequently infer modal knowledge about the kind.

In this paper, I'll argue that the essence-first modal epistemology that incorporates super-explanatory essentialism is explanatorily unsatisfying since it relies on input from pre-existing modal knowledge, which calls for further explanation, to get off the ground.

My argument unfolds as follows. I first note that how super-explanatory essences are known, which is a crucial component of the essence-first modal epistemology for super-explanatory essentialists, is underdescribed. Although empirical means like induction and abduction are briefly mentioned as ways of knowing super-explanatory essences, the details of how these methods yield such a knowledge deserve to be further spelled out and examined. To this end, I put forward a two-component epistemology of super-explanatory essences, which consists of two parts: first, an epistemology of common ground that is primarily based on Woodward's Interventionist framework; second, a bridge principle that allows us to identify the essence of a kind with its common cause inferentially. I contend that this framework provides the best reconstruction and rationalization for how super-explanatory essences are known. Nonetheless, I further argue that for such a two-component epistemology to function in practice, some pre-existing modal knowledge is required. In particular, the background knowledge that places us in a position to know a kind's common cause is saturated with prior modal knowledge. This ultimately reveals the explanatory unsatisfactoriness of essence-first modal epistemology for super-explanatory essentialists.

Here is the plan of the paper. Section 2 introduces the framework of essence-first modal epistemology that incorporates super-explanatory essentialism. In Section 3, I present the

two-component epistemology of essence that best aligns with the super-explanatory essentialist's overall framework. In Section 4, I argue that the essence-first modal epistemology for super-explanatory essentialists is explanatorily unsatisfactory due to its unavoidable reliance on pre-existing modal knowledge.

Before proceeding, several clarifications regarding the terminology and assumptions adopted in this paper should be made explicit. First, for brevity, I use *modal knowledge* to refer to specifically to *metaphysical* modal knowledge. The talk of necessities and possibilities in later discussion should also be understood in a metaphysical sense, unless otherwise specified. Second, in this paper, *metaphysical modality* is understood as the *objective* and *absolute* sense of alethic possibility and necessity.[ii] I will set aside views that question its philosophical significance (Clarke-Doane) and intelligibility (Priest). Evaluating whether these skeptical challenges succeed is beyond the scope of this paper. Finally, I will also remain neutral regarding the extent of our knowledge of metaphysical modality. In his "How to Make Possibility Safe for Empiricists," Norton develops an empiricist conception of modality.[iii] He maintains that "what is possible, according to the empiricist conception, is what our evidence positively allows; what is necessary is what it compels" (Norton 129). He then distinguishes between empirical and non-empirical metaphysical modalities, arguing that only the empirical one is defensible. Conversely, the non-empirical one is indefensible. That is, we have no rational basis to believe in metaphysical modal claims that lack support from empirical evidence. The cases discussed in this paper should fall within empirical metaphysical modalities in Norton's sense. Hence, whether Norton's take on the extent of modal knowledge is plausible will not influence my argument in this paper. I shall not take a stand on whether Norton's way of delineating the range of our modal knowledge is adequate for now. The issue deserves separate treatment elsewhere.

Essence-First Modal Epistemology and Super-Explanatory Essentialism

Modal claims, which concern the possibilities and necessities of things or states of affairs, play a crucial role in philosophical discussions. For instance, in his *Naming and Necessity*, Kripke's defense of *a posteriori* necessities poses a challenge to the once-dominant descriptivist theory of proper names. Or consider Chalmers's objection to physicalism in the philosophy of mind, which entertains the possibility of philosophical zombies. One immediate question emerges: what is the rational basis for our knowledge of these modal claims? Call this *the problem of modal knowledge*. In response, some theorists who endorse the metaphysical framework of essentialism defend an essence-first modal epistemology. According to the view, knowledge of essence serves as a basic source of our modal knowledge.[iv]

Traditionally, the modalist view of essence holds that essence is nothing more than the sum of an entity's *de re* necessary properties. Fine argues that this view is mistaken, as it fails to capture the fine-grained nature of essence and risks over-generating essential

truths. He then defends an alternative Aristotelian conception of essence, which can be roughly formulated as:

(FE) *Finean Conception of Essence*: Essence is the ontological basis of metaphysical necessity.

Inspired by Fine's insight expressed in (FE), essence-first modal epistemologists tell a story about how modal knowledge is obtained, one that runs parallel to his ontological picture. Let me further lay out the details of the epistemological story. An essence-first modal epistemology can be understood as the conjunction of two sub-components: first, an epistemology of essence; and second, an *essence-necessity bridge principle,* which can be formulated as follows:

(EN) *Essence-necessity Bridge Principle*: If *x* is essentially *F*, then *x* is necessarily *F*.

In brief, once we obtain knowledge of essence, we can then infer modal knowledge (particularly knowledge of necessity) with the aid of principles like (EN). Within the general framework of essence-first modal epistemology, (EN) not only expresses the ontological relation between essence and necessity expressed by (FE) but also functions as an inferential principle guiding our acquisition of modal knowledge. It is worth noting that (EN) is just one way of expressing the relationship between truths about essences and necessary truths concerning individuals. The subject need not be restricted to individual entities. Under the Finean conception of essence, a corresponding principle for kinds can be formulated as:

(ENk) If a kind *K* is essentially *F*, then it is necessarily *F*.

But how do we know such bridge principles in the first place? Most essentialists agree that our knowledge about bridge principles like (EN) or (ENk) are known *a priori*. Some appeal to intellectual faculties like intuition (Mallozzi S1952), while others regard these principles as instances of conceptual knowledge that are a constitutive part of the Finean conception of essence (Tahko 33-34). I'll take the knowledge of bridge principles to be a relatively unproblematic component of essence-first modal epistemology and move on with my discussion.[v]

Now, with the nature of the essence-necessity bridge principle clarified, proponents of the essence-first approach should also offer a plausible epistemology of essence. To do so, essence-first modal epistemologists should further elucidate (1) what essence is and (2) how we know essence in the first place. Addressing (1) is necessary, as a plausible epistemology of essence requires at least some understanding of its subject matter. Otherwise, the notion of essence remains elusive and obscure. Addressing (2) is crucial as well. Without a satisfactory answer to (2), the original question— "What is the source of modal knowledge?"—is just shifted to a new but equally unanswered one: "What is the source of knowledge of essence?"

Focusing on natural kinds, proponents of the recently developed super-explanatory essentialism advance their own version of essence-first modal epistemology that

incorporates their metaphysical view. In short, in answer to (1), super-explanatory essentialists identify the essence of a natural kind with its causal core, which explanatorily contributes to its typical features. With regard to (2), super-explanatory essentialists appeal to empirical means like induction and abduction.

To properly present the core idea of super-explanatory essentialism, I begin by outlining its advocates' characterization of natural kinds. First, according to super-explanatory essentialists, natural kinds are categories that support informative and inductive generalizations in scientific and empirical practices. That is, members of a natural kind share multiple typical features or properties that are correlated or co-instantiated. For instance, under standard conditions, all samples of lithium possess typical shared features such as electric conductivity, flammability, melting point, etc. Second, closely related to the first point, natural kinds exhibit a form of epistemic fertility which "further supports our scientific taxonomic and explanatory practices" (Mallozzi, S1944). They enable us to "describe and classify things as instances of a certain kind according to all their shared properties and behaviors" (S1944).

What explains a natural kind's capacity for generalization, its epistemic fertility, and the co-instantiation of typical features among all its members? Partially motivated by the contemporary discussions of causal ground in philosophy of science, super-explanatory essentialists argue that these phenomena are explainable by an underlying *common cause* of the kind.[vi] This causal core of the kind "determines kind-membership, and supports the whole range of projectable, lawful patterns and counterfactual dependencies that feature in the relevant scientific generalizations" (Mallozzi S1945). Godman et al. describe the common cause as playing a "unifying role" that causes the commonly shared features of a natural kind (Godman et al. 2). Super-explanatory essentialists refer to this common causal ground, which has special explanatory and unifying power, as the *super-explanatory property*, and they identify it with the essence of the kind.[vii]

Mallozzi illustrates what essence is according to super-explanatory essentialism with the example of the chemical element silver:

> Having atomic number 47 is the essence of silver because the specific number of protons (and subatomic configuration) in the nucleus of a sample of silver is what causes, given opportune environmental conditions, the many chemical and physical properties and behaviors typically shared by all those instances (e.g. melting and boiling point, electrical and thermal conductivity, disposition to combine chemically, tensile strength, color, and odor.) (Mallozzi S1945)

In this example, since the proton (atomic) number *causally contributes* to the subatomic configuration of silver and thereby explains its typical features, it can be taken as the essence of the kind *silver*. In contrast, the lustrousness of the silver is not essential since being lustrous "plays no causal and explanatory role for the many, many other properties typically shared by all instances of silver" (S1946).

Several notable features of the essentialist characterization of super-explanatory

properties merit attention. First, the explanation relation invoked in their discussion is "(a) fully objective or *metaphysical*; and (b) of central interest for both the natural sciences and metaphysics" (S1950). Clause (a) emphasizes that the explanation is not subjective or interest-relative, while clause (b) highlights that the kind of explanation at issue is central to scientific or metaphysical inquiry about what makes a thing (or a kind) what it is.[viii] One immediate worry is that super-explanatory properties highlight merely nomological or natural modality, rather than metaphysical modality. In response, Godman *et al*. maintain that their view is not "to *eliminate* modal kind essence in favor of nomological necessity, but rather to reduce them to a specific kind of nomological structure" (14). For now, I'll set aside the controversy over whether metaphysical modality should be reduced to nomological modality here, as the matter will not influence the later part of my argument. Another worry concerns whether the super-explanatory essentialist's explanation is genuinely *fully objective* or *metaphysical* as stated in (a). While Godman et al. affirm an objectivist view of natural kinds by maintaining that most natural kinds "would exist even if no humans or other intelligent beings had ever evolved to base inferences on them" (3), some theorists disagree. For instance, Craver argues that since conventional elements are not eliminable in the practice of individuating biological mechanisms, it is questionable whether the individuation of biological kinds based on mechanisms can be entirely objective (575). Similarly, by examining actual scientific practice, Zachar and Bartlett defend a *pragmatic nominalist* view of scientific concepts, according to which such concepts are selected or individuated in light of scientists' practical needs (191–192). As my focus in this paper is epistemological, I will not delve deeply into the metaphysical controversy over whether the competing pragmatic or conventionalist pictures are more convincing. However, in Section 4, I will discuss some epistemological implications that arise *if* super-explanatory essentialists must concede that pragmatic or conventional elements are ultimately ineliminable from their metaphysics.[ix]

The second notable feature is that the explanation of how a super-explanatory property causes typical co-instantiated properties of a natural kind is not complete without citing some other factors like contingent local environmental conditions, laws of nature, and other relevant background conditions. Mallozzi refers to these factors as "opportune environmental conditions" and maintains that:

> Essential properties and mechanisms should always be understood as operating together with the environment, as well as relevant laws of nature; and full structural explanations will ideally mention all the relevant surrounding factors. (S1947)

Thirdly, although super-explanatory essentialists often describe a kind's essence in terms of a single property, it is important to clarify that they are open to the idea that the causal core of a kind might consist of a set of properties, mechanisms, or an interconnected network of mechanisms (S1945). They are also open to the possibility that

the super-explanatory causal core might be a relational rather than an intrinsic property (Godman et al. 5-7).[x] Moreover, they do not exclude the possibility that essence may be dispositional rather than categorical.

With the main ideas of super-explanatory essentialism regarding (1) now laid out in detail, I turn to super-explanatory essentialists' response to (2). To them, knowing the essence of a natural kind *is* simply knowing its super-explanatory property:

> Our knowledge of essential properties in those cases is simply knowledge of the relevant structural core properties, or mechanisms, having the relevant causal and explanatory powers for all the instances of the kind, as identified by the results of the natural sciences. (Mallozzi S1952)

Accordingly, addressing (2) is just explaining *how we know super-explanatory properties of natural kinds at the first place*. In a brief remark, Mallozzi explains how super-explanatory properties are known by appealing to means like abduction and induction:

> […] discovering what plays the actual causal and explanatory roles for a kind, that is its essence, is an empirical matter. We typically carry it out within scientific practice, *through considerations of empirical nature, particularly inductive and abductive ones*. (Mallozzi S1953-1954, my emphasis)

In the literature, there are two further reasons that motivate the pursuit of an essence-first modal epistemology. First, knowledge of essence, an important component in the derivation of modal knowledge according to essence-first modal epistemologists, may also provide the information needed for certain methods to yield modal knowledge reliably. Consider, for example, that many take conceivability as a primary means of obtaining modal knowledge and thereby develop conceivability-based modal epistemologies (Chalmers; Yablo). While formulations differ among its proponents, the core tenet of the conceivability-based account can be spelled out as:

> (CP) *Conceivability-Possibility Principle*: The conceivability of *p* provides a rational basis for knowledge (or justification) of *p*'s possibility.

The principle (CP) has been called into question. Suppose I'm considering whether transparent iron is possible. I conceive a picture-like scenario where a transparent chunk of substance sits on the table with a label reading "transparent iron." Does the conceived scenario genuinely represent the possibility of transparent iron, thereby putting us in a position to know that *transparent iron is possible*? Not quite. It seems equally plausible that the conceived scenario merely depicts the possibility of someone mischievously placing a 'transparent iron' label next to a chunk of plastic.[xi]

This raises an immediate question: under what conditions can I be confident that a conceived scenario genuinely represents the possibility of transparent iron and provide the proper evidence to believe in such a possibility? According to Vaidya and Wallner, a subject "should be confident that [a conceived scenario] R verifies that transparent iron is present only if R involves no violation of what it is for something to be an instance of the kind iron" (Vaidya and Wallner S1913). More generally, they argue that "*when we are*

confident that we have at least not violated the nature of the entities in questions; that is, we have not violated the nature of the entities in question; that is, we have not violated what the fundamental nature of these entities is in our construction of the representations of the relevant scenarios" (Vaidya and Wallner S1914, their emphasis). In other words, for us to obtain modal knowledge via conceivability—according to a principle like (CP)—some pre-existing knowledge of the nature of relevant entities must already be in place to inform us of which features *should not* be conceived away. Here, knowing the nature of relevant entities, to Vaidya and Wallner, amounts to knowing their essences:

> For *x* to be confident that such a violation [of iron's nature] has not occurred it would seem that *x* must have either implicit or explicit information about *what* iron is. This essentialist information must also put *x* in a position to know that transparent iron is possible on the basis of conceiving S either through linguistic items images, or a hybrid combination of them. (Vaidya and Wallner S1913)

Without constraints provided by information such as knowledge of essence, our conceivability is very likely to lead us astray.[xii] In her work, Mallozzi expresses a similar thought:

> …essence first approach helps us address what might be regarded as *the* central problem for modal epistemology. We need suitable constraints for modal reasoning and imaginative exercises, so as to ensure (or at least enhance the chances) that they result in true beliefs. (Mallozzi S1940-S1941)

Hence, following the line of thought developed by Vaidya and Wallner, if we have a plausible epistemology of essence, then we can further explain how means such as conceivability yield modal knowledge under the constraints provided by knowledge of essence. As a joint product of the epistemology of essence and the (EN) principle, the discussion here also indirectly motivates the pursuit of an essence-first modal epistemology. Of course, this result will also render conceivability merely derivative, rather than a basic source of modal knowledge. Its reliability ultimately depends on whether we have other reliable sources for knowing essences which need further elucidation. Any explanation that appeals solely to conceivability, given the above discussion, remains *explanatorily unsatisfying*.

Second, essence-first modal epistemology appears to be in a good position to address Peacocke's *integration challenge*, which maintains that it is more feasible for theorists to develop "a simultaneously acceptable metaphysics and epistemology" (Peacocke 1). In earlier discussions, other accounts have primarily focused on identifying the conditions under which various methods (such as intuition, imagination, or similarity reasoning, etc.) yield modal knowledge. These accounts often remain silent regarding the metaphysical underpinnings of modality as "it is not of these theories primary aims to tackle the issue of the source of metaphysical modal truth" (Mallozzi S1940). Remaining silent in modal metaphysics is not necessarily a fatal flaw of these accounts. However,

being able to articulate both epistemological and metaphysical sides of the story surely puts theorists in a better position to comprehend and evaluate theories in a comprehensive way. Consider conceivability-based modal epistemology again. In his "Materialism and the Metaphysics of Modality," Chalmers made explicit his commitment to modal monism, according to which logical possibilities are coextensive with metaphysical possibilities. Being able to lay out the accompanied metaphysical picture thus enables theorists to consider Chalmers' conceivability-based modal epistemology from a broader perspective.[xiii] Similarly, grounded in their essentialist framework, essence-first modal epistemology provides a broader picture that deepens our understanding and allows for more informed evaluation.

Summing up, super-explanatory essentialists identify the essence of a natural kind with its super-explanatory property. Once we know what the super-explanatory property of the kind is via empirical means, we can then obtain modal knowledge inferentially, with the aid of the essence–necessity bridge principle. Take the arrow below to indicate the direction in which rational basis is provided; for example, "$X \rightarrow Y$" represents that X *provides the rational basis for* Y. The overall modal epistemological picture that super-explanatory essentialists have in mind can be expressed as Fig. 1 below:

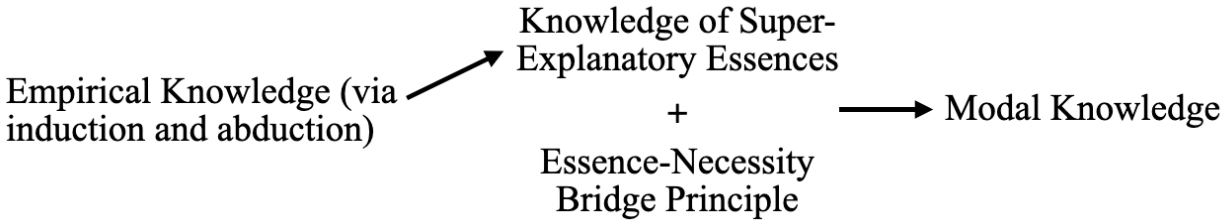

Fig 1.

Do super-explanatory essentialists provide a convincing version of essence-first modal epistemology? I contend this remains unclear for now, since Mallozzi's remark above on how we obtain knowledge of super-explanatory essences through induction and abduction is too brief and underspecified for us to evaluate the adequacy of super-explanatory essentialists' modal epistemology. In the next section, I aim to flesh out the underarticulated parts of how super-explanatory essences are known by proposing a two-component epistemology that reconstructs what super-explanatory essentialists might have in mind.

A Two-Component Epistemology of Super-Explanatory Essence

I propose to reconstruct the way in which super-explanatory essences are known with an epistemology that consists of two components. The first is an *epistemology of common cause*; the second, a *bridge principle* which can be formulated as follows:

> (CS) *From Common Causes to Super-Explanatory Essences*: If *X* is a common cause of all the typical properties of the natural kind *K*, then *X* is *K*'s super-explanatory essence.[xiv]

It is reasonable to expect an epistemology of common cause here, since super-explanatory essentialists heavily emphasize the identification of essences with the common causal bases of natural kinds. Also, an epistemology of common cause characterized by *a posteriori* method such as induction and abduction align well with Mallozzi's brief remark that super-explanatory essences are known empirically[xv] on the other hand, (CS) enables an inferential transition from our knowledge of common causes to knowledge of super-explanatory essences. I take (CS) to be a conceptual and constitutive principle that super-explanatory essentialists, given their core metaphysical commitments, should endorse.[xvi]Under my reconstruction, knowledge of super-explanatory essences, in brief, is derived inferentially from our knowledge of common causes together with (CS).

While endorsement of (CS) should be evident (*if* one is a super-explanatory essentialist), the manner in which an epistemology of common cause ought to be developed in detail is less straightforward. I propose that the epistemology of common cause should be primarily understood under Woodward's framework of interventionism, as the interventionist construal aligns well with how we actually come to know causal relations between various factors in practice of various fields as Woodward notes that:

> [The interventionist account of causation] fits naturally with the way such claims are understood and tested in many areas of biology and the social and behavioral science and with a substantial methodological tradition in statistics, econometrics, and experimental design, which connects causal claims to claims about the outcomes of hypothetical experiments. (20)

Based on his observation in various fields of study, Woodward contends that "it would be natural to expect that human beings often successfully learn causal relationships by performing interventions" (22).

In brief, Woodward spells out the core tenet of the account can be stated as follows:

> If it is possible to manipulate a cause in the right way, then there would be an associated change in its effect. Conversely, if under some appropriately characterized manipulation of one factor, there is an associated change in another, then the first causes the second (Woodward 20).

Woodward then proceeds to elaborate his analysis of causation through the conjunction of two principles:

> (SC) If (a) there are possible interventions (ideal manipulations) that change the value of X such that (b) if such an intervention (and no others) were to occur X and Y would be correlated, then X causes Y.[xvii]
>
> (NC) If X causes Y, then (a) there are possible interventions that change the value of X such that (b) if such interventions (and no other interventions) were

to occur, X and Y would be correlated. (Woodward 20)

Woodward's interventionist analysis of causation, as presented with (SC) and (NC) has two noteworthy features. First, by "manipulation" and "intervention," Woodward not only refers to contingent and voluntary actions performed by humans (or certain animals) that alter the value of one or more factors, but also allows that some naturally occurring events may qualify as interventions. As he explains, "a naturally occurring process (a "natural experiment") that does not involve human action at any point may thus qualify as an intervention if it has the right causal characteristics" (21). Second, an intervention need not *actually* occur. If the causal relation between X and Y is at issue, what matter is "not whether an intervention is actually performed on X but rather what would happen to Y *if* (perhaps contrary to actual fact) such interventions were to be performed" (22).

Now, with Woodward's principles (SC) and (NC) in place, I propose that we can identify the common cause of a natural kind by mapping its causal structure through two iterative steps. Step one: manipulate the relevant factors and observe the resulting changes in other related factors. And step two, infer the causal relations among these factors by applying principles (SC) and (NC).

Let me illustrate this with a simple example. Suppose a natural kind K instantiates three properties—A, B, and C. I assume here that the intervention is *ideal*; that is, the method of manipulating the value of one property does not influence other properties in ways that bypass the property being manipulated. Suppose I manipulate the value of B and observe changes in A and C. Let "A → B" mean that A causes B. Inferring with principle (SC), I might initially consider the following possible causal relations among the five presented as Fig. 2 below:

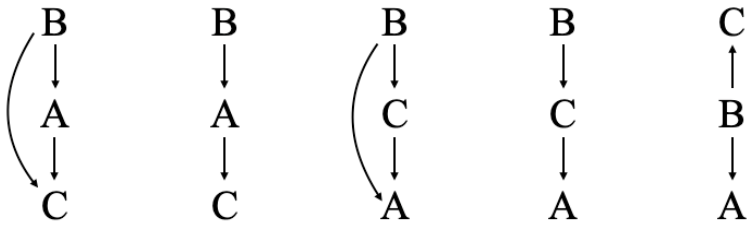

Fig. 2

To map the causal structure of K, I further manipulate A and C, respectively. Observing no change in the value of B or C when A changes, and no change in B or A when C changes, I conclude that A and C are causally independent. And the only tenable causal structure is C ← B → A, with B serving as the common cause of K.

Although, as previously stated, I take the epistemology of common cause to be largely understood within the interventionist framework, there are cases in which abduction can, I suggest, help with the identification of common causes. Such cases include situations where we do not investigate the causal structure of a kind exhaustively to infer its common cause, perhaps due to practical constraints such as limited time or funding, or where the common cause cannot be captured by currently existing scientific concepts. In

the latter kind of cases, Schurz argues that the abductive inference to a common cause should be understood as what he calls "creative abduction," in which a new scientific concept is introduced to capture and explain the various phenomena under consideration. He contends that the identification of the electric dipole structure as the common cause of various hydrophilic features should be understood as an instance of such a creative abductive inference (10–12). Based on consideration from scientific practices, I shall include abductive elements as part of the epistemology of common cause.

Overall, the abductive framework can be spelled out as follows:

The Abductive Framework for the Epistemology of Common Cause

(a) Observed phenomena regarding natural kind *K*.

(b) Among competing hypotheses, the hypothesis that *P being the common cause* stands out as the best explanation of (a), based on explanatory considerations and relevant background knowledge (such as relevant laws of nature and opportune environmental conditions).

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(c) Therefore, property *P* is the common cause of kind *K*.

In this framework, (a), the explanandum comprises all observable or inductively derived phenomena concerning kind K that call for explanation. This includes properties that are constantly and stably instantiated, as well as those that manifest only under specific environmental conditions. Knowledge of causal relations among the properties of a kind, obtained through the interventionist principles mentioned above, also constitutes an important part of this stage, as it informs us about the causal structure of the kind (even if the information might be incomplete.) (b) represents the stage of hypothesis selection in abductive reasoning, where a range of rival hypotheses of the form "ϕ is the common cause of kind ψ" are evaluated on the basis of various explanatory considerations. But which explanatory considerations should guide the selection? If all are taken into consideration without constraint, the process risks becoming messy and intractable. I propose that we focus on the following two:

> *Unification*: *Ceteris paribus*, a hypothesis that explains a broader range of phenomena is explanatorily superior.
>
> *Causal Adequacy*: *Ceteris paribus*, if the causal factor(s) specified by a hypothesis can plausibly produce the effects in need of explanation, then the hypothesis is causally adequate.

Since a common cause is typically understood as the causal base that contributes to the various features of a kind, this characterization naturally points toward a competing hypothesis, according to which a causal ground should contribute to as many typical features of the kind (qua Unification) as possible and should adequately correspond to

the cluster of causal knowledge we possess about the kind under consideration (qua Causal Adequacy).

Before proceeding, several clarifications should be in place. First, although not explicitly stated, induction plays a role in both the interventionist and abductivist frameworks discussed above by informing us about the relevant laws of nature, which properties of a natural kind are consistently instantiated, and which properties of a kind are correlated with one another.[xix] Second, I am aware that there are other explanatory considerations like simplicity and fruitfulness that might also play a role as well in the abductive search of common causes.[xx] I remain open to the possibility that the abductive process can incorporate these considerations as well. But for the sake of focus and brevity, I'll still center the discussion on Unification and Causal Adequacy. Third, I am aware that there are some concerns regarding the appeal to abduction. For instance, in *The Material Theory of Induction*, Norton finds it dubious whether there can be a unified account of abductive inference, since many of the key notions employed in abduction remain unclear. He notes, for example, that "philosophical analysis of explanation has failed even to find a univocal sense of explanation at work in science" (248). Elsewhere, philosophers have also questioned whether explanatory considerations in abduction are truth-conducive (Bueno and Shalkowski; van Fraassen). For the purposes of this paper, I shall set these worries aside for now.

Now that the details of the two components in the epistemology of common cause have been articulated, the overall picture of essence-first modal epistemology for super-explanatory essentialists can be further clarified and elaborated as:

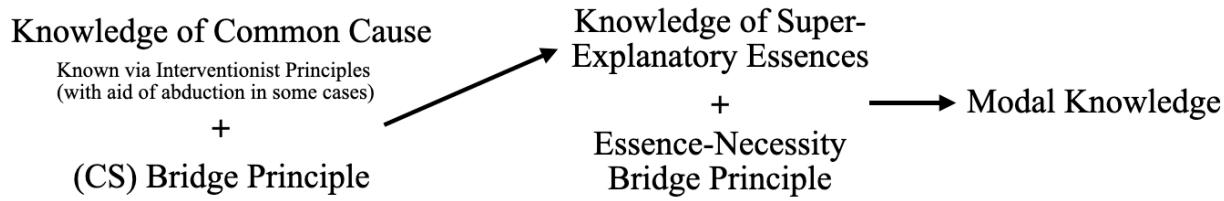

Fig. 3

The arrow represents the direction of inference. In short, knowledge of super-explanatory essence is the inferential joint product of our knowledge of common cause together with the bridge principle (CS). It then contributes to modal knowledge through the aid of the essence–necessity bridge principle discussed in Section 2.

Is the essence-first modal epistemology of super-explanatory essentialists, as outlined in Fig. 3, an explanatorily satisfactory account of essence-first modal epistemology? I shall argue that it is not.

The Problem of Pre-Existing Modal Knowledge

Recall that in Section 2, Vaidya and Wallner argue that conceivability must be informed by knowledge of essence. Without the constraint provided by pre-existing knowledge of

essence, conceivability can easily lead us astray, as we may conceive of scenarios in which the natures of certain entities are violated. One consequence of their argument is that conceivability should be understood as merely a derivative, rather than a basic, source of modal knowledge, since its reliability depends on prior knowledge of essence. If this is the case, however, any account that appeals solely to conceivability remains explanatorily unsatisfying, for the question of how we come to know essences still calls for further elucidation.

In this section, I shall argue that the essence-first modal epistemology advanced by super-explanatory essentialists faces a problem analogous to that which troubles conceivability-based accounts. In short, their view requires input from pre-existing modal knowledge. More specifically, one of its key subcomponents—the epistemology of common cause—inevitably relies on antecedent modal knowledge to get off the ground. In what follows, I will first explain why knowledge of common causes presupposes prior modal knowledge and then clarify why this dependence renders the essence-first account explanatorily unsatisfying.

That knowledge of common causes requires prior modal knowledge can be made explicit through consideration of two points. First, *knowledge of a natural kind's common cause depends on prior knowledge of its causal structure*. Second, *knowledge of that causal structure, in turn, depends on prior knowledge that is either implicit or explicitly modal*.

The first point should be reasonable. To identify a kind's common cause, we must already know which of its causal properties are central and which are peripheral, and this in turn presupposes some knowledge of the kind's overall causal structure.[xxi] The need for such knowledge becomes even clearer when we consider abduction to common cause according to what was said in the previous section. Without some grasp of a kind's causal structure, it would be difficult to identify its common cause through abductive reasoning, since appealing to explanatory considerations such as Unification (Does taking X as the common cause explain as many phenomena of the kind as possible?) and Causal Adequacy (Can X, as the common cause, fit coherently into the overall causal story of the kind?) requires reference to, and comparison with, information about the kind's general causal structure.

The second claim can be supported with considerations from various directions. As I indicated with the introduction of the interventionist framework in the previous section, roughly speaking, a natural kind's causal structure can be mapped out by systematically varying relevant factors and repeatedly applying principles such as (SC) and (NC). However, the process through which causal knowledge of a kind accumulates and eventually yields a map of its causal structure is itself loaded with modal knowledge. To begin with, knowing a factor is manipulable or intervenable is knowing the contingency of the factor. That is, it involves knowing *the possible ways* in which a factor may be realized or instantiated. For example, knowing that the shape of a chunk of silver is manipulable or changeable is to know that its shape is contingent. Suppose the chunk of silver O is

actually in shape M. To know that its shape is contingent is to know that, *possibly, O could have a shape other than M*. This point can be generalized. Our knowledge that a natural kind's factor (with its actual value F) or property (with its actual instantiation P) is manipulable amounts to knowing that *it is possible for the factor to have a value other than F*, or *for the property to be instantiated in ways other than P*. Furthermore, recall that in the previous section, Woodward points out that an intervention need not actually occur; we can consider circumstances involving *merely possible* interventions. This further strengthens my claim that some modal knowledge must already be in place for us to employ the interventionist framework in acquiring knowledge of a kind's causal structure.

In addition, knowing which factors are manipulable also requires background knowledge of the relevant environmental contingencies, as one crucial feature of causal explanation is that it cannot be complete without citing relevant background conditions or factors. In her work, Mallozzi acknowledges this requirement when she writes:

> Importantly, like in all causal explanations, a number of other factors will be relevant to fully explain certain effects, e.g., contingent local environmental factors, but also the relevant laws of nature, and other broad background conditions, depending on the case. Ideally, one should be able to lay out the details of the whole causal structure underlying a certain effect. (Mallozzi S1947)

In both cited paragraphs above and in Section 2, Mallozzi emphasizes that what she calls *opportune* or *contingent environmental factors* should be considered in causal explanations. These environmental factors in general might include temperature, atmospheric pressure, pH level, light intensity, air composition (like oxygen, carbon dioxide levels), radiation exposure (like exposure to ultraviolet, or ionizing radiation), wind speed, and even human's preferences, etc. The listed environmental factors are certainly not exhaustive, and different sets of factors (some factors are certainly not listed here) might be at play in different cases. Now, knowledge of these contingent environmental factors is also significant, since in practice we often manipulate various environmental conditions in our inquiries of causal relations. For example, we may regulate the velocity of a chemical reaction by raising the temperature or adjusting the pH level of the environment. Yet, knowing which environmental factors are manipulable again involves a body of modal knowledge. For instance, it involves knowing that *it is possible for the environmental pH level to take on a value other than H* (where H is the actual pH level), or that *it is possible for the temperature to take on a value other than T* (where T is the actual room temperature).

Picking up the thread left in Section 2 regarding the epistemic influence of conventional or pragmatic elements, I contend that if such elements indeed affect our individuation of a kind's causal structure, then this only further supports my claim that knowing a kind's common cause requires pre-existing modal knowledge. The contingency of conventional

and pragmatic factors must also be taken into account when we map out the overall causal structure of a kind within the interventionist framework.

Now, let me further apply the foregoing discussion to the analysis of an example in Mallozzi's work. In an earlier passage, Mallozzi remarks that "being so shiny plays no causal and explanatory role for the many, many other properties typically shared by all instances of silver; which is to say, being white and lustrous is not essential to being an instance of silver" (Mallozzi S1946). At this point, however, she has not yet explained how we come to know that being shiny plays no causal or explanatory role in accounting for many of silver's other typical properties. She later provides such an explanation in her discussion of the whiteness and lustrousness of silver:

> [Silver] being white and lustrous is largely a consequence of a variety of metaphysically contingent nomological and environmental mental conditions, including e.g., the particular intensity and frequency of a certain electromagnetic radiation; not to mention the particular features of the human eye and brain. It is plausible to think that had any of those conditions been different, silver might have been blue and dull, say, even if its atomic number were the same. (Mallozzi S1947)

I take her explanation to suggest that a property such as lustrousness is not essential to silver, nor does it play a central role in the causal explanation of its other features, because it varies easily with changes in various contingent factors. This further illustrates that in order to know what is or is not part of a kind's common cause, some antecedent modal knowledge is required. In practice, we often recognize that a property is not a kind's common cause precisely by observing that it varies readily with changes in environmental factors while leaving unaffected many of the other properties typically instantiated by the kind. Suppose a sample of silver *actually* exhibits the property L (lustrousness) under a room with light intensity I. Upon observing that the silver easily loses its lustrousness when the light intensity changes, and inferring from this that lustrousness is not a central component of silver's causal structure, I must already possess some antecedent modal knowledge, such as:

> Possibly, light intensity of the room is value other than I.
>
> Possibly, the sample silver has all other typical properties except being not-L.

To sum up, even when the epistemology of common cause is construed within the interventionist framework (with the aid of abduction in some cases), its successful application in identifying a kind's common cause presupposes some prior knowledge of the kind's causal structure. Yet, acquiring such knowledge through the interventionist framework itself requires antecedent knowledge of which factors and environmental conditions are manipulable. Such knowledge, in turn, is just either explicit or implicitly modal knowledge. The overall picture of essence-first modal epistemology for super-explanatory essentialists can be thus summarized with the following figure. In the figure, one important part is that knowing common causes requires prior modal knowledge

about natural kind's property and relevant background conditions.

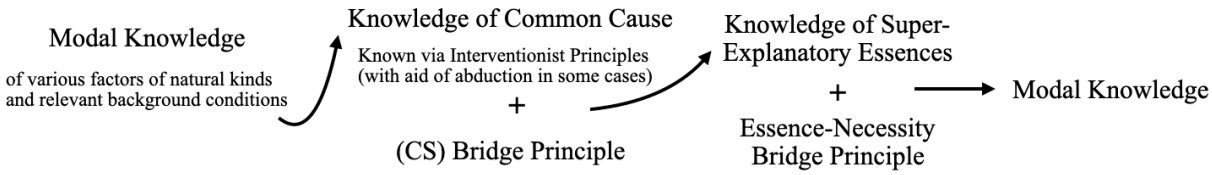

Fig. 4

Is it problematic for the super-explanatory essentialist's essence-first modal epistemology to rest on pre-existing modal knowledge? I shall argue that it is, for two reasons. First, as the very name *"essence-first"* suggests, the core idea of this approach is to explain modal knowledge on the basis of our knowledge of essence, which serves as its epistemic foundation. If, however, knowledge of essence itself turns out to depend on antecedent modal knowledge, then the epistemic role of essence will be far less fundamental than its advocates claim. Knowledge of essence would become merely an intermediate product, and the essence-first account would collapse into a more general form of modal epistemology. Second, the central aim of modal epistemology is to elucidate the source of modal knowledge. If an essence-first account lacks the theoretical resources to explain the very modal knowledge it presupposes, then the account is explanatorily unsatisfying—it leaves unexplained precisely what it set out to clarify.

But does the super-explanatory essentialist truly have no means of elucidating the antecedent modal knowledge on which their account relies? Super-explanatory essentialists such as Mallozzi, apart from stating that "we learn from the modal metaphysics that the epistemology of modality depends on the epistemology of essence" (S1939), say little about whether there are other ways of knowing modal matters. To clarify the options available to them, I suggest distinguishing between two readings of the essence-first modal epistemology endorsed by super-explanatory essentialists:

> Strong Reading: The route to modal knowledge outlined by super-explanatory essentialists is the only route to modal knowledge.
>
> Weak Reading: In addition to the route sketched by super-explanatory essentialists, there exist other routes to modal knowledge.

I contend that the Strong Reading is implausible for at least two reasons. First, this doesn't seem to align with our epistemic practices. When we first acquire knowledge about a natural kind, we begin with a cluster of knowledge about what we immediately observe and make inferences from these observations in practice. It seems that we obtain knowledge of contingent or possible features more immediately before we ever attain knowledge of super-explanatory properties. Second, if we must know the essence or the super-explanatory property of a kind to obtain knowledge of possibilities, then this invokes an unreasonable demand for knowing possibilities which is largely in conflict with our ordinary practices. It seems that even if we don't know what the essence of water or a chair is, we can still know and meaningfully discuss many possibilities concerning

them.

Appealing to the Weak Reading is not a particularly desirable option either. If there are theoretical resources other than knowledge of essence that serve as the basis for the antecedent modal knowledge in question, then knowledge of essence ultimately depends on epistemic sources external to what the essence-first account itself provides. This again undermines the distinctiveness of the essence-first framework, for it reduces the account to a derivative parcel within a broader landscape of modal epistemologies and thereby erodes its claimed explanatory primacy.

One remaining issue concerns how to explain the source of the modal knowledge involved in the factors and properties discussed in this section. Given the limited space, I shall briefly outline two possible routes to acquiring such modal knowledge. The first is through observation combined with the so-called *actuality-implies-possibility* principle (Hanrahan). In short, once I observe that *p* is the case, I can infer that possibly *p*. Moreover, to know that *p* is contingent is simply to know, on the basis of observation together with the *actuality-implies-possibility* principle, that both possibly *p* and possibly not-*p*. The second route concerns our knowledge of unactualized possibilities. In her "Similarity and Possibility: An Epistemology of De Re Possibility for Concrete Entities," Roca-Royes outlines a way in which we may come to know unactualized possibilities of concrete entities through inductive reasoning. Suppose I observe the breaking of a glass object *o*. By the actuality-implies-possibility principle, I infer that *o* possibly breaks. If I then observe several further instances of glass objects breaking and apply the same reasoning, I can inductively infer the following conditional: *if x is a glass object, then x possibly breaks*. When I later encounter a new glass object *o**, I may infer the possibility that *o** breaks on the basis of the conditional obtained through induction (even if the break does not actually occur). I do not claim that the two routes mentioned here exhaust all possible ways of acquiring modal knowledge discussed in this section, but I hope these brief remarks shed some light on the matter.

A final clarification: I remain neutral on whether the essence-first modal epistemology, under the framework of super-explanatory essentialism, faces the same problem when logic or mathematics is the subject matter. The modal epistemology appropriate for logic or mathematics may differ significantly from that for natural kinds. Some might take my position to echo Roca-Royes's remark that "epistemology of modality will be different for concrete and for abstract entities" (*Rethinking the Epistemology of Modality for Abstracta* 245). However, I shall clarify that I'm more reserved regarding the use of the concrete/abstract ontological distinction as the primary criterion for dividing modal epistemologies. It is possible, for instance, that for some artificial kinds (which can cut across concrete, (like a hammer) and abstract entities (like music according to some Platonism about music)), to have a modal epistemology that is drastically different from natural kinds (maybe the modal epistemology for artificial kinds is closer to the one for logic and mathematics). I leave the issue of whether modal epistemologies should be carved up according to the

concrete/abstract ontological difference to future research.

Conclusion

Focusing on cases involving natural kinds, super-explanatory essentialists maintain that a kind's causal core is identical with its essence and develop a corresponding modal epistemology aimed at elucidating our metaphysical modal knowledge. In this paper, I cast doubt on their account. I first argue that the epistemology of super-explanatory essences, which forms an essential component of essence-first modal epistemology, is seriously under described. I then propose that a two-component epistemology incorporating both interventionist principles and abductive elements offers the most promising framework for explaining how we might come to know super-explanatory essences. Nonetheless, I argue that such an epistemology inevitably requires input from pre-existing modal knowledge. This dependence, I contend, renders their modal epistemology explanatorily unsatisfying, since knowledge of essence becomes an intermediate product derived from prior modal knowledge. In this way, the super-explanatory essentialist framework loses its purported significance, as the status of essence-knowledge as epistemically foundational is thereby compromised.

Notes

[i] In other literature, the essence-first view is also referred to as *essence-based modal epistemology* or *essentialist deduction theory*.

[ii] Following super-explanatory essentialists' assumption, I adopt a broadly realist conception of metaphysical modality. That is, at least some part of modal reality is mind-independent and does not depend on our conceptual matters, conventions, interests, or semantic rules. Here, the anti-realist theories of metaphysical modality I have in mind include, for example, Sidelle's modal conventionalism which grounds modal truths in our conventions, and Thomasson's modal normativism, which takes metaphysical modal claims as expression of our actual semantic rules.

[iii] Many thanks to one anonymous reviewer for pressing me to clarify this.

[iv] According to advocates of essence-first modal epistemology, knowledge of essence can also serve as a source of knowledge of possibilities since the possibilities of an entity are just those states for affairs compatible with the essence of the kind. Hence, knowing what is possible for an entity is just knowing what is compatible with its essence. However, previous literature has placed greater emphasis on knowledge of essence as a source of knowledge of necessity.

[v] See Horvath for a discussion of the epistemological tensions between essence-necessity

bridge principles and Lowe's essence-first modal epistemology.

[vi] For further discussion of common cause in the philosophy of science, see works by Boyd and Khalidi.

[vii] While super-explanatory essentialists primarily focus on causal explanations in their works, Mallozzi clarifies that the scope of their account needs not be limited to causal explanations. In her view, "the causal and non-causal form of determination, and the corresponding explanations, are not mutually exclusive" (Mallozzi S1949). For example, she is open to the possibility for non-causal relation such as constitution to be part of a kind's essence. Also, although super-explanatory essentialism put its focus primarily on natural kinds, it might also extend to explain essence of other kinds, such as artificial kinds. Godman et al. discuss the example of *Alice in Wonderland*: although copies of the book might differ physically (e.g., paperback editions, e-books), they all share content originating from Lewis Carroll's manuscript. Ultimately, it is the authorship of Lewis Carroll that determines the shared typical features of the copies of *Alice in Wonderland* (like plots, main characters, etc.) On the super-explanatory essentialist view, the authorship (*being written by Lewis Carroll*) is the super-explanatory property (and hence the essence) of *Alice in Wonderland*.

[viii] Mallozzi points out that super-explanatory essentialism can effectively address certain dissatisfactions concerning how Kripkean *a posteriori* necessities are known. For Kripke, knowing that *necessarily, gold has atomic number 79* is the joint product of two components: first, our empirical knowledge that gold has atomic number 79; and second, a conditional that can be expressed as:

(G) If gold has atomic number 79, then necessarily gold has atomic number 79.

One immediate question is why we should infer the *a posteriori* necessity about gold from (G). Kripke responds that we know we should do so by means of "a prior philosophical analysis" (109). Mallozzi finds this response unsatisfactory, noting that "it took some scientific investigation to find out about molecular structure" (S1943). Alternatively, super-explanatory essentialism can offer a more straightforward explanation: we should infer with (G) because (G) contains embedded information about gold's essence—its atomic number—which is the source of its metaphysical necessity (S1943).

[ix] I thank an anonymous reviewer for pressing me to address this.

[x] While remaining open to the possibility that essences may take the form of mechanisms, networks of mechanisms, dispositions, or relational properties within their general theoretical framework, super-explanatory essentialists do not further comment on what essences should *not* be identified with. They do, however, discuss what the super-

explanatory essence could not be on a case-by-case basis. For instance, in their "Species Have Historical Not Intrinsic Essences," against Devitt, who argues that biological essence should be intrinsic, Godman and Papineau argue that the essence of a biological kind should not be understood as the intrinsic genetic features shared by its members, but rather as the *historical origin* common to them. I am grateful to an anonymous reviewer for prompting me to clarify this point.

[xi] The transparent iron case is first presented in van Inwagen's work and is used to cast doubt on Yablo's conceivability account specifically.

[xii] Indeed, if we have a plausible epistemology of essence, we can properly elucidate the constraint on conceivability here. However, one question that has not received much discussion in the literature is why we do not consider an epistemology of necessity first. None of Vaidya, Wallner, or Mallozzi offers an explanation of why we should prioritize an epistemology of essence over an epistemology of necessity. I speculate that their direct appeal to knowledge of essence is partly motivated by their metaphysical commitments. While I take this issue to be worth further consideration and exploration, I shall set it aside for now to avoid unnecessary complexity and in view of limitations of space.

[xiii] In his "Modal Rationalism and Modal Monism," Vaidya motivates his criticism of Chalmers's conceivability-based account through a close examination of Chalmers's commitment to modal monism. Vaidya first argues that, given Chalmers's characterization of the notion of ideal positive conceivability, a commitment to modal monism is entailed. He then advances objections to modal monism and contends that its implausibility would also undermine Chalmers's conceivability-based account. Vaidya's criticism, I contend, is possible only if Peacocke's integration requirement is upheld. Namely, that both the metaphysical and epistemological aspects of a subject matter be developed in tandem.

[xiv] Here, to follow the super-explanatory essentialist's characterization of what can count as a common cause, I leave open the possibility that X may be a single property, a mechanism, or a network of mechanisms.

[xv] I do not rule out the possibility that certain *a priori* principles or forms of reasoning may contribute to our knowledge of the common causes of natural kinds. Nevertheless, it should be evident that empirical knowledge and methods remain primarily constitutive in acquiring such knowledge.

[xvi] I'll also leave aside the issue of whether (CS) is a priori as it involves controversies regarding how we understand the nature of knowledge of metaphysical theories. While apriorists like Bealer will maintain that our knowledge of theses about philosophical theories should be largely *a priori*, theorists argue that our metaphysics should be

informed by empirical knowledge (Papineau).

[xvii] In (SC), by "ideal manipulations," what Woodward means is that "the intervention on X (or anything that causes the intervention) affects Y via a causal route that does not go through X" (21).

[xviii] See Magnani's "Model-Based and Manipulative Abduction in Science" for more on the use of abduction in scientific practices.

[xix] By "induction," I shall primarily refer to enumerative induction, that is, the inference of a generalized claim such as "all As are B" from multiple instances of "A is B." In his "A Little Survey of Induction," Norton further distinguishes and discusses a range of accounts of inductive inference. For reasons of space, I will not elaborate on these accounts or assess them in detail here.

[xx] For a more systematic and detailed discussion of various explanatory considerations, see the work by Keas.

[xxi] One might contend that it is possible to know what the common cause of a natural kind is without possessing knowledge of its causal structure, for instance, through epistemic routes such as scientific testimony. Although this line of reasoning constitutes an objection worthy of consideration, it ultimately relies upon a controversial form of anti-reductionism about testimony, which regards testimonial belief as a non-inferential and basic source of knowledge. As a provisional reply, I appeal to considerations at the level of theorization. When we attempt to account for the reliability of a testifier with respect to knowledge of common causes, it remains necessary to explain by virtue of what methods or what background knowledge the testifier's testimony can be regarded as reliable. From the standpoint of theoretical explanation, therefore, methods for the acquisition of modal knowledge, or at least some antecedent body of modal knowledge, must still be incorporated into the overall epistemological framework. See Gerken's *Scientific Testimony: Its Roles in Science and Society* for more discussion on scientific testimony.

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