

Helmholtz's Cognitive Psychology and Quinean Epistemological Naturalism: Is Hermann von
Helmholtz an Epistemological Naturalist?

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Abstract

As a scientist and philosopher writing in the nineteenth century, Hermann von Helmholtz attempts to use the emerging findings of physiology and his own theories of learning, memory, and perception (what we would now call cognitive psychology) to answer questions of epistemology. In his theories of cognitive psychology, Helmholtz concludes that our understanding ultimately operates by representing causal structure. Through this claim, Helmholtz attempts to justify a principle of causation that warrants our entitlement to inductive inference. Not widely popularised in epistemological discussion until the latter half of the twentieth century, *epistemological naturalism* is the view that science is a legitimate and autonomous discipline that does not need a grounding in *a priori first philosophy*. According to the epistemological naturalist, explaining the phenomena of *knowing* using the tools of science itself (in particular, through the use of psychology) is the true role of the epistemologist. This paper tries to answer whether or not Helmholtz's use of cognitive psychology to answer questions of epistemology makes him an epistemological naturalist. In particular, I characterize epistemological naturalism according to Willard Van Orman Quine's formulation in his widely read and canonical "Epistemology Naturalized." The paper concludes that Helmholtz is in fact a thoroughgoing epistemological naturalist.

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1. Introduction

An interesting fact about the German physiologist and physicist Hermann Von Helmholtz is that, despite his clear venture into topics of epistemology, he never considered himself a philosopher. Helmholtz saw himself as a scientist foremost, and this would remain the case for the entirety of his career. His contributions as a scientist were numerous, as he published work in physiology, thermodynamics, fluid dynamics, acoustics, and electrodynamics. All the while, his work in epistemology is still noteworthy: Helmholtz was one of the chief inspirations for the neo-Kantian movement of the late nineteenth century.¹

True to his role as a scientist first, Helmholtz attempts to use the emerging nineteenth-century physiology and cognitive psychology to answer several longstanding issues of epistemology. How we come to form representations of space was chief among them. Helmholtz understands Kant to be a nativist towards spatial perception. That is to say, he saw Kant's view as entailing that spatial perception must be an innate feature of human cognition. Opposing the Kantian conception of space, Helmholtz attempts to use his cognitive psychology to purportedly show that spatial perception is in fact acquired. Moreover, in light of Johannes Müller's findings in the physiology of sensations, Helmholtz concludes that our perceptions *cannot* be *images* of their causes, thereby ruling out the possibility that our representations of objects can be true *in virtue* of an imagistic correspondence between the representation and its cause. In response, he proposes what he sees as the only plausible alternative account of truth and uses the theory of perception developed in his cognitive psychology to explain how we then come to form true representations of objects. This is the long way of saying that Helmholtz attempts to answer

¹ For a biographical sketch of Helmholtz's career, see Hatfield, *The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz*, chapter 5 or Hatfield, "Helmholtz and Philosophy: Science, Perception, and Metaphysics, with Variations on Some Fichtean Themes," (2018). For a timeline of Helmholtz's career and explanations of several of Helmholtz's scientific achievements, see Patton, "Hermann von Helmholtz," (2018).

questions typically relegated to epistemology by using certain theories of emerging nineteenth-century natural science.

Categorizing philosophers who attempted to answer questions of philosophy using science as “naturalists” did not become commonplace until the mid to late twentieth century. With respect to questions of epistemology, the classical formulation of epistemological naturalism comes from Willard Van Orman Quine’s 1969 paper “Epistemology Naturalized.”² According to Quine’s formulation, epistemological naturalism rejects the traditional view of epistemology as the discipline that establishes the a priori foundations of knowledge. Having then rejected the traditional foundationalist account of knowledge, the proper subject matter of epistemology is to provide an account of the phenomena of knowing using the methods of natural science itself. This task, according to Quine, is best achieved by using psychology to explain the inferential steps between sensory evidence and justified belief (i.e., knowledge).³

According to this formulation of epistemological naturalism, does Helmholtz’s attempt to use the tools of emerging nineteenth-century science to answer questions of epistemology warrant calling him an epistemological naturalist? Does Helmholtz wholly reject the foundationalist paradigm in favour of viewing science as a legitimate discipline independent of providing it any a priori grounding? The latter question is the more perplexing of the two given that Helmholtz believes science to rest upon an a priori principle of causation. Yet when we examine his argument for the apriority of this principle of causation, he appears to be drawing his claims as a consequence of his cognitive psychology, thereby coming into conflict with the notion of a priority as “justified independently of *any* experience.”

² For an account of the canonical status of Quine’s “Epistemology Naturalized” in the current discussion of Epistemological Naturalism, see both Audi, “Naturalism as a Philosophical and Scientific Framework: A Critical Perspective,” (2014) and Rysiew, “Naturalism in Epistemology,” (2021).

³ Quine, “Epistemology Naturalized,” 69–90.

The questions above are the central questions I will attempt to answer in this paper. In what follows, I construct an interpretation of Helmholtz that suggests that he is in fact a thoroughgoing epistemological naturalist. However, in order to do so, I will first need to explain the emerging science that Helmholtz uses to answer questions of epistemology.

This paper is thus organized into three main sections, with each of these sections then having three sub-divisions. The first section explains Helmholtz's cognitive psychology. Here I show how he explains the process of learning, the distinction between sensation and perception, and the acquisition of spatial perception. The second section explains Helmholtz's epistemological views. I begin by showing how Helmholtz's views in epistemology are a response to the epistemic challenges he sees entailed by Müller's research in physiology. Following this, I then show how Helmholtz uses his cognitive psychology to answer these challenges.

The final section contains my argument that Helmholtz is an epistemological naturalist. I begin this section by carefully defining what I mean by both *methodological naturalism* and *epistemological naturalism*. In particular, I characterize epistemological naturalism according to Quine's classic formulation. The latter parts of this section argue that Helmholtz is a methodological naturalist toward questions of cognitive psychology and the mind and that, ultimately, he then extends this methodological naturalism to questions of the *knowing* mind. The central task of arguing that Helmholtz is an epistemological naturalist concerns addressing his perplexing arguments for the law of causation.

2. Helmholtz's Cognitive Psychology

This section will explain the chief tenets of Helmholtz's cognitive psychology. In particular, I will attempt to explain his account of the development of our perceptual abilities

through an extended example of an infant progressing towards perceptual maturity. This extended example will point out the various noteworthy stages in the infant's development according to Helmholtz's theory of perception. In the subsequent section on Helmholtz's epistemology, we will ultimately use the framework laid out in his cognitive psychology to explain our higher-cognitive functions involved in making *true* judgments.

The current section, however, will begin by considering the experiences of the newborn infant as, without any previous experience of the world beyond its mother's womb, it is the starting point of Helmholtz's account of learning and perceptual development. I give an account of how this newborn infant develops its first "memories" in order to explain Helmholtz's account of the cognitive process of learning. Following this, I use this account of learning to explain Helmholtz's subsequent theory of perception. Finally, these two developments will then permit us to explain his theory of the acquisition of spatial perception. The section ends with an explanation of Helmholtz's resulting account of representation.

2.1 *Associative Learning*

The first experiences had by any newborn likely consist of being cradled and nursed by its mother or primary caregiver. Moreover, these will likely be the most frequently repeated experiences during the first several days of a newborn's life. It is also clear that, as anyone who has observed a newborn infant knows, a newborn infant is *incapable* of voluntary movements of the large motor groups and the eyes at this stage in their development. Hence, even for tasks as simple and essential as eating, the infant must have the bottle or nipple placed in its mouth before it can suckle.

According to the theory of perceptual development proposed by Helmholtz, what does the infant learn from these initial experiences? Moreover, what are these experiences like *from*

the perspective of the newborn infant itself? As mature perceivers, we of course know that the newborn will eventually come to understand this experience as being fed by having a bottle or its mother's nipple placed in its mouth. However, according to Helmholtz's account of our perceptual development, a newborn has yet to develop the ability to represent things spatially. Hence, we cannot describe the experiences of the newborn infant using spatial descriptions such as "the bottle moved (spatially) towards my mouth." From the perspective of the newborn then, we can only talk about qualitatively distinct sensations in temporal succession. For example, being nursed is experienced by the infant as having a warm, spongy tactile sensation in the mouth followed by the sensation of a warm liquid (i.e., a warm tactile sensation having a slightly different resistive character than the bottle or nipple). Finally, this is succeeded by something like the sensations of pleasure at the elimination of a particular bodily sensation of discomfort (what, as mature perceivers, we would call the appeasing of our sensations of hunger).

We can use this example of an infant being nursed to illustrate how the newborn infant gradually learns to associate certain sensations. For instance, the infant will eventually learn to associate the comfort and pleasure of nourishment with certain tactile sensations of swallowing a warm liquid. That is to say, we can explain the process of how the newborn learns the fact that swallowing certain liquids *causes* the cessation of its sensations of hunger. This process, which I shall refer to as "associative learning," stands as the foundation of Helmholtz's cognitive psychology. Let us explore this process in more detail with our example of a newborn infant being fed.

Later that day, presumably once the caregiver suspects the newborn is hungry again, the newborn experiences the same (or, at least, a highly similar) tactile sensation of swallowing a warm liquid followed by the sensations of its hunger being appeased once again. Again, multiple

times on the following day, the infant experiences this particular tactile sensation followed by the sensation of the satiation of its hunger. This process continues day after day until, finally, through the extensive repetition of the experience of swallowing a warm liquid followed by the sensation of the satiation of its hunger, the infant gradually *associates* the sensation of swallowing a warm liquid with the sensations of the satiation of its hunger. That is to say that the infant will come to *expect* that swallowing a warm liquid will *cause* these sensations of satiation.

For Helmholtz, this is the process of *associative learning*. In his words, it is the “fixed and inevitable associations of ideas due to frequent repetition”⁴ or the process whereby “the traces of like kind which are left behind in our memory by often repeated perceptions reinforce one another, it is precisely the lawlike which repeats itself most regularly in like manner, while the incidental fluctuation is erased away.”⁵ This process purports to account for the cognitive process of learning and memory in terms of a *psychological law* asserting that we remember that two different phenomena are causally connected after we have experienced them as being *causally* connected a *sufficient* number of times. Alternatively, that is to say that, after experiencing two phenomena as causally connected a sufficient of times, when we think of the cause, we will then think of its usual effect (or vice versa).

Now returning to the example of the newborn infant, Helmholtz’s account of learning would suggest that, given that swallowing this warm liquid has been frequently (or reliably) experienced as causally connected to the satiation its hunger, the infant begins to associate the prior sensation (the sensation of swallowing the warm liquid) with its effect (the sensation of satiation of its hunger). The result is that, when the infant now experiences the sensations of swallowing this warm liquid, it now *anticipates* the sensations of the satiation of its hunger.

⁴ Helmholtz, *Physiological Optics*, 5.

⁵ Helmholtz, “The Facts in Perception,” 131.

Likewise, when the infant has the thought (i.e., memory) of either the sensations of the satiation of its hunger *or* the sensations of swallowing this warm liquid, this thought can be succeeded by its effects. That is to say, a memory of sensations of the satiation of its hunger conjures the memory of the sensations of swallowing a warm, opaque, whitish liquid; conversely, the memory of the sensations of swallowing the warm, opaque, whitish liquid, if it occurs first, conjures the memory of the sensations of the satiation of its hunger. In short, memory works by recalling causal structure.

Finally, of chief importance to Helmholtz's account of associative learning is the role of active testing and experimentation through motor activity. Helmholtz writes, "the tests we employ by voluntary movements of the body are of the greatest importance in strengthening our conviction of the correctness of the perceptions of our senses."⁶ In the "Facts in Perception," he elaborates that

[w]e rather observe during our own continuing activity, and thereby attain an acquaintance with the enduring existence of a lawlike relationship between our innervations and the becoming present of the various impressions from the current range of presentables. Each of our voluntary movements, whereby we modify the manner of appearance of the objects, is to be regarded as an experiment through which we test whether we have correctly apprehended the lawlike behaviour of the appearance before us...⁷

In short, that testing consists in our voluntary motor activity whereby we alter our body's relation to the stimuli and observe the resulting changes in sensation. In doing so, we are able to learn both the generality of these causal laws and the situations in which they apply or do not apply. Of course, in the case of the newborn infant, they have yet to develop the ability for voluntary movement and, hence, can do little in the way of intentional tests. However, as the infant matures

⁶ Helmholtz, *Physiological Optics*, 29

⁷ Helmholtz, "The Facts in Perception," 136.

and gradually acquires the ability for voluntary motor activity through learning the appropriate muscular innervations, the ability to test causal relations becomes more and more significant.

Let us give an example of the testing employed by an infant who has recently acquired some strength and coordination of its hands. The infant may observe (through both its visual and haptic system) that, while keeping the neck straight and its eyes pointed straight ahead, a certain innervation of its muscles causes its palm to face downwards and its fingers to open. Consequently, the toy it was holding in this hand then falls to the ground. Thus, the infant infers that when the toy is in the hand and it executes this *particular* innervation of the muscles, the toy will *always* fall. However, through experimenting and varying the conditions under which it opens the hand that is holding the toy, the infant observes that, in fact, the toy does *not* always fall, such as in the case when it places its *other* hand palm up and directly beneath the toy. Hence, the infant comes to recognize that its previous generalization was, in fact, incorrect. Instead, through this experimentation, the infant learns the more comprehensive set of innervations of the muscles that will *ensure* the toy will fall.

2.2 The Theory of Unconscious Inferences

Having given an illustration of the thesis of associative learning, we can now use it to explain Helmholtz's doctrine of *unconscious inferences*. The theory of unconscious inferences begins with the fact that Helmholtz holds the distinction between *sensations* and *perceptions*. That is to say that, according to his cognitive taxonomy, sensations (being the effects of some stimuli interacting with the body) are the more primitive matter from which we construct perceptions. The process of unconscious inference explains how these sensations are integrated

into perceptions.⁸ Moreover, the theory of unconscious inferences also acts as the link between Helmholtz's thesis of associative learning and his theory of perception.

Let us return to our infant example to illustrate the theory of unconscious inferences. What occurs once the infant has firmly formed the association between certain sensations and their effects? According to Helmholtz's theory of unconscious inferences, once we have learned the causal connection between two phenomena (i.e., formed the association between the two), it gets integrated into our perceptions through an unconscious process. When presented with some sensation that we have already learned to be reliably causally connected to some effect, this process entails that we *unconsciously* anticipate (or expect) its effect. For instance, in the above example where the infant is being nursed, the infant will eventually come to unconsciously anticipate the appeasing of its hunger when presented with the sensations of swallowing the warm, whitish liquid. (In the case of an infant, by being "unconscious," I simply mean that it is not the direct object of the infant's attention.)

By explaining the infant's unconscious inference in terms of the *anticipation* of the usual effects (or cause) of a given sensation, I mean to suggest that, once the infant has formed the association between two events, the infant is no longer surprised (e.g., it no longer arouses the same excitement or bewilderment) when usual effect (or cause) of this sensation is present. For example, the infant is no longer surprised when the sensation of a warm liquid in its mouth is followed by a sensation of the appeasing of its hunger. Thus, the cognitive process of *unconscious inferences* can be explained in terms of the "expectations" or "anticipations" of the subject. Through this process, the infant's representation of swallowing the warm, whitish liquid

⁸ For recent scholarship on Helmholtz's distinction between sensations and perception along with the role of the unconscious inference in integrating these sensations into representations, see Patton, "Helmholtz's Physiological Psychology," (2018). According to Patton, sensations can be understood as the effects of external stimuli on our sense organs.

can *now* be said to *contain* the causal information about the effects of this liquid. Namely, that swallowing this warm, whitish liquid has *reliably caused* the satiation of its hunger in the past.

Let us give another example of an unconscious inference to better grasp this process. Consider another crucial moment in an infant's development where they come to recognize that certain things operate independently of their *will*.⁹ This occurs as the infant repeatedly experiences that certain changes in sensations *are not* reliably connected to any of the innervations of the muscles. For instance, if we hold our hand in front of our face, no innervation of the muscles will reliably make the hand in front of our face turn green. As mature perceivers, we simply understand this as meaning that the colour of our hand is independent of our will. Another example is that no innervation of the muscles can reliably make a table pliable and spongy. Again, as mature perceivers we recognize this as the simple fact that thick wooden objects are always sturdy and impenetrable (that is, impenetrable to human appendages unaccompanied by the use of tools).

Finally, through the sheer repetition of experiencing things that are not reliably causally connected to the will, the infant comes to *represent* these things as being independent of its will. That is to say that, when having the sensations of some phenomenon that, in its past experience, could not be reliably altered by its sensations of muscular innervations, the infant unconsciously infers that this phenomenon can, therefore, *not* be altered by its muscular innervations. Hence, the infant now perceives this phenomenon as operating *independently* of its muscular innervations (i.e., its will). Alternatively, this says that its perception of this phenomenon now

⁹ Edgar sees Helmholtz as holding the view that our will is "the innervation of muscles that bring about movement" (Edgar, "The Physiology of the Sense Organs and Early Neo-Kantian Conceptions of Objectivity: Helmholtz, Lange, Liebmann," 110).

contains the information that these sensations do not stand in any reliable causal relation with respect to our sensations of muscular innervations.

What this ultimately shows is that, beyond the mere qualitative experience of the sensations caused by various stimuli, our perceptions also include information about the casual laws these sensations stand in. Regarding this point, Helmholtz writes that,

[i]n previous studies I characterised as unconscious inferences the connexions between representations which thereby occur—unconscious, inasmuch as their major premiss is formed from a series of experiences, each of which has long disappeared from our memory and also did not necessarily enter our consciousness formulated in words as a sentence, but only in the form of an observation of the senses. The new sense impression entering in present perception forms the minor premiss, to which there is applied the rule imprinted by the earlier observations.¹⁰

In a word, that is to say that sensory qualities alone *do not* exhaust our conception of the perceptual image generated in a representation. For Helmholtz, the content of a perception is composed of an explicitly qualitative dimension from our sensations along with certain counterfactual claims regarding the causal relations these particular sensations *should be* expected to stand in. More precisely, these are the causal relations these sensations should be expected to stand in *were* we to engage in further motor activity that would alter our body's orientation to the stimuli. In this way, Helmholtz is able to explain that our sensations differ from our perceptions *in virtue of* this causal information.

Now that we have given an account of how the theory of unconscious inferences is used to explain the difference between sensations and perceptions, let us look at Helmholtz's motivations for proposing the theory. For Helmholtz, the chief role of the unconscious inference is to explain how we come to form representations of the existence and the position (i.e., the spatial determinations) of objects. According to him, our unconscious inferences are the "psychic

¹⁰ Helmholtz, "The Facts in Perception," 132.

activities that lead us to infer that there in front of us at a certain place there is a certain object of a certain character,” which then enables us to then “form an idea as to the possible cause of this action.”¹¹

Another chief reason why Helmholtz proposes the theory of unconscious inferences is to explain several perceptual anomalies. He suggests that, rather than being a result of the physiological process explaining our sensations, several phenomena in which our perceptions appear to differ from the stimuli they intend to represent can be accounted for by a *psychological* process. The reason, according to him, is that when we are presented with certain sensations, we infer them as having the same causes they have reliably had in our past experiences (i.e., we see them as being *signs* of certain causal relations). Hence, represent them according to these causal relations. However, if it turns out that, on some rare occasion, this aggregate of sensations has some different cause, we will (on account of our unconscious inferences) mistakenly represent it as having its usual cause. Applying this to our visual representations, he suggests the following principle:

[t]he general rule determining the ideas of vision that are formed whenever an impression is made on the eye, with or without the aid of optical instruments, is that *such objects are always imagined' as being present in the field of vision as would, have to be there in order to produce the same impression on the nervous mechanism, the eyes being used, under ordinary normal conditions.*¹²

Helmholtz’s chief example regarding this principle is the case of the eyeball being mechanically stimulated from the outer corner. This mechanical stimulation of the eye causes a sensation of light coming from the bridge of the nose despite there not being any source of light radiating into the retina from this direction. Citing the above explanation, Helmholtz concludes that, given the vast majority of our past experiences of luminous sensations of this character were

¹¹ Helmholtz, *Physiological Optics*, 4.

¹² Helmholtz, *Physiological Optics*, 2.

from a luminous source in the direction of the bridge of the nose, we end up representing these sensations as coming from the direction of the bridge of the nose.¹³ Of course, upon further investigation, it will quickly become apparent that this luminous sensation does not stand in its usual causal relationships (e.g., that it does not change position in our field of view as we move our body into different positions around the room). Summarizing what has occurred here, he remarks that

[t]hese unconscious conclusions derived from sensation are equivalent in their consequences to the so-called conclusions from analogy. Inasmuch as in an overwhelming majority of cases, whenever the parts of the retina in the outer corner of the eye are stimulated, it has been found to be due to external light coming into the eye from the direction of the bridge of the nose, the inference we make is that it is so in every new case whenever this part of the retina is stimulated...¹⁴

From these considerations, Helmholtz proposes another general characteristic of our perceptions. Namely, that we only pay attention to (i.e., become conscious of) the parts of sensation that are useful in allowing us to recognize external objects. He remarks that “*we are not in the habit of observing our sensations accurately, except as they are useful in enabling us to recognize external objects. On the contrary, we are wont to disregard all those parts of sensations that are of no importance so far as external objects are concerned.*”¹⁵ Again, we must recall that the role of the theory of unconscious inferences is to explain how we represent the existence and position of external objects. The point here is thus that if some property of a sensation proves to be ineffective in allowing us to infer the cause of our present sensations, it is then overlooked in our unconscious inferences that integrate our sensations into our conscious

¹³ See Helmholtz’s *Physiological Optics*, pp. 2–3, for this example.

¹⁴ Helmholtz, *Physiological Optics*, 4–5.

¹⁵ Helmholtz, *Physiological Optics*, 6.

perceptions (i.e., our representations of the causes of our sensations). Hence, why Helmholtz thinks we do not notice the blind spot in our visual field, for instance.¹⁶

2.3 *Spatial Perception and Representations*

Having discussed Helmholtz's theory of unconscious inferences, we now have the required tools to explain Helmholtz's account of spatial perception. Let us return to our infant example once again to illustrate the process of how our unconscious inferences eventually lead us to represent spatial structure.

Helmholtz's account of spatial perception requires that the infant must first develop the coordination of its eyes, neck, and several large motor groups. Again, given these two capacities are not simply given at birth in virtue of our physiology, they must then be acquired through the process of associative learning. As we might expect, this process entails learning the regularities between the changes in sensations of the innervations of our muscles. Helmholtz details this process:

[o]nly physiology teaches us that we put into an excited state—or innervate—the motor nerves, that their stimulation is passed on to the muscles, that these consequently contract and move the limbs. Yet all the same we know, even without scientific study, which perceivable effect follows each of the various innervations that we are able to initiate. That we learn it by frequently repeated attempts and observations, may be demonstrated with assurance in a long series of cases... We can learn innervations for moving our ears, for squinting with our eyes inwards or outwards, or even upwards and downwards, and so on. The difficulty in performing such things consists only in our having to seek, by making attempts, to find the as yet unknown innervations needed for such previously unexecuted movements. We ourselves, moreover, know of these impulses in no other form, and through no other definable feature, than precisely the fact that they produce the intended observable effect. Thus this effect also alone serves to distinguish the various impulses in our representation.¹⁷

Thus, after some amount of accidental eye, neck, and limb movement, the infant begins to learn the requisite sensations of innervation of the muscles to begin moving the eyes, head,

¹⁶ See Helmholtz, *Physiological Optics*, pp. 6–9, for this example.

¹⁷ Helmholtz, "The Facts in Perception," 123.

and (certain) limbs about at will (e.g., is now capable of associating the proper sensations of innervation of the ocular muscles to their resulting movements of the eyes).¹⁸ This newly acquired ability to move certain body parts about voluntarily allows the infant to actively experiment and, hence, further improves its coordination. Finally, once it has developed the coordination to alter the position of the neck and eyes at will, the infant can now orient the eyes and head in order to “scan” various patterns in the visual field. By scanning the eyes across the visual field, the infant learns that there are certain enduring regularities of sensations in the visual field.

How does the ability to alter the orientation of the head and eyes teach the infant that there are certain enduring regularities in the visual field? When the infant experiences some innervation of the neck and ocular muscles that orients the head and the eyes in a different direction, the visual sensations change. For example, the infant experiences visual sensations of white from having its eyes and head pointed towards a wall that is painted white. Then, after a particular sensation of innervation of the neck and ocular muscles, its head and eyes turn to the right and it experiences visual sensations of green as the grass outside the window now comes into view. Now, there is another particular sensation of innervation of the muscles that is *qualitatively distinct* from the previous sensation of innervation that pointed the head and eyes towards the window that will cause the infant’s head and eyes to point back towards the wall. That is to say, this next innervation of the muscles reverses the previous one. In this case, the infant’s next innervation of the neck and eyes happens to be the very innervation that reverses

¹⁸ My use of the term “movement” (and later use of “position) might strike the reader as problematic as, given that they are both spatial descriptions, it might seem to presuppose the infant’s ability for spatial perception. This would of course contradict Helmholtz’s claim that spatial perception is acquired. To view these terms this way would be mistaken, however. I am simply describing the infant from the third-person perspective of a *mature* perceiver who has the ability for spatial perception. From the perspective of an infant without the ability for spatial perception, a different “position” of the head is simply another qualitatively distinct bodily sensation. Similarly, a movement of the head and eyes would be experienced as the temporal succession of qualitatively distinct bodily sensations.

the initial innervation that caused its head and eyes to face the window. Hence, with its head and eyes facing the wall, the infant experiences the visual sensations of white once again. Finally, through an extensive number of cases like this, the infant begins to learn the sensations of innervation of the muscles that reverse one another. Ultimately, they thereby learn that certain sensations of innervation will reliably allow them to re-experience certain sensations in their visual field again.¹⁹

Using this process of learning the innervations of the muscles that reverse a previous movement (i.e., that reliably allows us to re-experience a previous sensation), we can give an example of one of the infant's earliest spatial perceptions. Consider the case where the infant is placed before a high contrast pattern. Say a 1950s-era black and white checkered tile floor, for instance. On this day, the infant innervates the ocular muscles and rotates the eyes to have them focus on a different region of the visual field. Following the previous example, the infant has learned the sensations of innervation that will reverse this first innervation of the ocular muscles and allow them to re-experience the visual sensations had before having performed it. The infant first sees one black square of the checkerboard pattern and then, through its first innervation of the ocular muscles, its eyes are re-oriented such that the adjacent white square is the primary tile in view. Then, through a second innervation of the ocular muscles (and, in particular, the innervation that undoes the first one) the infant's eyes are re-oriented towards the black tile causing the infant to experience the visual sensations of the black tile once again.

Through this process, the infant is able to establish spatial directions for the first time. That is to say that, for instance, that to the left here is the sensation of white—that the white tile is to the left of the black tile—since executing a certain bodily movement after seeing that

¹⁹ Of course, the same process would apply to the infant's other sensory modalities.

particular visual sensation of black reliably yields a visual sensation of white. We call this particular sensation of innervation “to the left.” Likewise, to the right there is a sensation of black. Helmholtz, details this process:

our observer is tied at this time to a certain range of presentables, but any individual one of which he can make present at any moment he wishes by executing the relevant movement. Each individual presentable from this group thereby appears to him as enduring at every moment of this period of time. He has observed it at every individual moment that he wanted to. The assertion that he would have been able to observe it also at any other intervening moment that he might have wanted to, is to be regarded as an inductive inference, drawn from the case of every moment at which a successful attempt was made to that of every moment whatsoever in the relevant period of time. Therefore, the representation of an enduring existence of different things at the same time one beside another can in this manner be acquired.²⁰

Helmholtz’s point here is simply that spatial directions are cognized by learning the muscular innervations required for the bodily movements to re-experience certain phenomena. That is to say that our spatial descriptions such as to the right or left, for instance, are “only names for certain eye *movements*.”^{21, 22}

Of course, during this same period, the infant would presumably also learn the innervations of the neck and ocular muscles required to move the head and eyes up and down (i.e., to re-experience things that the previous left-right movements could not reliably yield). Hence, this would give them the ability to perceive in two dimensions. Following this depth (i.e., a third dimension) would also be added through establishing the muscular innervations required for appendage movements that permit us to re-experience certain sensations that the up-down

²⁰ Helmholtz, “The Facts in Perception,” 125.

²¹ Helmholtz, “The Facts in Perception,” 126; my italics.

²² Of course, without any language skills, the infant would not be signifying this to themselves with the words “left” and “right,” the infant would simply have a representation of sequences of sensations of innervations of the muscles.

and left-right movements *cannot* reliably cause us to re-experience.²³ After all, “in front and behind” stand for “certain movements of the hands,” remarks Helmholtz.²⁴

This view of spatial representations is nicely summarized by Helmholtz in the following passage:

[s]uppose we namely ask whether there is a common characteristic, perceivable in immediate sensation, whereby every perception relating to objects in space is characterized for us. Then we in fact find such a characteristic in the circumstance that motion of our body places us in different spatial relations to the perceived objects, and thereby also alters the impression made by them upon us.²⁵

In short, that spatial directions are simply defined through our sensations of *bodily movements* (or, more precisely, the sequences of sensations of muscular innervations that we call bodily movements). However, it is through this very fact that one of Helmholtz’s more radical claims about spatial representation emerges: representing spatial structure simply *is* representing *causal* structure. Given that spatial representations are explained on the basis of the causal laws that explain which sensations of innervation allow us to re-experience some previous sensation, they are thereby defined (and *cognized*) as causal relations.

Now, once we have learned these causal laws regarding the sequences of sensations of innervation that permit us to re-experience various phenomena (i.e., have learned to discern spatial directions), their integration into our perceptions will of course need to be explained. Unsurprisingly, given that spatial directions are simply causal laws we acquire through associative learning, they are integrated into our perceptions via our unconscious inferences.

²³ While this may be somewhat esoteric for readers without a background in mathematics, we can make the notion of learning spatial dimensions a bit more precise by using the mathematical notion of dimension. This process is essentially learning the sequences of sensations of innervation to move the body (or certain body parts) along certain vectors and, chiefly, to also learn to undo these changes by learning the sequence of sensations of innervations that are the additive inverse of each of these vectors. Establishing three dimensions thus entails that, from one fixed position of the body, they have learned the sequences of sensations (and their inverses) for three vectors that are all pairwise linearly independent.

²⁴ Helmholtz, “The Facts in Perception,” 126.

²⁵ Helmholtz, “The Facts in Perception,” 123.

That is to say that, for instance, once the infant is slightly more mature, they no longer need to *consciously* think of the “right” (i.e., to one side of the body) as corresponding with a sequence of innervations of the muscles: its perceptions will eventually come to include the causal information about the sequences of sensations defining spatial directions. Helmholtz explains that

[b]ecause this intuited spatial order of things stems originally from the sequence in which the qualities of sensation offered themselves to the moving sense organ, there finally persists a curious consequence even in the completed representation of an experienced observer. The objects extant in space namely appear to us clothed in the qualities of our sensations.²⁶

To illustrate the fact that the causal laws that define spatial structure are integrated into our perceptions, Helmholtz uses the example of a person trying to find their way through a dark room. By feeling the objects around them with their hands, their unconscious inferences regarding the spatial properties of these objects allow them to find their way through the room despite not being able to *see* the spatial properties of these objects. He writes that,

[w]hen wanting to find our way in the dark, we usually feel over larger objects with five or ten finger-tips simultaneously. We then obtain five to ten times as many reports in the same time as with one finger, and also use the fingers, like the tips of an open pair of dividers, for measuring magnitudes in the objects.²⁷

Thus, although they cannot see the room, their tactile perception contains the causal information of the sequence of visual sensations that would correspond to this sequence of tactile sensations had the room been well-lit.

The final significance of Helmholtz’s account of spatial perception is the resulting account of representation. As we have seen, beyond just the qualitative character of the sensations in our perceptions, our perceptions equally contain counterfactual information

²⁶ Helmholtz, “The Facts in Perception,” 127–128.

²⁷ Helmholtz, “The Facts in Perception,” 126.

regarding the causal laws these sensations stand in. More precisely, these laws quantify the changes in sensations that would occur were we to put our body in a different orientation to the stimulus. Moreover, through this process, our sensations become *perceptions* whereby we *represent* the external stimuli causing these sensations. Hence, our representations are *necessarily* representations of causal structure. In light of this, Helmholtz concludes that, in order to represent some stimulus, the requirement is that we know the causal laws regarding the changes in sensation we would experience were we to put our body in various different orientations to this stimulus. Explaining this, he writes that,

[i]f one wishes to try to represent to oneself something which has never before been seen, one must know how to depict to oneself the series of sense impressions which, according to the known laws of the latter, would have to come about if one observed that object and its gradual alterations successively from every possible viewpoint and with all of one's senses... Since by presupposition it is a thing which is considered never yet to have been observed, no previous experience can come to our help and guide our fantasy in seeking out the requisite series of impressions; instead, this can only happen by way of the *concept* of the object or relationship to be represented.²⁸

3. Helmholtz's Epistemology

This section aims to explain the core principles of Helmholtz's epistemology. Having covered the core tenets of Helmholtz's cognitive psychology, the secondary aim of this section will be to explain how his cognitive psychology and epistemology link up. In particular, I will try to show how the theory of unconscious inferences and the resulting account of representation influences both his account of truth and his argument for the basis of our entitlement to inductive inferences.

I begin by discussing Helmholtz's sign theory of perception, where, as a result of the recent findings in physiology, he concludes that our perceptions are not *images* of their causes. This leads Helmholtz to reject the commonplace notion of truth as the *imagistic correspondence*

²⁸ Helmholtz, "The Facts in Perception," 129.

between a representation and its cause. This is followed by detailing his supplementary account of truth. Finally, I end this section by tracing the arguments for the *law of causation*, a purported a priori principle that entitles us to inductive inference.

3.1 *The Sign Theory of Perception*

The sign theory of perception begins with the observation that, as several findings of empirical psychology and physiology had recently shown, *differing* stimuli are capable of causing the *same* sensations. For instance, Helmholtz remarks that light entering the retina causes a sensation of light while mechanical stimulation of the outer corner of the eye can also cause the same sensation of light.²⁹ Put more generally, Johannes Müller’s research in the physiology of sensations had discovered that the sensory qualities of a sensation are not dependent on the stimulus alone, but also depend (in part) on the particular sensory organ of our nervous system this stimulus interacts with.³⁰ For instance, Helmholtz gives the example of the antiquated “aether vibrations” that are “felt by the eye as light” but “felt by the skin as heat.”³¹ Helmholtz’s point here is simply to make the innocuous observation that electromagnetic radiation (as we would now describe it) results in the sensation of light when it interacts with the visual system but results in the sensation of heat when interacting with the haptic system. From these observations, Helmholtz concludes that “[o]ur sensations are indeed effects produced in our organs by external causes”; however, “how such an effect expresses itself naturally depends quite essentially upon the kind of apparatus upon which the effect is produced.”³²

²⁹ Helmholtz, *Physiological Optics*, 2–3.

³⁰ Müller’s most thorough defense of this view is found in his 1833–1840 *Handbook of Human Physiology*.

³¹ Helmholtz, “The Facts in Perception,” 120.

³² Helmholtz, “The Facts in Perception,” 121.

Helmholtz offers a similar but slightly more general argument in his *Physiological Optics*. On conceptual grounds, he considers the implications of Müller's findings for the *objectivity* of our perceptions:

[o]ur apperceptions [perceptions] and ideas are effects wrought on our nervous system and our consciousness by the objects that are thus apprehended and conceived. Each effect, as to its nature, quite necessarily depends both on the nature of what causes the effect and on that of the person on whom the effect is produced. To expect to obtain an idea which would reproduce the nature of the thing conceived, that is, which would be true in an absolute sense, would mean to expect an effect which would be perfectly independent of the nature of the thing on which the effect was produced; which would be an obvious absurdity.³³

Here Helmholtz argues that the pervasive and seemingly commonsensical notion that the *objective* properties of something are the properties it possesses *independently* of any human perception, representation, or theorizing (i.e., as a things-in-itself) is mistaken. Given that they depend on *both* our cognitive constitution and our physiology, our perceptions thereby fall short of this criterion. While Helmholtz does eventually propose an alternative account of objectivity that overcomes this challenge, if the above account of objectivity is assumed in the meantime, his criticism entails that our perceptions cannot be relied upon to give us objective information about the world.

Finally, given Müller's conclusion that there is no *one-to-one* correspondence between stimuli and sensations, along with Helmholtz's resulting argument concerning the objectivity of our perceptions, Helmholtz draws the conclusion that our sensations *cannot* be images of the stimuli that cause them. In the "Facts in Perception," he remarks that,

[i]nasmuch as the quality of our sensation gives us a report of what is peculiar to the external influence by which it is excited, it may count as a symbol of it, but *not* as an *image*. For from an image, one requires some kind of *aliqueness* with the object of which it is an image...³⁴

³³ Helmholtz, *Physiological Optics*, 19.

³⁴ Helmholtz, "The Facts in Perception," 122; my italics.

In response to the conclusion that our sensations do not resemble their causes, Helmholtz proposes that our sensations can instead be seen as “signs” or “symbols” of their causes.³⁵

In its most general sense, a “sign” means a reliable causal indicator for Helmholtz. He gives the example that “berries of a certain kind in ripening develop at the same time a red pigment and sugar, then a red colour and a sweet taste will always be found together in our sensation for berries of this type.”³⁶ He immediately concludes that,

although our sensations, as regards their quality, are only *signs* whose particular character depends wholly upon our own makeup, they are still not to be dismissed as a mere semblance, but they are precisely signs of *something*, be it something existing or happening, and—what is most important—they can form for us an image of the *law* of this thing which is happening.^{37, 38}

In not being dismissed as “mere semblance,” Helmholtz’s point is that, when two events are found as reliably causally connected, associative learning and the theory of unconscious inferences entail that we can eventually unconsciously infer one event from the other. Thus, our inference from a given cause to its effect is said to be the cause *signifying* its usual effect to us. Likewise, an effect also signifies its usual cause to us.

In denying that our sensations can be images of their causes, Helmholtz’s sign theory of perception entails the rejection of what may be termed the “copy” theory of perception. That is to say, he is rejecting the commonplace and *seemingly* commonsensical notion that our perceptual

³⁵ Tracz (2018) argues that, despite rejecting the view that we perceive things-in-themselves, Helmholtz is not committed to any kind of subjectivism (i.e., the view that we only perceive the properties of our representations). Instead, Tracz suggests that Helmholtz is committed to the view that the properties we perceive are *relational* properties between the subject and object.

³⁶ Helmholtz, “The Facts in Perception,” 122.

³⁷ Helmholtz, “The Facts in Perception,” 122.

³⁸ The following two remarks are also fairly illuminating on Helmholtz’s use of “sign.” He writes that “a sign need not have any kind of similarity at all with what it is the sign of. The relation between the two of them is restricted to the fact that like objects exerting an influence under like circumstances evoke like signs, and that therefore unlike signs always correspond to unlike influences” (Helmholtz, “The Facts in Perception,” 122). Similarly, his remark that “like things are indicated in our world of sensations by like signs, an equally regular sequence will also correspond in the domain of our sensations to the sequence of like effects by law of nature upon like causes” (Helmholtz, “The Facts in Perception,” 122) equally suggest this reading of “signs” as “reliable causal indicators.”

image is an accurate imagistic reproduction of the stimulus. I.e., the view that we receive a “copy” of the stimulus that accurately reproduces the visual, tactile, auditory, olfactory, gustatory, etc., properties of the stimulus. Regarding this Helmholtz remarks that,

[t]o ask whether the idea I have of a table, its form, strength, colour, weight, etc., is true per se, apart from any practical use I can make of this idea, and whether it corresponds with the real thing, or is false and due to an illusion, has just as much sense as to ask whether a certain musical note is red, yellow, or blue.³⁹

Several analogies can be offered to better explain the view Helmholtz has in mind. Patton suggests the copy theory of perception can be understood along the lines of an analogy to pressing a key into soft wax. Here the key represents some external stimulus and the wax represents our sensations. When the key is pressed into the wax, the spatial properties of the key are preserved in the impression left in the wax such that our sensations (the imprint in the wax) visually resemble the key itself.⁴⁰ However, while this analogy is straightforward and illustrative of the relationship between the stimulus, our sense organs, and the resulting perception according to the copy theory, it ultimately proves to be somewhat problematic since it only illustrates a resemblance of the spatial properties between the stimulus and our sensations. Helmholtz’s sign theory, however, is as thoroughgoing as to reject “every kind of similarity or equivalence to the things they [the signs (our sensations)] denote.”⁴¹

An alternative analogy to explain the copy theory of perception is to think of a person and a portrait of that person (whether painted or taken using a camera). It is clear that the color relations of the person are preserved in the portrait of them in such a way that the portrait and the person resemble each other on grounds of these color relations. It is along these lines that Helmholtz ultimately rejects the copy theory of perception: that our perception of a stimulus *is*

³⁹ Helmholtz, *Physiological Optics*, 19.

⁴⁰ Patton, “Hermon von Helmholtz,” in the *Stanford Encyclopedia of Philosophy*.

⁴¹ Helmholtz, *Physiological Optics*, 18.

never like a *portrait* of the stimulus. However, Helmholtz is not just intending to reject the view that our sensations are accurate reproductions of the color relations of the stimulus; he is, in fact, rejecting the view that our perceptions can be seen as accurately reproducing (in a manner analogous to the way a portrait accurately reproduces the color relations of its subject) *any* of the auditory, olfactory, gustative, or tactile relations of the stimulus.

3.2 *Practical Truth and Objectivity*

By asserting that our psychologically primitive sensations (and, by implication, also our perceptions) do not resemble their causes, the implications of the sign theory are epistemic in nature for Helmholtz. As discussed, the sign theory of perception entails a rejection of the copy theory of perception, which, for Helmholtz, also entails a rejection of the (once again) *seemingly* commonsensical notion of truth as an *imagistic* correspondence between a representation and its cause. That is, a rejection of the “popular opinion, which accepts in good faith that the images which our senses give us of things are wholly true.”⁴² Make no mistake, however, Helmholtz’s argument is *not* advocating the dubious view that we cannot have any true representations. Rather, he is simply denying that our representations are true *in virtue of* an imagistic correspondence between the representation and its cause.⁴³ That is to say, a representation cannot be true (i.e., “correspond” or “agree” with its cause) in terms of something like an *imagistic-isomorphism* or *portrait-like* relation between them.

For example, correctly judging that there is a brown, wooden table in front of me would, according to Helmholtz, not be true in virtue of my representation of the table visually

⁴² Helmholtz, “The Facts in Perception,” 122.

⁴³ On the concern of skepticism, Helmholtz remarks that “on this view of the matter [a rejection of the copy theory of perception], we must be on our guard against saying that all our ideas of things are consequently *false*, because they are not *equal* to the things themselves, and that hence we are not able to know anything as to the *true nature* of things” (Helmholtz, *Physiological Optics*, 24).

resembling the stimulus that caused it. That is, it would not be true *in virtue* of the stimulus (i.e., the table) possessing the color brown *independently* of *anyone* observing it. And, in general, beyond just visual resemblance, my representation of the table cannot be true *in virtue* of a resemblance between any of the other qualities that characterize my sensory representation of the table (such as having a firm surface) and the stimulus possessing these properties (e.g., firmness) as a thing-in-itself.

Consequently, Helmholtz concludes that, given “[o]ur ideas of things *cannot* be anything but symbols, natural signs for things,”⁴⁴ there “can be no possible sense in speaking of any other truth of our ideas except of a *practical truth*.”⁴⁵ For Helmholtz *practical truth* simply means that a representation is true *in virtue* of its ability to guide motor activity. That is to say, it consists in the ability to learn “how to use [the representation] in order to regulate our movements and actions.”⁴⁶ Moreover, the adequacy of a representation’s ability to guide motor activity is its capacity to permit us to “adjust our actions so as to bring about the desired result; that is, so that the expected new sensations will arise.”⁴⁷ All of this is to say that, when we engage in some motor activity to change our sense organ’s orientation to the stimulus, a “good” or “true” representation will allow us to adequately forecast the changes in sensations. Or, in Helmholtz’s own words, that “the idea of a thing is correct for him who knows how to determine correctly from it in advance what sense-impressions he will get from the thing when he places himself in definite external relations to it.”⁴⁸

⁴⁴ Helmholtz, *Physiological Optics*, 19.

⁴⁵ Helmholtz, *Physiological Optics*, 19.

⁴⁶ Helmholtz, *Physiological Optics*, 19.

⁴⁷ Helmholtz, *Physiological Optics*, 19.

⁴⁸ Helmholtz, *Physiological Optics*, 23.

For example, Helmholtz suggests that “[t]he idea of a single individual table which I carry in my mind is correct and exact, provided I can deduce from it correctly the precise sensations I shall have when my eye and my hand are brought into this or that definite relation with respect to the table.”⁴⁹ To illustrate what Helmholtz means here, let us in fact use an example of correctly perceiving that there is some common, everyday object in front of us, such as a common piece of household furniture.

Firstly, given that we will need to talk about certain relevant changes in sensations, it warrants quickly specifying what initial sensations are being referred to when we talk about the piece of furniture in question to avoid unnecessary confusion. In this case, the object in question is a small wooden desk constructed such that there is a solid piece of wood covering the backside of it. On a Helmholtzian interpretation, the top surface of the desk, for instance, would be understood as referring to the continual succession of visual sensations of an opaque brown color (as the desk is wooden) over some spatial interval as the eyes scan from left to right. Likewise, regarding tactile sensations, as some part of the body (e.g., a hand) moves from one boundary to another across the previously described opaque brown surface, that body part continually has the sensations of a uniform normal force pushing upwards against it. Moreover, these visual and tactile sensations found together for some relatively long temporal interval and can, therefore, be re-experienced at will by employing the right innervation of the muscles.

The judgment that “the back of the desk is a flat and impenetrable surface,” for instance, entails that, upon engaging in some innervation of the muscles to alter our body’s position such that the back of the desk can be felt or is put into view, we inevitably experience the sensations signified by a “flat and impenetrable surface.” Or that, each time I execute the muscular

⁴⁹ Helmholtz, *Physiological Optics*, 23.

innervations required to maneuver my body so that the back of the desk is in my visual field, moving my eyes from one boundary to another of the vertical surface results in a continuous experience of visual sensations of an opaque brown colour. Likewise, when I execute the muscular innervations to put the back of the table into contact with some part of my body (say my hand), moving this body part from one boundary to the other results in the continuous experience of the sensations of a uniform normal force pushing out against it. Furthermore, no innervation of my muscles outside of altering the desk's composition (as, in that case, we would not be referring to the same object) changes the fact that, when I actually go about putting the back of the desk into my visual field (or when I actually go about putting my body into contact with the back of the desk), I experience the sensations signified by "flat and impenetrable."

One immediate consequence of Helmholtz's notion of practical truth is that we finally get his account of objectivity. According to Helmholtz, "it is a *contradictio in adjecto* to want to *represent* the real, or Kant's 'thing in itself', in positive terms but without absorbing it into the form of our manner of representation."⁵⁰ This should be unsurprising as, if we recall his earlier argument where, on account of the findings of Müller, he concludes that the objectivity of a judgment *cannot* plausibly consist in ascertaining the properties of something as they are *independent* of any human perception, representation, or theorizing. Instead, entailed in the notion of practical truth is the consequence that, rather its properties as a *thing-in-itself*, the objective content of a representation is simply the parts of this representation that are *independent* from our *will*. For instance, that

by our movements we find out that it is the stationary form of the table in space which is the cause of the changing image in our eyes. We explain the table as having existence

⁵⁰ Helmholtz, "The Facts in Perception," 140–141; my italics on "*represent*."

independent of our observation, because at any moment we Like, simply by assuming the proper position with respect to it, we can observe it.”⁵¹

Recalling our earlier discussion of the will (section 2.2), a property’s *independence* from our will simply means that it is *not* reliably causally connected to any innervations of the muscles.

According to this conception of objectivity, the objectivity of our judgments then consists in the inalterable causal regularities between our sensations. Helmholtz remarks that “what we can find unambiguously, and as a fact without anything being insinuated hypothetically, is the lawlike in the phenomena.”⁵² For instance, consider the above example of the surface properties of the desk once again. It was remarked that the desk’s smoothness, for instance, consists in the fact that, no matter how I manipulate my body, the resulting sensations of smoothness (i.e., the regularities in the normal force generated by the micro-texture of the surface) are inalterable. Hence, this smoothness is an objective property of the desk *in virtue of* the fact that no intent of my will (i.e., no muscular innervations) can change these regularities between certain movements of my body and the resulting sensations of smoothness.

Important to Helmholtz’s conception of objectivity is the change it goes through over the course of his career. By mid-career, at the time of the publishing of his *Physiological Optics*, he sees the objective content of our knowledge as consisting in the inalterable causal structure of the mind-independent world, which we can infer by means of an *a priori* principle of causation. At this point, Helmholtz refers to this causal principle as “the law of sufficient basis,” which he conceives of as akin to the *principle of sufficient reason*.^{53, 54} Although our representations are

⁵¹ Helmholtz, *Physiological Optics*, 31; my italics.

⁵² Helmholtz, “The Facts in Perception,” 138.

⁵³ Helmholtz, *Physiological Optics*, 34.

⁵⁴ The *principle of sufficient reason* is generally taken to mean the principle that *absolutely everything* has a prior cause or explanation.

not images of their causes, he maintains that the law of causation allows us to infer causal relations among things-in-themselves.

For instance, Helmholtz remarks that “[t]he external events, like their perceptions, proceed in time; and so the temporal relations of the latter may be the faithful reproduction of the temporal relations of the former.”⁵⁵ Following this, he concludes that

the ideas of the external world are images of the regular sequence of natural events, and if they are formed correctly according to the laws of our thinking, and we are able by our actions to translate them back into reality again, the ideas we have are also the only true ones for our mental capacity.⁵⁶

Thus, in Helmholtz’s *Physiological Optics*, our representations of causal structure (when correct) are to be regarded as (in some sense) *isomorphic* to the causal relationships of things outside of experience. (Keeping in mind, of course, that the notion of practical truth would entail that the causal relations of a representation are only said to be isomorphic when they allow us to correctly infer the incoming sequences of sensations upon engaging in some motor activity.)

However, by the time of his 1878 address to the University of Berlin, “The Facts in Perception,” Helmholtz abandons the view that the causal principle is justified to infer the existence of a mind-independent world. He contrasts what he terms the “realist” hypothesis—the hypothesis there are mind-independent things that cause our perceptions—and the “subjective-idealist” hypothesis, which regards “life as a dream.”⁵⁷ In Hatfield’s words, the latter hypothesis, subjective idealism, is the view that “the world is a product of the knowing mind.”⁵⁸ However, in

⁵⁵ Helmholtz, *Physiological Optics*, 22.

⁵⁶ Helmholtz, *Physiological Optics*, 24.

⁵⁷ Helmholtz, “The Facts in Perception,” 137.

⁵⁸ Hatfield, *The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz*, 213.

the absence of the causal principle being justified to infer an external world, Helmholtz stresses that both were, at best, simply “hypotheses.”^{59, 60}

Despite his rejection of the causal principle’s applicability to things outside of experience, Helmholtz observes that the notion of objectivity as the inalterable regularities between our sensations is common to *both* the realist and the idealist hypotheses. His remark that “what we can find unambiguously, and as a fact without anything being insinuated hypothetically, is the lawlike in the phenomena,” is made in reference to the common ground shared by both the realist and idealist hypotheses.⁶¹ He writes that

[o]ne does not yet need to think of substantial things as what are here supposed to exist one beside another... Now at other times the range of presentables, for the same group of impulses of the will, is going to be a different one. This range, with the individual which it contains, will thereby confront us as something given, as an 'objectum'. Those alterations which we can produce and revoke by conscious impulses of the will, are distinct from ones which are not consequences of such impulses and cannot be eliminated by them.⁶²

The significance of his mature conception of objectivity is that it does not require a commitment to any *a priori* philosophical or metaphysical assumptions of a mind-independent world. That is, it does not require the assumption of “substantial things” “one beside another” existing as *things-in-themselves*. The result of Helmholtz’s mature conception of objectivity is that, regardless of whether we assume the realist hypothesis or idealist hypothesis instead, the objective content of knowledge still consists in forming “an image of lawfulness in the processes

⁵⁹ Helmholtz, “The Facts in Perception,” 137–138.

⁶⁰ To quickly summarize Helmholtz’s rejection of the law of causation’s ability to infer the mind-independent world of the realist hypothesis: given he concedes that the law of causation is simply the presupposition for knowledge of the actual (i.e., of things in experience), Helmholtz is then forced to conclude that the law of causation is *only* valid *within* experience. That is to say, given that the law of causation is only justified as the condition of being able to *represent* things, the law of cause is then limited to the sphere of our representations. See pages 139–143 of “The Facts in Perception.”

⁶¹ Helmholtz, “The Facts in Perception,” 138.

⁶² Helmholtz, “The Facts in Perception,” 126.

of the *actual* world [i.e., the world *in* experience].”^{63, 64} This conception of objectivity, it will later turn out, will come to Helmholtz’s aid in the project treating epistemological concepts naturalistically.

Finally, of some interest is the fact that Helmholtz’s account of objectivity and practical truth conveniently permits him to recover some sense of the familiar, common-sense notion of truth as *correspondence*. Evidently, Helmholtz has already ruled out that our true representations “correspond” in terms of accurately picturing the properties of the representation’s external cause *independent* of any observer. Instead, a representation is thought of as corresponding when it accurately predicts the resulting sensations that will arise from various muscular innervations. That is to say that, our representation of the anticipated sequence of sensations following some innervation of the muscles “corresponds” when, after actually going about moving our respective sense organs according to this innervation, the anticipated sequence of sensations in fact arises. For instance, in the desk example, our visual representation of the back of the desk anticipates the backside as being a flat and smooth surface upon engaging in certain motor movements that permit us to feel this backside of the desk. This representation “corresponds” to the desk if, upon actually executing the innervations of the muscles that put our body into contact with the back of the desk, we in fact experience the sequence of sensations signified by “a flat and smooth surface.”

3.3 *The Law of Causation*

As Helmholtz’s theory of practical truth aims to show, any discussion of truth is, in turn, a discussion of inductive inferences. That is to say, if a true judgment consists in our ability to

⁶³ Helmholtz, “The Facts in Perception,” 122; my italics.

⁶⁴ For a more detailed account of the development in Helmholtz’s conception of objectivity see Edgar, “The Physiology of the Sense Organs and Early Neo-Kantian Conceptions of Objectivity: Helmholtz, Lange, Liebmann” (2015).

accurately forecast changes in sensations upon engaging in some motor activity, then truth is really just a matter of talking about our ability to forecast changes in sensations by learning general causal laws from past experience. However, in explaining true judgments on the basis of inductive inferences, Helmholtz then sees the need for a principle that justifies our use of inductive inferences. That is, we need a principle justifying that “trusting that an item of lawlike behaviour, which has been observed up to now, will also prove true in all cases which have not yet come under observation.”⁶⁵ Ultimately, the principle that serves as the “peculiar ultimate basis, which gives convincing power to all our conscious inductions” is none other than *the law of causation*.⁶⁶

The significance of Helmholtz’s law of causation is twofold. Firstly, it can be understood as both a principle asserting that all events have a prior cause and, secondly, a principle of the uniformity of nature. The latter asserts that the same causes must always be succeeded by the same effects uniformly throughout nature. Concerning these two properties of the law of causation, he writes that

[i]f two natural phenomena have frequently been observed to occur together, such as thunder and lightning, they seem to be regularly connected together, and we infer that there must be a common basis for both of them. And if this causal connection has invariably acted heretofore, so that thunder and lightning accompany each other, then in the future too like causes must produce like effects, and the result must be the same in the future.⁶⁷

Helmholtz offers various arguments to justify the law of causation. Unchanging, however, is his doubt that the law of causation can be justified inductively. In his *Physiological Optics*, for instance, Helmholtz critiques J.S. Mill’s purported inductive justification of the law of causation on the grounds of its circularity. He remarks that

⁶⁵ Helmholtz, “The Facts in Perception,” 142.

⁶⁶ Helmholtz, *Physiological Optics*, 29.

⁶⁷ Helmholtz, *Physiological Optics*, 29.

there is good reason to think that the empirical proof of the law [of causation] is extremely doubtful. For the number of cases in which we think we can trace perfectly the causal connection between natural processes is small as compared with the number of those in which we are absolutely unable to do so at present.⁶⁸

Helmholtz seems to have grasped that, without first presupposing a principle of the uniformity of nature, an inductive justification of the law causation would be subject to the problem of induction. However, a principle of the uniformity of nature is exactly what the law of causation itself is seeking to establish; thus, any inductive justification would be circular.

Given that the law of causation cannot be justified inductively, Helmholtz concludes that it must be given *a priori* instead. He subsequently remarks that

the law of causation, by virtue of which we infer the cause from the effect, has to be considered also as being a law of our thinking which is prior to all experience. Generally, we can get no experience from natural objects unless the law of causation is already active in us. Therefore, it cannot be deduced first from experiences which we have had with natural objects.⁶⁹

However, in addition to its usual meaning of “not justified by appeal to experience,” “a priori” seems to also mean that it *cannot* be *refuted* by experience for Helmholtz. For instance, consider his remark that

the law of causation bears on its face the character of a purely logical law, chiefly because the conclusions derived from it do not concern actual experience, but its interpretation. Hence it cannot be refuted by any possible experience. For if we founder anywhere in applying the law of causation, we do not conclude that it is false, but simply that we do not yet completely understand the complex of causes mutually interacting in the given phenomenon.⁷⁰

To give an example of Helmholtz’s point, if we observed some instance where thunder did not follow lighting, we would not reject the law of causation and conclude that like effects do not always follow like causes. Rather, we would simply conclude that our description “thunder

⁶⁸ Helmholtz, *Physiological Optics*, 33.

⁶⁹ Helmholtz, *Physiological Optics*, 33.

⁷⁰ Helmholtz, *Physiological Optics*, 33.

always follows lightning” is somehow incorrect and that, instead, there must be a more general law explaining in what instances thunder does and does not follow lightning. Hence, it appears that treating the law of causation as a *normative principle* is really what Helmholtz has in mind. That is to say that, in contrast to purely a descriptive law, which would view as being capable of revision, the law of causation is a principle we “hold” nature accountable to conforming to. Thus, we can also conclude that treating the law of causation as irrefutable by experience is equally not a consequence of our certainty in the law of causation.

Then if the law of causation is a normative principle, what is Helmholtz’s justification for its normativity? Evidently, he identifies that we are in the *habit* of treating the law of causation as a normative principle given that, whenever we observe some phenomenon that appears to contradict the law of causation, we simply endeavor to find a new causal explanation that can account for the irregularity. However, as a justification, this would of course rely on induction: from the almost exhaustive past experience of phenomena exhibiting lawlike behavior, we come to expect that nature should *always* be lawlike. Thus, it would simply amount to another circular defense of the law of causation. Hence, the mere fact that it is habitual for us to treat the law of causation as a normative principle does little in the way of justifying the law of causation.

Instead, the heart of Helmholtz’s argument for regarding the law of causation as irrefutable by experience (and hence also as a normative principle) lies in the fact that the law of causation is the *condition of the comprehension of nature*. The reason for this, as the earlier sections of Helmholtz’s *Physiological Optics* argued, is a result of the fact that our comprehension operates by representing causal structure. In Helmholtz’s words, that is to say that the very “process of our comprehension with respect to natural phenomena is that we try to

find *generic notions* and *laws of nature*.”⁷¹ From these considerations, Helmholtz concludes that “when we cannot trace natural phenomena to a law, and therefore cannot make the law objectively responsible as being the cause of the phenomena, the very possibility of comprehending such phenomena ceases.”⁷² That is to say that any kind of experience that could seemingly falsify the law of causation—i.e., anything that could *never* be subsumed under any law of cause and effect—would be utterly incomprehensible to us *by* the very fact that it *cannot* be subsumed under any law of cause and effect. Thus, quite similar to Kant, the law of causation is irrefutable by experience for Helmholtz *in virtue of* the fact that the condition of comprehending any experience that could refute the law of causation lies in, none other, than obeying the law of causation itself. Hence, comprehending any experience that falsifies the law of causation would be a blatant contradiction.

Helmholtz’s final point in the *Physiology Optics* seeks to assuage any apprehension the reader might have towards regarding the law of causation as the condition of comprehensibility of experience. Here Helmholtz draws an analogy between human comprehension and the biological functions of the eye:

[j]ust as it is the characteristic function of the eye to have light sensations, so that we can see the world only as a luminous phenomenon, so likewise it is the characteristic function of the intellect to form general conceptions, that is, to search for causes; and hence it can conceive of the world only as being causal connection. We have other organs besides the eye for comprehending the external world, and thus we can feel or smell many things that we cannot see. Besides our intellect there is no other equally systematized faculty, at any rate for comprehending the external world. Thus, if we are unable to conceive a thing, we cannot imagine it as existing.⁷³

The point of the analogy is that the characteristic *function* of human thought, according to Helmholtz, is to represent things causally in a way that is similar to the fact that the function of

⁷¹ Helmholtz, *Physiological Optics*, 34.

⁷² Helmholtz, *Physiological Optics*, 34.

⁷³ Helmholtz, *Physiological Optics*, 35.

the human eye is to produce sensations of light upon being stimulated by electromagnetic radiation. However, the chief difference between our sense organs and the intellect is that we have multiple sense modalities that, thereby, give us multiple means of perceiving various objects. In the case of our comprehension, however, there is no other “intellectual modality” to fall back on when an experience fails to exhibit causality.

Helmholtz’s argumentative strategy in “The Facts in Perception” is, by and large, quite similar to his strategy in the *Physiological Optics*. In a similar vein, he maintains that the law of causation must be justified a priori. He remarks that “the law of causality actually is an a priori given, a transcendental law. A proof of it from experience is not possible, since the first steps of experience, as we have seen, are not possible without employing inductive inferences, i.e. without the law of causality.”⁷⁴ Moreover, he thereby continues to align himself with his position in the *Physiological Optics* by maintaining that the law of causation is the condition of comprehension of experience.

However, by this point, Helmholtz seems to recognize the full force of the problem of induction. He remarks that “we have no further guarantee for the applicability of the law of causality than this law’s success.”⁷⁵ That is to say that, without first assuming that the law of causation should be applicable in the future, the future applicability of the law of causation seems to rest in the inductive inference from its past applicability. Consequently, in the face of the thoroughgoing skeptic, Helmholtz is forced to concede that, despite the law of causation being the condition of the comprehensibility of nature, we must still assume that nature will still be comprehensible in the future. In the end, Helmholtz’s final solution to the problem of induction amounts to trusting in the future comprehensibility of nature and willingness to act

⁷⁴ Helmholtz, “The Facts in Perception,” 142.

⁷⁵ Helmholtz, “The Facts in Perception,” 142.

despite our lack of foreknowledge of this future comprehensibility. He writes, “[i]t would still follow from such experience only by an inductive inference, i.e. by presupposing the law of causality, that the law of causality would then also hold in the future. Here the only valid advice is: have trust and act!”⁷⁶

What is the significance of this purported solution to the problem of induction? Does relegating the justification of the law of causation to “trust” imply that the law of causation (and by implication, inductive inferences) rely on faith? Perhaps this is the case; however, there appears to be some reason that Helmholtz might resist treating this kind of “trust” and this imperative to “act” as articles of faith.

On the one hand, it could be suggested that “trust” differs from “faith” in the sense that trusting in something is a product of that thing’s “track record” (i.e., its frequent occurrence or predictive success in the past). An example of faith in this sense is the individual who believes in astrological explanations for human behavior over the explanations of empirical psychology. Any careful observer knows that empirical psychology has far a better track record than astrology as regards its predictive success in explaining human behavior. Thus, most would concede that the proponent of astrology has a *faith* in astrology while the proponent of empirical psychology *trusts* in psychology on account of its past success. As concerns the law of causation then, the law of causation is not an article of faith in the sense of a belief that utterly lacks any track record of success. In fact, on these grounds, the law of causation would be as far as possible from an article of faith given that, from the first moments of experience onwards, we have encountered every moment as abiding by the law of causation. In this sense, the law of causation is then one of the most universally held beliefs.

⁷⁶ Helmholtz, “The Facts in Perception,” 142.

However, as far as justification for induction goes, this makes Helmholtz equally as guilty of the circularity he criticizes in Mill's argument. If our trust in the law of causation is warranted by the law's past success, then it still relies on the inductive inference from its past success. The significance of Helmholtz's solution must then lie in the imperative to "act!"

What is the significance of the pragmatic suggestion to act? What Helmholtz's discussion hopefully made clear is that comprehension is also the condition of voluntary action. After all, on Helmholtz's analysis, voluntary action is the product of being able to forecast the changes in sensation that should occur upon innervating certain muscles. This, as we have seen, is achieved through learning the causal regularities that pertain between sensations of muscular innervation and the resulting changes in sensation. Thus, while an unconditional guarantee of the comprehensibility of nature is, of course, not given (and hence will not justify the law of causation in the face of the thoroughgoing skeptic), Helmholtz's solution can be thought of as "raising the stakes" for the skeptic. On his analysis, any intentional or meaningful action is impossible in the absence of the law of causation. In Hatfield's words, this entails that, "whether we are entitled to consider ourselves as thinkers"—that is, as being capable of comprehending nature—"can [only] be answered by *acting* in a way that presupposes the law."⁷⁷ After all, Helmholtz concedes that "[h]ypotheses are even more necessary for conduct, because one cannot continually wait until an assured scientific decision has been reached, but must decide for oneself—whether according to probability or to aesthetic or moral feeling."⁷⁸

4. Helmholtz's Naturalism

Having covered the relevant parts of both Helmholtz's cognitive psychology and his epistemology, we can now begin the task of explicitly considering whether or not Helmholtz is

⁷⁷ Hatfield, *The Natural and the Normative*, 217; my italics.

⁷⁸ Helmholtz, "The Facts in Perception," 138.

an epistemological naturalist. This section begins by first clarifying what is meant by both *methodological naturalism* and *epistemological naturalism*. Following this, I consider the reasons that Helmholtz is a methodological naturalist toward both cognitive psychology and the mind. The final part of this paper will attempt to show how Helmholtz's views in epistemology are the product of his views in cognitive psychology. In the end, I conclude that, despite some reason to suspect the law of causation resists naturalistic analysis, Helmholtz's orientation towards the law of causation is naturalistic after all.

4.1 *Defining Methodological Naturalism and Quinean Epistemological Naturalism*

Often seen as a response to the suspect and speculative approaches of metaphysics and theology, *naturalism* can be understood as the intellectual or epistemic orientation that takes scientific inquiry as the paradigmatic method of inquiry. However, a subject is typically only given the label of a “naturalistic” response when the subject at hand is traditionally viewed as falling outside the realm of scientific inquiry. Paradigmatically, attempting to answer some question that is traditionally seen as falling under the banner of philosophy—e.g., the ontological relationship between the mind and body—is given the label of a “naturalistic” approach when the question is treated as contiguous with scientific inquiry.⁷⁹

Under the banner of naturalism, a further distinction between *metaphysical naturalism* and *methodological naturalism* is typically made. The former, metaphysical naturalism, is the comprehensive ontology that all that exists simply is the *natural world*, where the natural world is typically explained as consisting of “physical” stuff (i.e., the stuff studied by physicists and

⁷⁹ For instance, see the following: Audi, “Naturalism as a Philosophical and Scientific Framework: A Critical Perspective,” (2014); Quine, “Epistemology Naturalized” (1969); Kornblith, “Introduction: What is Naturalized Epistemology” (1994); Kornblith, *Knowledge and its Place In Nature*, chapters one and two; Kornblith, “Naturalism: Both Metaphysical and Epistemological” (1994); Hatfield, *The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz*, chapters one and six.

chemists). In consequence of this comprehensive ontological claim that all that exists is the very stuff studied by scientists, the metaphysical naturalist concludes that all subjects should then admit to scientific answers. Alternatively put, this can be viewed as the metaphysical thesis that “the natural world is exhausted by all the physical facts.”⁸⁰ Unsurprisingly, metaphysical naturalists typically hold a materialist or physicalist ontology and, view themselves as naturalists towards the mind as a result of the view that “the mind is identified with organized matter and is thereby rendered truly a ‘part’ of nature.”⁸¹

More modestly, perhaps, methodological naturalism eschews this ontological basis and instead sees the methods of the natural sciences as the paradigmatic methods for acquiring knowledge. Thus, not motivated by an ontology, methodological naturalism proposes that the best method of inquiry into some *particular* subject is the scientific method. In addition, there is an additional accessory view sometimes held by methodological naturalists which further stipulates that the methods of explanation of the natural sciences are also the best means of explanation.

On this definition, methodological naturalism amounts to the view that the

causes and explanations of natural phenomena should be sought in the natural world, paradigmatically in terms of what meets at least three commonly endorsed criteria for a scientific theory—testability, publicity, and empiricity... Methodological naturalism requires conducting scientific inquiry in what might be called descriptive natural categories and with testability and the experimental, public, predictive character of science in mind; but it does not imply a comprehensive ontology nor even deny the existence of anything supernatural.”⁸²

The consequence of this definition of methodological naturalism is that one does not need to be committed to the strong metaphysical claim that the world is “exhausted” by the physical facts in

⁸⁰ Stroud, “The Charm of Naturalism,” 48.

⁸¹ Hatfield, *The Natural and the Normative*, 237.

⁸² Audi, “Naturalism as a Philosophical and Scientific Framework: A Critical Perspective,” 16.

order to be a naturalist. That is to say, one can be a naturalist towards a given subject matter without having to believe that every other subject matter ought to be effectively naturalized or else eliminated. In eschewing the thesis that *every* single subject ought to be capable of naturalization, one becomes a methodological naturalist towards some *particular* subject (rather than being a methodological naturalist *in general*). That is to say, methodological naturalism towards a given subject only requires that one believes that the methods of scientific inquiry are the best methods of investigating this *particular* subject. For instance, one could be a methodological naturalist with respect to questions about the knowing mind if they employed the methods of cognitive psychology to explain knowledge yet, at the same time, pursue theistic explanations about the origin of the universe. In this case, their attitude towards questions of the origin of the universe would simply not warrant being characterized as “naturalistic.”

The point that methodological naturalism is always subject-specific is something I do not take to be controversial amongst philosophers and thus simply intend to point it out for the sake of clarification. Conveniently, the fact that methodological naturalism is always attributed with respect to some particular subject allows the explanation of *epistemological naturalism* to be fairly straightforward. According to the view I am proposing, epistemological naturalism is the application of methodological naturalism to questions of epistemology. That is to say, an attempt to answer questions of epistemology—e.g., explaining our concepts of truth, justification, etc.—using the methods and modes of explanation of natural science.

Quine’s influential 1969 essay “Epistemology Naturalized” marks the beginning of the contemporary discussion of epistemological naturalism. Here Quine contrasts the theories of traditional epistemology with the aims of his proposed “naturalized” epistemology. According to him, traditional epistemologies are concerned with establishing the foundation of knowledge in a

deductive-like manner. One notable attempt carried out during the early to mid-twentieth century sought to do so by reducing our knowledge into strictly sensory terms and then creating logical constructions out of these terms. Quine sees this as a shared project of both David Hume and Rudolf Carnap. Regarding Hume, he writes that

[h]is handling of the conceptual side of the problem, the explanation of body in sensory terms, was bold and simple: he identified bodies outright with the sense impressions. If common sense distinguishes between the material apple and our sense impressions of it on the ground that the apple is one and enduring while the impressions are many and fleeting, the, Hume held, so much the worse for common sense; the notion of its being the same apple on one occasion and another is a vulgar confusion.⁸³

Shortly thereafter, he remarks that “[t]o account for the external world as a logical construct of sense data—such, in Russell’s terms, was the program” and that “[i]t was Carnap, in his *Der logische Aufbau der Welt* of 1928, who came nearest to executing it.”⁸⁴

However, according to Quine, the recent historical developments in philosophy show the project of becoming more certain in our knowledge by using logic and set theory to construct this knowledge out of the indubitable truths of immediate experience to be unassailable. He continues,

the Humean predicament [i.e., the problem of induction] remained unaltered. Carnap’s constructions, if carried successfully to completion, would have enabled us to translate all sentences about the world into terms of sense data, or observation, plus logic and set theory. But the mere fact that a sentence is couched in terms of observation, logic, and set theory does mean that it can be *proved* from observation sentences by logic and set theory. The most modest of generalizations about observable traits will cover more cases than its utterer can have had occasion actually to observe. The hopelessness of grounding natural science upon immediate experience in a firmly logical way was acknowledged. The Cartesian quest for certainty had been the remote motivation of epistemology, both on its conceptual and its doctrinal side; but that quest was seen as a lost cause. To endow the truths of nature with the full authority of immediate experience was as forlorn a hope

⁸³ Quine, “Epistemology Naturalized,” 71–72.

⁸⁴ Quine, “Epistemology Naturalized,” 74.

as hoping to endow the truths of mathematics with the potential obviousness of elementary logic.^{85, 86}

Disregarding the problem of induction altogether, why is the attempt to build our knowledge strictly out of sensory terms using only logic and set theory a lost cause?⁸⁷ According to Quine's analysis, this project fails on account of the "dogmas of empiricism." Chiefly, among them is the belief in the "reductionist" account of meaning. That is, "the belief that each meaningful statement is equivalent to some logical construct upon terms which refer to immediate experience."⁸⁸ Quine thus concludes that the epistemologists had

to acquiesce in the impossibility of strictly deriving the science of the external world from sensory evidence. Two cardinal tenets of empiricism remained unassailable. However, and so remain to this day. One is that whatever evidence there is for science is sensory evidence. The other, to which I shall recur, is that all inculcation of meanings of words must rest ultimately on sensory evidence.⁸⁹

The essential precursor where Quine outlines his rejection of the so-called "reductionist" account of meaning is in his 1951 paper, "Two Dogmas of Empiricism." Here, Quine famously argues against the possibility of a strong distinction between analytic and synthetic truths on account of his concerns with meaning. That is to say, he rejects the familiar distinction between sentences that are true in virtue of their meaning (or "logical" structure) and sentences that are true in virtue of some extra-linguistic fact (namely, a fact of experience). According to Quine, it is misleading to speak of the empirical meaning or "experiential" content of an individual

⁸⁵ Quine, "Epistemology Naturalized," 74.

⁸⁶ There is a longstanding debate on whether or not Quine is mistaken to characterize Carnap and the other logical positivists as foundationalists. There is little consensus among historians of philosophy on whether Quine's appraisal of Carnap is correct. For this reason, I will avoid addressing this issue. Evidently, given that the overarching goal of this paper is to characterize Helmholtz's naturalism with respect to Quine's conception of epistemological naturalism, I am only concerned with trying to reconstruct Quine's arguments in a manner that is faithful to how Quine himself views Carnap and the other logical positivists.

⁸⁷ Concerning the problem of induction, Quine remarks that "[o]n the doctrinal side [i.e., the side concerned with truth as opposed to meaning], I do not see that we are farther along today than where Hume left us. The Humean predicament is the human predicament" ("Epistemology Naturalized," 72).

⁸⁸ Quine, "Two Dogmas of Empiricism," 20.

⁸⁹ Quine, "Epistemology Naturalized," 75.

sentence given that the meaning of any statement presupposes a whole body of knowledge and, hence, must be considered “holistically” with respect to this body (or “field”) of knowledge.

According to Quine’s “holistic” picture of knowledge, this body of knowledge is like a field with experience sitting around its “periphery.” At times, a conflict with experience will force us to revise and modify the field and the

[t]ruth values [will then] have to be redistributed over some of our statements. Re-evaluation of some statements entails re-evaluation of others, because of their logical interconnections—the logical laws being in turn simply certain further statements of the system, certain further elements of the field. Having re-evaluated one statement we must re-evaluate some others, whether they be statements logically connected with the first or whether they be the statements of logical connections themselves.⁹⁰

According to Quine’s field metaphor, while it may seem that certain statements “have a sharper empirical reference than highly theoretical statements of physics or logic or ontology,” it is mistaken.⁹¹ These theoretical and *seemingly* “analytic” statements should instead “be thought of as relatively centrally located within the total network, meaning merely that little preferential connection with any particular sense data obtrudes itself.”^{92, 93}

Moreover, given that modern logic and physics rule out the possibility of Kant’s *synthetic a priori* truths, Quine sees the only possibility of the *a priori* as being given by analytic truths. However, in rejecting that any acceptable distinction between synthetic and analytic truths could be offered, Quine is thereby forced to reject the possibility of *a priori* truths altogether. The conclusion Quine draws from the above considerations is the radical revisability of belief:

[a]ny statement can be held true come what may, if we make drastic enough adjustments elsewhere in the system. Even a statement very close to the periphery can be held true in

⁹⁰ Quine, “Two Dogmas of Empiricism,” 39.

⁹¹ Quine, “Two Dogmas of Empiricism,” 41.

⁹² Quine, “Two Dogmas of Empiricism,” 41.

⁹³ In “Epistemology Naturalized,” Quine summarizes his mature position towards analyticity as follows: “[m]y rejection of the analyticity notion just means drawing no line between what goes into the mere understanding of the sentences of a language and what else the community sees eye-to-eye on. I doubt that an objective distinction can be made between meaning and such collateral information as is community wide” (Quine, “Epistemology Naturalized,” 86).

the face of recalcitrant experience by pleading hallucination or by amending certain statements of the kind called logical laws. Conversely, by the same token, no statement is immune to revision. Revision even of the logical law of the excluded middle has been proposed as a means of simplifying quantum mechanics; and what difference is there in principle between such a shift and the shift whereby Kepler superseded Ptolemy, or Einstein Newton, or Darwin Aristotle?⁹⁴

Consequently, no truth is incapable of revision for Quine, which rules out the possibility of building our knowledge upon some necessary and non-revisable starting points.

Thus, in light of the development of his thought in “Two Dogmas of Empiricism,” Quine suggests that a naturalized epistemology must ultimately be revisable and hence anti-foundationalist. By foundationalism, I mean the view that any knowledge claim is ultimately justified by appeal to some fundamental set of knowledge claims that are themselves each self-justified or indubitable. While various foundationalist programs have differed in their treatment of these epistemically fundamental beliefs, Quine has the particular strain of foundationalism in mind that attempts to construct scientific knowledge from some distinct a priori or “philosophic” standpoint.⁹⁵ He writes that

[t]he old epistemology aspired to contain, in a sense, natural science; it would construct it somehow from sense data. Epistemology in its new setting, conversely, is contained in natural science, as a chapter of psychology. ... This interplay is reminiscent again of the old threat of circularity, but it is all right now that we have stopped dreaming of deducing science from sense data. We are after an understanding of science as an institution or process in the world, and we do not intend that understanding to be any better than the science which is its object.⁹⁶

Hence, science is seen as a legitimate and autonomous discipline that does not need any grounding in *first philosophy* as pursued according to the foundationalist picture.

⁹⁴ Quine, “Two Dogmas of Empiricism,” 40.

⁹⁵ Quine’s interpretation of Carnap and the logical positivists notwithstanding, he is chiefly alluding to logical positivism here.

⁹⁶ Quine, “Epistemology Naturalized,” 83–84.

Despite Quine's rejection of foundationalism, his proposed "naturalized" epistemology is nevertheless still concerned with the foundations of science. Albeit, this concern with the foundations of science is in a much different sense than the apriorist foundationalists'. Rather than establishing an a priori foundation from a distinct philosophic standpoint, the role of naturalized epistemology is to simply describe the phenomena of knowing using the methods of natural science. That is to say "[t]he epistemologist, therefore, reflects on science from within science; there is no theory of knowledge distinct from science."⁹⁷ With this in mind, Quine suggests that "[i]f all we hope for is a reconstruction that links science to experience in explicit ways short of translation, then it would seem more sensible to settle for psychology. Better to discover how science is in fact developed and learned than to fabricate a fictitious structure to a similar effect"⁹⁸ According to this view, "psychology replaces epistemology in much the same way that chemistry has replaced alchemy."⁹⁹

Why does Quine think that epistemology must be replaced by psychology if it is to be properly naturalistic? According to Hilary Kornblith's account of epistemological naturalism,

a scientific psychology characterizes the cognitive faculties of human beings. On the other, our current scientific theories give living proof of what those cognitive faculties are capable of. We must now try to explain how creatures with the faculties cognitive science tells us we have could have come to understand the kind of world which the sciences generally tell us that we inhabit.¹⁰⁰

That is to say that the task of explaining how we acquire and justify knowledge by treating it as a natural phenomenon is best achieved by explaining the inferential process between sensory evidence and justified belief. As a natural phenomenon, describing the process of perception and inference is what (in a contemporary setting) we would now call cognitive psychology.

⁹⁷ Hylton and Kemp, "Willard Van Orman Quine" in the *Stanford Encyclopedia of Philosophy*.

⁹⁸ Quine, "Epistemology Naturalized," 78.

⁹⁹ Kornblith, "Introduction: What is Naturalistic Epistemology," 7.

¹⁰⁰ Kornblith, "Naturalism: Both Metaphysical and Epistemological," 43.

In the end, reducing the epistemic concepts such as inference, justification, and truth to cognitive psychology results in an account of knowledge that purports to explain belief and justification in terms of causal processes. While these causal accounts of knowledge are often seen as opposed to the traditional account of knowledge as *justified true belief*, the “causal theorists of knowledge [i.e., epistemological naturalists] believe that knowledge is *reliably* produced true belief.”¹⁰¹ And, ultimately, for the epistemological naturalists, reliability is explained in terms of its predictive success in forecasting sensations.

A brief clarification about the requirement of anti-foundationalism should be made here. While Quine and Kornblith are explicit that a commitment to epistemological naturalism entails a rejection of foundationalism, they are not, however, suggesting that epistemological naturalism and anti-foundationalism are logically equivalent. That is to say, one is *not* an epistemological naturalist simply *in virtue of* rejecting foundationalism, as one could seemingly hold some form of anti-foundationalism yet not exhaustively employ a methodological naturalist attitude towards questions of epistemology. According to the epistemological naturalists, however, this is precisely what we must do: we must investigate the phenomena of knowledge using nothing other than the methods of natural science itself. According to this reading of epistemological naturalism, it is ultimately a consequence of the exhaustive application of methodological naturalism to epistemology that would have us presuppose the validity of scientific reasoning and hence reject the foundationalist paradigm of justification.

4.2 Helmholtz’s Methodological Naturalism Towards Cognitive Psychology and the Mind

In light of this account of methodological and epistemological naturalism, what can be said about Helmholtz’s naturalism? What are the reasons for thinking Helmholtz is a

¹⁰¹ Kornblith, “Beyond Foundationalism and the Coherence Theory,” 132; my italics.

methodological naturalist towards questions of cognitive psychology and the mind? Further, how far is Helmholtz willing to extend this methodological naturalism towards the mind to questions of the *knowing* mind *qua* knower? That is to ask, does Helmholtz extend his methodological naturalism to the point of being an epistemological naturalist?

Viewed as a whole, the late nineteenth-century neo-Kantian movement that Helmholtz's work inspired saw itself as "repudiat[ing] the foundationalism of the speculative idealist tradition."¹⁰² Moreover, "[t]hey very much accepted the autonomy of the empirical sciences, and they firmly believed the sciences stood in no need of a foundation from philosophy."¹⁰³ Yet, despite being associated with the neo-Kantian movement, it is not clear that Helmholtz easily meets this categorization of an anti-foundationalist who wholly accepts the autonomy of science.

Nevertheless, at least in some respects, Helmholtz does appear to treat the sciences as autonomous and, hence, at his disposal for inquiry into certain questions historically relegated to philosophy. As we have briefly seen (see sections 2.2 and 2.3), he attempts to study perception and cognition as a physiologist and empirical psychologist thereby embodying a naturalistic attitude towards the questions of cognitive psychology and the mind. Moreover, he viewed the very findings of nineteenth-century physiology and empirical psychology (or what we would now call cognitive psychology) as finally giving us the scientific means to investigate what Kant called "the subjective conditions of [human] intuition."^{104, 105} That is to say, the conditions of a subject truthfully representing something.

¹⁰² Beiser, *After Hegel*, 38.

¹⁰³ Beiser, *After Hegel*, 38.

¹⁰⁴ Kant, *The Critique of Pure Reason*, 176.

¹⁰⁵ It may seem redundant to specify that a doctrine in psychology is "empirical" or "naturalistic" given that, as a science, it would seemingly employ the methodology of natural science by definition (thereby also making it empirical). As a contemporary definition of psychology, this would certainly be the case. However, in the time of Helmholtz's work, this was certainly not the case. Hence, it warrants distinguishing between psychology pursued naturalistically (i.e., by employing the methods of the natural sciences) in contrast to psychology pursued according to more speculative approaches.

Hence, where Helmholtz is concerned with proposing naturalist answers to epistemological questions, he does so by trying to explain them in terms of the findings of nineteenth-century physiology and psychology. Yet, despite his clear attempt to answer certain questions of epistemology using the tools of physiology and psychology, it is not clear that Helmholtz thinks science can satisfactorily and exhaustively answer *all* questions of epistemology.

Let us first examine Helmholtz's naturalism towards cognitive psychology. Ideally, given that the naturalistic aspects of his epistemology ultimately depend on his cognitive psychology, by first showing how his attitude towards questions of the mind and cognition were naturalistic, we can then better show how he answers questions of epistemology naturalistically. After having done this, we will then be in a better position to consider whether his methodological naturalism is exhaustive in its application to *all* the questions of epistemology he entertained.

The first thing that is clear regarding Helmholtz's methodological naturalism towards questions of the mind is that he is *not* motivated by a commitment to materialism or physicalism. Hence, why I have been referring to his naturalism towards the mind as methodological rather than metaphysical. Helmholtz's attitude towards the mind is thus naturalistic in the sense that he attempts to employ the findings of physiology and empirical psychology to explain our cognitive operations without resorting to a priori metaphysics or a distinct "philosophic" standpoint. More specifically, he tries to explain the steps between sensory input and our higher cognitive functions (such as judgments) by discovering the physiological and psychological processes involved in spatial perception. For example, he explains that

[i]n my works on physiological optics, I have sought to explain how our acquaintance with the visual field can be acquired by observation of the images during the movements of our eyes, provided only that there exists, between otherwise qualitatively alike retinal

sensations, some or other perceptible difference corresponding to the difference between distinct places on the retina.¹⁰⁶

This is, of course, only one of many examples of how Helmholtz employs empirical psychology and physiology to explain various mental phenomena or cognitive operations. The details of which were explained in the earlier sections on Helmholtz's account of spatial perception and his account of true judgments (see section 2.3).

We must note that, at the time of Helmholtz's work, the dominant characteristic of "naturalistic" attitudes towards the mental is, as Hatfield remarks, the drive "to explain all mental phenomena by appeal to mechanistic laws of the mind, modeled after (but not necessarily reducible to) Newton's laws and devoid of explanatory appeal to mental powers such as judgment or reasoning."¹⁰⁷ For the student of philosophy, Hume's associationist model of cognition is perhaps the most familiar account of explaining the mind in terms of mechanistic-like laws of association. In his magnum opus, *A Treatise of Human Nature*, Hume famously sought to "introduce the experimental method of reasoning [i.e., scientific reasoning] into moral [i.e., thinking] subjects."^{108, 109} This culminates with his three basic laws of association purporting to explain the succession of thoughts along with an additional principle explaining the derivation of our thoughts from our sense impressions.¹¹⁰

¹⁰⁶ Helmholtz, "The Facts in Perception," 133.

¹⁰⁷ Hatfield, *The Natural and the Normative*, 25–26.

¹⁰⁸ Hume, David, *A Treatise of Human Nature*, xi.

¹⁰⁹ It is generally agreed upon that, by "experimental method," Hume means to employ a methodology similar to what Newton employed in his works in physics. That is to say that Hume attempts to explain human cognitive processes by using a small number of laws that would, ideally, mirror the achievements Newton's laws had for the explanatory power and conceptual economy of physics. See Steinberg's introduction to the second edition of Hume's *An Enquiry Concerning Human Understanding* or chapters one and two of Hatfield's *The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz*, for instance.

¹¹⁰ According to Hume, the three principles that can explain the association of all thoughts is their resemblance to one another, their contiguity in a similar time or place, or one being either the cause or effect of the other. Moreover, his famous *copy principle* asserted that our ideas (or thoughts) are simply less vivacious copies of our sense impressions (Hume, *An Enquiry Concerning Human Understanding*, 9–15).

In this regard, Helmholtz is clearly a successor to Hume's project regarding understanding the mind: Helmholtz attempts to explain cognitive operations by reducing them to basic laws of association. In Helmholtz's case, this is achieved by reducing all our cognitive processes to associative learning. In Helmholtz's own words, that is (as we have already seen in section 2) to explain our cognitive processes in terms of the "fixed and inevitable associations of ideas due to frequent repetition."¹¹¹

For the philosopher, the most memorable aspect of Helmholtz's purported reduction of cognitive operations to associative learning is likely his rejection of Kant's conception of intuition and its "spatial" form. According to Helmholtz, the Kantian view is mistaken because it regards spatial intuition as "a simple psychic process, incapable of further resolution."¹¹² He claims that

the resolution of the concept of intuition into the elementary processes of thought as the most essential advance in the recent period. This resolution is still absent in Kant, which is something that then also conditions his conception of the axioms of geometry as transcendental propositions. Here it was especially the physiological investigations on sense perceptions which led us to the ultimate elementary processes of cognition.¹¹³

It warrants reiterating that, by the "ultimate elementary processes of cognition,"¹¹⁴ Helmholtz simply means the operations of our associative memory.

4.3 Helmholtz's Epistemological Naturalism

The remaining task is to establish how far Helmholtz extends this methodological naturalism into the domain of epistemology. Doubtless, there is reason to believe that he does treat certain epistemic concepts as continuous with science, as evidence, for instance, in his reduction of discussions of truth to inductive inferences (i.e., his "practical truth"). In contrast

¹¹¹ Helmholtz, *Physiological Optics*, 5.

¹¹² Helmholtz, "The Facts in Perception," 129.

¹¹³ Helmholtz, "The Facts in Perception," 143.

¹¹⁴ Helmholtz, "The Facts in Perception," 143.

with this, by couching our justification of inductive inference in the law of causation, he appears to grant the law of causation a suspicious status as an a priori first principle, thereby seeming to conflict with Quine's suggestion that a naturalized epistemology be anti-foundationalist. Further complicating things, however, is the fact that Helmholtz's justification for the law of causation appears to draw on his own cognitive psychology, seemingly bringing us back around full circle.

What becomes apparent right away is that, as regards his work in epistemology, Helmholtz's naturalism is difficult to accommodate within the traditional dichotomy of a "naturalized" versus "traditional" epistemology. Let us look into these concerns to see whether any headway can be made.

The most evident place where Helmholtz employs a methodological naturalist attitude towards questions of epistemology is (as mentioned) in his notion of practical truth. As we have seen in section 3.2, a representation is true in virtue of its ability to guide motor activity. This, I have suggested, is the result of two considerations. Firstly, according to the physiological research of Müller, our sensations *cannot* be thought of as accurate imagistic reproductions of their external causes. This culminates with the fact that our representations of objects could not possibly be true in virtue of an imagistic-like correspondence between the representation and its cause. This ultimately pushes Helmholtz to propose an alternative account of how our representations of objects can be thought of as "true." Here Helmholtz concludes that the only plausible way our representations can be thought of as true is through the representation's ability to accurately forecast changes in sensations upon engaging in some motor activity. This leads to the second consideration: the very ability to forecast changes in sensation upon engaging in some motor activity is, after all, the result of our unconscious inferences.

Our unconscious inferences, as we saw in section 2.3, are formed from the frequent repetition of the causal laws our sensations stand in. That is to say, they boil back down to the process of associative learning. Hence, while the findings of physiology lead us to reject one notion of truth, Helmholtz's cognitive psychology supplements the alternative notion of truth. In this way, Helmholtz is at least partly on the way to regarding "knowledge as a natural phenomenon" as Kornblith suggests is the requisite for epistemological naturalism.¹¹⁵ Moreover, in this way Helmholtz is also able to explain true judgments without resorting to a non-reducible truth discerning mental process or faculty.

However, in contrast to his account of practical truth, treating the law of causation as the a priori principle that entitles us to inductive inferences (and hence ultimately entitling us to scientific knowledge) appears to commit Helmholtz to the view that our knowledge is justified according to the foundationalist framework. That is to say, it seems that he is actively identifying the law of causation as an *a priori first principle* that safeguards our knowledge from the skeptic (and, in this particular case, safeguards knowledge against skepticism from the problem of induction). Hence, this would seemingly make him guilty of the very kind of apriorist foundationalism Quine and the other epistemological naturalists oppose. But if science is supposed to be autonomous after all, our scientific knowledge is then in no need of an a priori principle entitling us to induction. Thus, at least on the first pass, it would appear that Helmholtz's law of causation contradicts Quine's and Kornblith's requirement that a naturalized epistemology reject any kind of apriorist foundationalism.

Moreover, in addition to the above criticism, Helmholtz states that the law of causation cannot be refuted by experience.¹¹⁶ The reason for this, I have urged, is that in being the

¹¹⁵ Kornblith, *Knowledge and its Place in Nature*, 27.

¹¹⁶ For instance, recall the following remark from Helmholtz:

condition of the comprehensibility of experience, any experience that could falsify the law of causation would be utterly incomprehensible to us and, hence, despite contradicting the law of causation, it would never amount to a valid refutation from the *human* standpoint. The concern, however, is that if epistemological naturalism entails that any question of epistemology is subject to the same methodology as natural science, then Helmholtz's contention that the law of causation cannot be refuted by experience clearly puts him at odds with this project. Given that scientific methodology is characterized by the possibility of revisability in light of contradictory experiences, how can it be that the law of causation is non-revisable yet also ascertained naturalistically?

Hence, on these grounds, we seemingly have good reason to say that Helmholtz is not committed to the complete naturalization of his epistemology: in the end, the principle that warrants our entitlement to inductive reasoning ultimately resists naturalistic analysis.

However, upon further reflecting on Helmholtz's central argument for the law of causation, a troubling paradox seems to emerge: it would appear that his central premise, that the law of causation is the condition of the comprehensibility of experience, is built from none other than his cognitive psychology. More precisely, stating that the law of causation is the condition of the compressibility of experience appears to be the result of his view that reducing all of our cognitive operations to associative learning results in the fact that we always (and can only) represent things causally. On these lines then, the law of causation would seemingly be justified

[f]inally, the law of causation bears on its face the character of a purely logical law, chiefly because the conclusions derived from it do not concern actual experience, but its interpretation. Hence it cannot be refuted by any possible experience. For if we founder anywhere in applying the law of causation, we do not conclude that it is false, but simply that we do not yet completely understand the complex of causes mutually interacting in the given phenomenon. (Helmholtz, *Physiological Optics*, 33)

by experience after all. Let us revisit Helmholtz's argument for the apriority of the law of causation (section 3.3) to see if we can make sense of this puzzling claim.

According to Helmholtz, comprehension "is the method whereby our thought masters the world, orders the facts and determines the future in advance."¹¹⁷ Determining the future in advance is, as we have seen in Helmholtz's account of practical truth, a matter of our unconscious inferences that form our representations accurately forecasting the changes in sensation upon engaging in some motor activity. Thus, in the end, when we have a representation, we are ultimately representing to ourselves the lawlike relations that would pertain between these sensations if we were to engage in certain motor activities. Helmholtz writes that "[t]he relationship which remains alike between altering magnitudes, we call the law connecting them. What we perceive directly is only this law."¹¹⁸ Ultimately, this was taken to mean that our manner of representation is, as a result of our associative memory, to represent causal structure.

Hence, my interpretation of Helmholtz's argument is that his claim that the law of causation is the condition of comprehensibility is the *direct* result of the fact that, according to his cognitive psychology, our *only* mode of representation is to represent causal structure. If this interpretation is right, then his defense of the law of causation appeals directly to his cognitive psychology. Moreover, given that Helmholtz held a thoroughly naturalistic attitude towards cognitive processes, this would make his appeals to cognitive psychology naturalistic. Hence, this would ultimately have Helmholtz presuppose inductive reasoning, which seemingly grants science the very autonomy from the apriorist foundationalism that the epistemological naturalists

¹¹⁷ Helmholtz, "The Facts in Perception," 142.

¹¹⁸ Helmholtz, "The Facts in Perception," 139.

are seeking after all. In light of these considerations, it would then appear that Helmholtz is simply offering a more covert naturalistic defense of the law of causation.

There is, I think, one potential avenue left to object to the naturalistic interpretation of Helmholtz's account of the law of causation. According to Helmholtz's cognitive psychology, we represent causal structure; however, it is an entirely separate claim that understanding *consists in* representing causal structure. Thus, in the end, an anti-naturalist interpretation of Helmholtz's law of causation might have it that his claim that the law of causation is the condition of comprehensibility (i.e., understanding) comes from an a priori analysis of the understanding. According to this line of argument, Helmholtz's cognitive psychology only goes so far as to show us that we represent causal structure; our a priori analysis of the understanding is what actually gives the law of causation its justification as the condition of comprehension. However, such criticism seems to stand at odds with his statements such as “[c]omprehension, in the sense in which I have described it, is the method whereby our thought masters the world, orders the facts and determines the future in advance.”¹¹⁹

What is understanding (or comprehension) for Helmholtz? The best we come to an explicit account of the process of understanding is through various tangential remarks in his accounts of practical truth and the theory of unconscious inferences. His example of using our native language is likely the most illustrative remark he makes that touches on the process of understanding. He writes that

[o]ne of the most striking examples of this kind is our understanding of our mother tongue. Its words are arbitrarily or accidentally chosen signs—every different language has different ones. Understanding of it is not inherited, since for a German child who was brought up amongst Frenchmen and has never heard German spoken, German is a foreign language. The child becomes acquainted with the meaning of the words and sentences only through examples of their use. In this process one cannot even make understandable to the child—until it understands the language—that the sounds it hears are supposed to

¹¹⁹ Helmholtz, “The Facts in Perception,” 142.

be signs having a sense. Lastly, on growing up it understands these words and sentences without deliberation and effort, without knowing when, where and through what examples it learnt them, and it grasps the finest variations of their sense—often ones where attempts at logical definition only limp clumsily behind.¹²⁰

According to this example, our understanding of our native language consists in the fact that it takes little to no conscious effort on our part to understand common expressions and phrases in this language. As a native English speaker, when someone says “pour me a glass of water” for instance, I understand immediately and without any conscious effort what kinds of actions are being referred to by the speaker and the kinds of effects the speaker is likely trying to bring about by uttering this phrase. The meaning of the sentence is thus seemingly contained in my perception of the auditory sensations caused by the speaker.

When Helmholtz employs this example, he is discussing the “assurance and rapidity for the occurrence of specific representations with specific impressions can also be acquired—even when no such connexion is given by nature.” Hence, the native language example is meant to show that understanding a phrase (or a word) in our native language is acquired from the past experience of the effects that followed from this auditory (or visual, if it is written) stimuli (even if these effects are due to convention rather than being out necessity from some physical or physiological law). Of course, all this is the long way of saying that we acquire the meanings of a word through associative learning. And, moreover, that the immediate familiarity with the meaning of some word or phrase is simply the usual effects of this word or phrase being integrated into our perception by means of our unconscious inferences.

On this analysis, understanding (or comprehending) some phenomenon simply means that our representation of this phenomenon (whether it is a linguistic phenomenon or not) contains sufficient causal information to guide action. In Helmholtz’s example, we understand

¹²⁰ Helmholtz, “The Facts in Perception,” 131.

words and sentences in our native language because the *meanings* of these words and sentences are integrated into our representations of these linguistic entities. Understanding would thus be akin to practical truth, which (if correct) sidesteps the concern that establishing the condition of comprehensibility is done via an alternative a priori analysis of comprehension.

The puzzle, of course, is that the naturalistic account of the law of causation seems to stand in conflict with the very fact that Helmholtz refers to the law of causation as an “a priori given, a transcendental law.”¹²¹ What is noteworthy, however, is Helmholtz’s peculiar and non-standard use of the term “a priori”. This, in turn, leaves us with some room to potentially resolve the inconsistency between his claims of the apriority of the law of causation and the actual argument he gives in defense of it. Let us examine Helmholtz’s account of apriority to see if it supports the reading that the law of causation admits to a naturalist analysis after all.

In his endnote commentary to Helmholtz’s “The Facts in Perception,” Moritz Schlick remarks that

once again Helmholtz uses the words a priori and transcendental in a quite different sense from what Kant does. According to the philosopher, a proposition is called a priori if it is valid, and can be seen to be valid, independent of experience. And precisely this, according to what Helmholtz declares both before and after this point, is not so with the principle of causality. In using the words a priori Helmholtz wants merely to state that the principle of causality cannot be gathered from experience by induction, but instead must always already be presupposed in the interpretation of experiences. But such a presupposition, whose validity is not established in advance, has the character of a hypothesis.¹²²

Schlick’s commentary points us in a good direction to better understand what Helmholtz means by designating the law of causation as “a priori.”

Why can the law of causation not be gathered by induction as Schlick suggests? On the first pass, it was assumed that, if the law of causation is the principle that warrants our use of

¹²¹ Helmholtz, “The Facts in Perception,” 142.

¹²² Schlick, “The Facts in Perception,” 142 n.60.

inductive inference, it could not be given by induction without presupposing itself—that is, it could not be established inductively on account of the circularity. Unless Helmholtz never foresaw the conflict between the two, the fact that the law of causation appeals to his cognitive psychology rules out the possibility he is concerned with offering a foundationalist defense of the law of inductive inference. Hence, I take it to be implausible that Helmholtz is attempting to address the radical skeptic with these arguments. Anyone pushed to be seriously skeptical of induction as a result of the problem of induction would, one can only imagine, find an appeal to some doctrine of psychology to be seriously question-begging.

Then, the alternative is, as Schlick suggests, that the law of causation cannot be ascertained inductively because it “must always already be presupposed in the interpretation of experiences.”¹²³ The key idea here is that the law of causation is not justified by the inductive generalization that, given all our past experiences obeyed the law of causation, our future experiences must also obey the law of causation. Rather, the law of causation needs to be presupposed for the *interpretation* of experience. And what does interpreting experience mean? On Helmholtz’s analysis, causality is, after all, the means through which we represent spatial structure and, hence, also objects. And, moreover, it is also how we forecast the incoming changes in sensation upon engaging in some motor activity.

Thus, justification of the law of causation is not the inductive conclusion that “every experience must obey the law of causation” based on the observational sentences that “each past moment was experienced as obeying the law of causation.” Rather, the law of causation is a “logical law,”¹²⁴ meaning it follows conceptually (i.e., deductively) from a hypothesis. That is to say that the apriority of the law of causation must consist in the fact that, in light of our best

¹²³ Schlick, “The Facts in Perception,” 142 n.60.

¹²⁴ Helmholtz, *Physiological Optics*, 33.

current *scientific hypotheses*, it follows from these hypotheses that the law of causation should have to be presupposed in order to interpret (or comprehend) experience. Moreover, given that, according to these hypotheses, the law of causation is the condition of the comprehensibility of experience, it would also follow as a consequence of these hypotheses that the law of causation cannot be refuted by experience.

If this is the case, then Helmholtz is explaining a priority in terms of an implication of our scientific hypotheses in physiology and psychology. One way to think of this is to say that he is offering a thoroughly *psychologized* and (perhaps) *biologized* account of apriority. Another way of putting it is to say that Helmholtz is attempting to offer a naturalistic account of the apriority. Following from scientific hypothesis, this account of the apriority of the law of causation would, after all, still be anti-foundationalist in the sense that the epistemological naturalists think a naturalized epistemology must be.

Part of the confusion with classifying the law of causation as naturalistic is, I think, the result of this non-standard use of apriority. In using a non-standard meaning, there are bound to be dissenters who object that “justified independently of *any* experience” is what we actually mean by “a priori.” In addition, the fact that Helmholtz seems to flirt with the problem of induction is no less confusing. If his justification for the law of causation appeals to induction (at least in a tangential manner), why is he concerned with the problem of induction as he appears to be in his criticism of Mill’s argument.

This latter concern is still somewhat unresolved. Part of the problem is that contemporary naturalists are simply not interested in talking about finding a justification for induction. After all, it is Quine who remarks that “I do not see that we are farther along today than where Hume

left us. The Humean predicament is the human predicament.”¹²⁵ Hence, once epistemological naturalism had formed a self-conscious movement at the beginning of the second half of the twentieth century, responding to the problem of induction was seen as obsolete. One potential resolution to this comes in the form of suggesting that Helmholtz is trying to provide a naturalistic response to the problem of induction. However, a proper appreciation of the problem of induction, as Quine correctly points out, makes it conceptually immune to a naturalistic response. Hence, we are unfortunately left with little clarification on why Helmholtz chose to criticize Mill’s inductive arguments for the law of causation.

Despite these concerns, the fact of the matter remains: Helmholtz attempts to defend the law of causation through an appeal to science itself rather than through an appeal to some independent “philosophic” standpoint. Hence, he further aligns himself with the project of epistemological naturalism. Thus, regardless of whether we accept Helmholtz’s peculiar account of apriority or not, both possibilities are spelled out naturalistically.

What is the result of this thoroughly naturalistic interpretation of Helmholtz’s epistemology? The big takeaway is that the cognitive norm entitling us to induction is a naturalistic one. This normative principle is, of course, the law of causation, and the law of causation is justified by appeal to cognitive psychology. A significant but equally noteworthy step made by Helmholtz is his effort to naturalize the notions of *truth* and *objectivity* by explaining them in terms of inductive inferences. Truth is a matter of using inductive inference to move about the world successfully—that the representational accuracy of a representation consists in its ability to cause us to move about successfully in the world. Moreover, the objectivity of these representations consists in the fact that the causal structure they represent is

¹²⁵ Quine, “Epistemology Naturalized,” 72.

inalterable by our muscular innervations. For the contemporary naturalists unconcerned with addressing the problem of induction, these two developments make Helmholtz's naturalism relevant to the contemporary discussion.

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