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Evidence and Cause in Nineteenth-Century Naturalized Kantianism

Helmholtz, Lange, and Quine's Argumentative Strategies

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ABSTRACT

This paper argues that W. V. O. Quine's twentieth-century evidential and proximal theory of meaning and belief, developed in opposition to Donald Davidson, employs argumentation strategies strikingly similar to those of Hermann von Helmholtz and Friedrich Albert Lange in their nineteenth-century efforts to naturalize Kant's epistemology. Contrary to Jim Hopkins's interpretation, which links Helmholtz's theory of unconscious predictive inferences with Davidson's causal theory of action and truth-conditional semantics (2018), this paper contends that Quine's epistemic externalism, rooted in a naturalized account of evidentiality and proximality, aligns more closely with Helmholtz and Lange's psychophysiological theory of meaning.

1. Introduction

A consensus in the secondary literature on analytic epistemology history suggests that some nineteenth-century neo-Kantians share argumentative strategies with W. V. O. Quine's naturalized epistemology by reinterpreting Kant's epistemology in psychophysiological terms. Naturalized epistemology, in this context, refers to the redefinition of epistemology informed by the natural sciences, positioning it as a subset of psychology that emerges from the disappointment with the foundational ambitions of traditional epistemology. This alignment was initially identified by Theo C. Meyering (1989, 220) and Gary Hatfield (1990, 260–61), and

later corroborated by Andrew Chignell (2008, 261), Georg Schiemann (2009, 46–47), and David Hyder (2013, 275). Few, except for Lydia Patton (2009), Michael Friedman (2012), and Jim Hopkins (2018), have rigorously assessed the significance and scope of these similarities. Jim Hopkins's (2018) paper is particularly relevant as it contends that Quine and Davidson's theory of meaning finds its roots in Helmholtz's theory of unconscious predictive inferences. However, Hopkins undercuts his argument by conflating Quine's naturalized epistemology with Davidson's radical interpretation, overlooking their debate on meaning, truth, and belief.

My paper argues that Helmholtz's psychophysiological work, supported by Friedrich Albert Lange,[1] aligns with Quine's argument that the "triggering of nerve endings" can serve as *proximal evidence* to justify our beliefs, a point Davidson denies.[2] Quine's "proximal" theory of meaning emphasizes the role of nervous stimuli in aligning private meanings with a public standard. In contrast, Davidson's "distal" theory of meaning focuses on the properties of objects within a shared social environment, essential for effective communication between speakers. The "evidentiality" of nervous stimuli, as Quine suggests, implies that sensory input contains all the information necessary for verifying scientific theories. Conversely, Davidson assigns nervous stimuli a merely "causal" role, denying their capacity to serve as confirmatory evidence for a belief or proposition.

[1] There are two reasons for including an additional investigation into Friedrich Albert Lange's writings. First, it supports the idea that there is more regularity than expected among neo-Kantian naturalized epistemology in the second half of the nineteenth century. Second, it encourages renewed interest in secondary authors whose significance at the time has since been forgotten.

[2] I am aware that my approach, which compares Quine's twentieth-century epistemology to that of Helmholtz and Lange in the nineteenth century, carries some anachronism risk. The naturalized Kantian epistemology of the nineteenth century responds to the materialism dispute, which is unrelated to Quine's rejection of the rational reconstruction of scientific assertions by Viennese logical empiricism. Additionally, there was a significant gap between the logical and psychological paradigms of the nineteenth and twentieth centuries, when naturalized epistemology first emerged. Therefore, an interpretation based on the sociohistorical setting may struggle to reconcile diverse epistemologies separated by centuries. However, a thematic examination of the three writers' epistemological issues and answers over the nineteenth and twentieth centuries reveals similarities between their two distinct epistemologies.

To explain how sensory stimulation provides proximal evidence, I offer a thematic reconstruction of the argumentative strategies of Helmholtz, Lange, and Quine. This reconstruction acknowledges the century-long gap between their theories and the different contexts in which their naturalized approaches address epistemological challenges. Nevertheless, a thorough analysis reveals key conceptual overlaps in their shared understanding of belief formation as a capacity to guide action, rooted in pre-existing beliefs, environmental conditions, and anticipated outcomes.

To understand how Helmholtz's, Lange's, and Quine's epistemologies intersect without a causal-historical connection, this paper is structured as follows. First, I review Hopkins's argument, highlighting his connections between Helmholtz's theory of unconscious predictive inference and Davidson's theory of action and meaning. I also discuss how Hopkins could have made his argument more explicit by comparing Davidson's truth-conditional semantics with Helmholtz's practical theory of truth. Next, I examine the Quine-Davidson debate on meaning and belief, focusing on the two aspects mentioned above. Third, I show how Helmholtz's and Lange's epistemology aligns with Quine's attribution of an evidential function to the proximal nerve stimulations of sensory organs. I conclude that this function acts as a mediator between the concepts mobilized by a theory and its empirical content. In each case, proximal sensory information plays a central epistemological role, both as the cause of the formation of a belief (or proposition) and as part of its evidential significance within a broader theory. Based on this 'proximity' and 'evidentiality,' I conclude that Quine's naturalized epistemology shares strategic affinities with nineteenth-century neo-Kantian naturalized epistemology, enhancing our understanding of their comprehensive theory of meaning, belief, and truth.

2. How Hopkins Uses Davidson's Causal Theory of Action

Hopkins draws on Davidson's causal theory of action to clarify the connection between belief and meaning. He explains that Helmholtz's unconscious inferences share the causal predictive role that Davidson ascribes to "desires and intentions . . . signaled (and partly implemented)

. . . [described] in terms of the conditions of satisfaction or fulfillment . . . . As Davidson noted, this is a way of describing causes in terms of (predicted) effects" (Hopkins 2018, 129–30). Davidson claims that rationalizing an action, or providing reasons for an agent's action, is a type of causal explanation. Primary reasons for an action describe "some sort of pro attitude toward actions of a certain kind" or "believing (knowing, perceiving, noticing, remembering) that his action is of that kind" (Davidson 1963, 685–86), or both. Once these desires and beliefs are understood within their rational, social, economic, and linguistic context, it becomes possible to reconstruct a practical syllogism attributing a decision-making model to the rational agent's actions. Hence, cognitive and conative aspects of the proposition "I wanted to turn on the light" give good reasons for the truth of the proposition "I turned on the light" (Davidson 1963, 688). However, Davidson does more than just assert that describing the primary reasons is a necessary condition for intentional action; he contends that primary reasons are also genuine causes for action. The explanation "that the agent performed the action *because* he has the reason" (Davidson 1963, 691) relies on a causal relationship between distinct events; namely, the agent's belief or desire and the subsequent action. As a result, the explanation of an agent's action involves two distinct kinds of relata: a logical relation between propositions describing the agent's primary reasons and actions and a causal (or law-like) relation between individual distinct events. A casual relationship can explain an agent's action just as an individual distinct event can provide the causal link between an agent's action and why that action occurred. Thus, the efficacy of Hopkins's analogy between Davidson's causal theory of action and Helmholtz's theory of unconscious predictive inferences relies on two presuppositions: the rationality of the agent, "whose choices, beliefs, and desires cohere in the sense of Bayesian decision theory" (Davidson 2001, 139), and the causal explanation of the generation of "predictions—and further predictive representations including desires and intentions—about the sensory consequences of motor activity that, if it were initiated, would lessen error in the circumstances as modeled" (Hopkins 2018, 129). Helmholtz's theory of meaning, and I argue Lange's argument is the same, explains how the visual system identifies the probable causes of sensory stimuli, interprets object behaviour in the visual field, and enables effective en-

gagement with the surroundings, aligning with Davidson's argument.[3] Helmholtz uses a (limited) analogy with syllogistic reasoning to explain this unconscious inferential processing of information transmitted by nerve stimulation and voluntary movement.[4]

Memorized past experiences form the basis for an interpretation rule (akin to the major premise of a syllogism), allowing the subject "to determine correctly ... in advance what sense-impressions [the subject] will get from the things when he places himself in definite external relations to it" (Helmholtz [1867] 1925, 23). The representation [*Vorstellungen*] (or "the whole group of sensation aggregates which can be brought about during the period under discussion, by a certain specific and limited group of impulses of the will" (Helmholtz [1878] 1977, 125)) is linked to aggregates of sensations present at an instant t [*Perception*] (like the minor premise of the syllogism). An empirical synthesis, which Helmholtz calls "unconscious inference," then generates a perception "of an enduring existence of different things at the same time one beside another" (Helmholtz [1878] 1977, 125) (like the conclusion of a syllogism). This unconscious inferential process acquires "through practice a mechanical character, which joins a class of involuntary relations of ideas that come into existence when two representations appear very frequently together eliciting one another with an assured natural necessity" (Helmholtz [1855] 1896, 112). Similarly, Lange highlights the *a priori* and necessary psychophysical constraints imposed on sensitive

[3] More precisely, Helmholtz and Lange address an inverse problem in perception that arises when explaining how a localized object is represented in the visual field based on cognitive processing of retinal images. This problem does not allow for a unique solution that would be stable enough to explain how an object is identified in perception. Unlike a direct problem, such as how light from a three-dimensional object affects the bidimensional surfaces of two retinas, an inverse problem cannot be solved with a simple mechanical explanation through a linear transformation of how the representation of an object in the visual field arises from the retinal nerve activation. To understand how the representation of an object in the visual field arises from retinal nerve activation, internalized aprioristic constraints that limit the number of possible visual interpretations must be considered (for example, the physical behaviour of rigid objects, the intensity, or the quality of sensitive signs). Similar explanations on the inverse problem in perception can be found in Fechner (1877, 3). For further information, see Pizlo (2001), Hohwy (2013), and Swanson (2016).

[4] For more information on Helmholtz's theory of perception, see Tracz (2018), Patton (2018) or Isaac (2020).

signs in perception using a rudimentary interpretation of Helmholtz's theory of unconscious inferences.

Lange draws a comparison between this unconscious inferential process and syllogistic reasoning using the standard example of the physiological blind spot (or Mariotte's blind spot).[5] This region on the retina, where the optic nerve enters the cerebral cortex, lacks light-sensitive nerve receptors. Unconscious inferential processes compensate for the lack of visual stimulation by considering the visual representation of sensitive signs next to Mariotte's spot (equivalent to the minor premise) and presentable sensitive signs based on the shape, position, and size of objects in the visual field (analogous to a major premise). Lange concludes that the quality of "[the *prima facie* simplest sensations] is by no means merely determined by the external stimulus and the fixed constitution of an organ, but by the constellation of the collective occurrent sensations" (Lange [1875] 1880b, 203–04).

Helmholtz and Lange's theory of unconscious inferences relies on anticipated "hypothesis realized as perceptual experience" (Hopkins 2018, 126) (similar to primary reasons) to explain how perceptions form "whenever an impression is made on the eye" such that "objects are always imagined as being present in the field of vision as would have to be there to produce the same impression on the nervous mechanism, the eyes being used under ordinary normal conditions" (Helmholtz [1867] 1925, 2) (Lange [1875] 1880b, 217). This theory implies a causal account of action since "the success of the movement and actions depends on the accuracy of the pictures that the eye gives us [which] forms a continual test and confirmation of the accuracy" (Helmholtz 1995, 130) (Lange [1875] 1880b, 219). Thus, apperceptions and ideas are the best causal and intersubjective (or species-specific) (Edgar 2015, 115) explanations for a subject's awareness of the outside world, the "objectum," the "not-I," or objects in their immediate environment. As "*effects* brought on our nervous system and our consciousness by the objects that are thus apprehended and conceived" (Helmholtz [1867] 1925, 19), they describe the object in terms of (predicted) effects, causally bridging primary reasons and the perception (or action). According to Davidson, they make "the sentences that describe the agent's desire true, by making

[5]The same example can also be found in Helmholtz ([1855] 1896).

true those that (would) describe the sensory consequences of acting on those desires" (Hopkins 2018, 129).

3. Hopkins's Analogy: Davidson's Truth-Conditional Semantics

This excerpt introduces the second cornerstone of Hopkins's argument, referring to Davidson's truth-conditional semantics, which sheds light on the relationship between beliefs and truth. Hopkins rightly pays little attention to Davidson's Tarski-style semantic method for defining truth for any language *L*. This theory of truth, developed in the first half of the twentieth century, provides limited grounds for drawing analogies with Helmholtz's pragmatic definition of truth from the late nineteenth century. Instead, Hopkins emphasizes Davidson's redefinition of truth within a theory of communication (or interpretation), arguing that truth is dependent on "a speaker and . . . a time" (Davidson 1967, 320). Reframing it places special emphasis on the relationship between truth, belief, and meaning, focusing on the "intrinsically veridical" nature of belief or "how an interpreter could confirm its truth" (Davidson 2001, 156). If we momentarily take aside Tarki's deflationist definition of truth, as Hopkins does (Hopkins 2018, 136), and concentrate exclusively on Davidson's reframing of the relationship between truth and belief, an analogy with Helmholtz's (and Lange's) pragmatical conception of truth becomes plausible.

Davidson states that "a correct understanding of the speech, beliefs, desires, intentions, and other propositional attitudes of a person leads to the conclusion that most of a person's beliefs must be true" (Davidson 2001, 146). He assumes that humans, who are "generally right about the nature of . . . [their] environment, must know what a belief is, and how in general beliefs are to be detected and interpreted" (Davidson 2001, 146). Assuming that beliefs are "general facts we cannot fail to use when we communicate with others" (Davidson 2001, 146) and that "too great deviations from consistency and correctness leave no common ground on which to judge either conformity or difference" (Davidson 2001, 148), Davidson concludes that a coherent set of beliefs must contain mostly true beliefs, even if individual beliefs might be false. This assumption regarding the veridicality of beliefs also bridges belief and meaning

by expanding the principle of charity, which "directs the interpreter to translate or interpret to read some of his standards of truth into the pattern of sentences held true by the speaker" (Davidson 2001, 148). This principle limits the variability (or freedom) experienced by the notion of belief, provides conditions for assent (or dissent) in communication, and accounts for the reference to the human use of language in defining truth.

Hopkins's treatment of Davidson's assumption about the veridicality of beliefs reveals an affinity with Helmholtz's (and Lange's) account of truth.

In his *Physiologische Optik*, Helmholtz argues that "there can be no possible sense in speaking of any other truth of our ideas except of a practical truth. Our ideas of things cannot be anything but symbols, natural signs for things which we learn how to use to regulate our movements and actions" (Helmholtz [1867] 1925, 19). He states that "[a] system of signs may be more or less perfect and convenient. Accordingly, it will be more or less easy to employ, more exact in denoting or more inexact. . ." (Helmholtz [1867] 1925, 19). Helmholtz emphasizes that the relationship of adequacy between the regular succession of natural events and the cognitive interpretation of the complex of symbols or signs that correspond to it "does not have to be either perfect or exact" (Helmholtz [1867] 1925, 24) to be practical or operational. As a result, the truth or falsehood of a judgment is not determined by a conceptual explanation of worldly objects; rather, it characterizes how inferences about the world help humans reach epistemic goals. Despite the unavoidable reference to the correspondence between objects (or laws of nature) and their cognitive representation, Helmholtz emphasizes the psychophysical relativity of truth, which "adjust[s] our actions to bring about the desired result . . . so that the expected new sensations will arise" (Helmholtz [1867] 1925, 19).

Similarly, Lange explains that "[o]ur sense organs are organs of abstraction; they show us some important effect of a form of motion, which does not even exist in the object itself." This psychophysical process of abstraction "leads to knowledge of [relative] truth . . . so far as we speak of that knowledge which necessarily results from our organization, and therefore never contradicts itself" (Lange [1875] 1880b, 218). He notes that "[i]n the relations of science we have fragments

of truth, which are continually multiplying, but continually remain fragments" (Lange [1875] 1880b, 282). Both Helmholtz and Lange emphasize that psychophysical organization shapes epistemic objectives and that the relationship between the regular succession of natural events and the cognitive interpretation of the complex of symbols or signs that correspond to it is fragmentary. And while truth correspondence has limits, it is practical and valuable. We must adjust the criterion for correspondence between the regular succession of phenomena in nature, their cognitive processing, and their conceptualization in the form of judgment while considering the epistemic objectives unique to humans.

In Helmholtz and Lange's theory of truth, the acuteness of sensory information processing, the predictive power of beliefs, the assent of others that legitimizes conviction in that belief, and the effectiveness of the interaction with the environment fulfill a role analogous to Davidson's principle of charity.[6] This supports the idea that most visual phenomena "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, . . . [they] are also the *only true* ones for our mental capacity. All others would be false" (Helmholtz [1867] 1925, 24). Simply put, these "largely correct perceptual representation of [the] environment and [corresponding] correct perceptual beliefs" (Lepore and Ludwig 2005, 202) should not be seen as the result of repeated, successful goal-driven predictions. Instead, they should be viewed as a necessary condition for justifying the meaning of beliefs (including perception) and affirming their truth.

4. The Quine-Davidson Debate

Even though these comparisons are appealing, Hopkins's view has a few shortcomings. He claims that Quine and Davidson shared a naturalized

[6]Gregor Schiemann extends Helmholtz's definition of truth to his construction of scientific theories. These theories become operational, allowing us to understand and control the behaviour of physical entities in nature. This supports Hopkins's Davidsonian argument through analogy. See "[t]he validity of experimental results depends significantly on the successful execution of the experiment, the extent to which the results are confirmed in technical contexts and generally, whether the desired effect is achieved (among which on can also count being recognized as sounds by the scientific community)" (Schiemann 2009, 134). For a similar account, see Lange ([1875] 1880b, 282).

epistemology, rejected sense-data theories, embraced epistemic externalism, and relied on semantic holism. However, this is problematic since Davidson's formulation of epistemic externalism, discussed in his namesake essay ([1991] 2001), clearly distinguishes his position from Quine's theory of meaning and belief. By focusing on the epistemological and semantic aspects of the third dogma of empiricism, I argue that Helmholtz and Lange's epistemology aligns better with Quine's evidential and proximal theory of meaning, highlighting the flaws in Hopkins's earlier analogies.

On the semantical side, the contentious issue revolves around the proximal account for the meaning of observational sentences. Observational sentences like "It's red," "It's raining," or "He's a bachelor" are situated at the "boundary conditions of experience" (Quine 1951, 39), closest to sensory evidence. These sentences, whose truth value varies from one occasion to another, combine "evolving irradiation patterns of all durations up to some convenient limit or *modulus*" (Quine 2013, 28) and a behavioural response conditioned by a "[l]anguage as a socially inculcated set of dispositions..." (Quine 2013, 40). The relative uniformity in assent and dissent they trigger among competent speakers is achieved through 'perceptual similarity.' As Quine notes, this similarity is "the basis of all learning, all habit formation, and it is testable in people and other animals by the reinforcement and extinction of conditional response" (Quine 2008, 116).

Davidson critiques Quine's account of meaning sameness—how similar presentations elicit similar judgments—by asserting that it "ties together meaning and content to the firing of sensory nerves" (Davidson 1990, 68). According to Davidson, this perspective leads to an "account of the nature of knowledge, which is first person and Cartesian" (Davidson 2001, 194).[7] Because the anatomy of nerve endings varies from speaker to speaker, different stimulations should result in different meanings for observational sentences. Furthermore, the nerve stimulation involved in their linguistic behavioural response to any event—on which the evidentiality of a proximal theory is based—is "no guarantee we have an even roughly correct view of a public world" (Davidson 1990, 74) as it often goes undetected and unknown by the competent speaker.

[7] On the evolution of Quine's theory of meaning, see Hylton (2007), Sinclair (2007), or Kemp (2013).

Davidson chose a "distal theory [that] connects meaning directly to the conditions that make sentences intersubjectively true or false" to neutralize the skepticism resulting from potential intersubjective and intrasubjective discrepancies between the triggering of their nerve endings and their linguistic behavioral response (Davidson 1990, 75). The meaning of observational sentences relies on their truth conditions in communication rather than on the evidence provided by nerve endings. Since, the *cause* of a possible communication is in the external, shared events, objects, or situations that elicit assent or dissent, the evidentiality of sensation becomes useless because "your pattern of stimulations and mine are guaranteed to prompt assent to distally inter-translatable sentences only if those patterns are caused by the same distal events" (Davidson 1990, 77).

On the epistemological side, the contentious issue concerns the evidential and informative bearings of sensory stimulation patterns that prompt assent or dissent to the utterance of observational sentences. Quine repeatedly affirms that "... surface irritations ... exhaust our clues to an external world" (Quine 2013, 20) or "... whatever there *is* for science *is* sensory evidence. ... all inculcation of meanings of words must rest ultimately on sensory evidence" (Quine 1969, 75). This evidential (and not only causal) feature of the patterns of sensory stimulation introduces an empiricist theory of verification of scientific propositions without a second dogma of empiricism (or the sense-data vocabulary). In other words, this "tribunal of sense experience" (Quine 1951, 38) becomes an *epistemic* intermediary between the conceptual schema and its empirical content (or, in Kantian terms, between perception and judgments) responsible for a naturalized justification of beliefs.

This squarely challenges Davidson's causal theory of meaning, as experience cannot constitute "a basis for knowledge outside the scope of our beliefs" (Davidson 2001, 141). Davidson rejects any verification theory, claiming that "[s]ensations cause some beliefs and in *this* sense are the basis or ground of those beliefs. But a causal explanation of a belief does not show how or why the belief is justified" (Davidson 2001, 143). Sensations (described as events in the world or our sensory apparatus) cannot confirm or disconfirm a proposition or a belief since "... nothing can count as a reason for holding a belief except another belief" (Davidson 2001, 141). Sensations are responsible for causal

interactions between interlocutors and events leading to beliefs, but the meaning of beliefs does not depend on non-conceptual evidence. Rather, it is based on a relation of maximal coherence of beliefs held to be true by a speaker under observed circumstances. Davidson also opposes the 'conceptual relativism' resulting from this empiricist theory of verification, explaining that sensory evidence is not "a fixed stock of meanings" or "a theory-neutral reality" that provides "a ground for comparison of conceptual schemes" (Davidson 1974, 17); it is not even something that makes a sentence or a theory true. Rather, since "knowledge ... comes only with the ability to interpret words, the only possibility at the start is to assume general agreement on beliefs" (Davidson 1974, 18–19).

5. Semantical Consequences: Quine on Proximality

On the semantical side, an analogy can be drawn between Helmholtz, Lange, and Quine regarding the *proximality* of their theories of meaning and knowledge, offering a counterpoint to Hopkins's claim. In his early writings, Quine explains the similarity in meaning—how the same presentations elicit similar responses—by invoking an "approximate intersubjective homology of neuroreceptors" (Quine 1990b, 74). This proximal nerve-stimulus homology, rooted in what Quine calls the "pre-linguistic qualitative space" (Quine 2013, 76), "is what behavioral testing continues to show, and it is the continuing basis of habit formation, or stimulus generalization. With the accumulation of further habits or generalizations of the stimulus, the relationship of perceptual proximity continues to evolve" (Quine 2013, 30). Observational propositions developed in response to appropriate neurological stimulation are learned earliest, both by toddlers and field linguists (Quine 1969, 89). For example, a child's prelinguistic innate quality space enables them to "weight qualitative difference unequally" (Quine 2013, 75) (following their caregivers' interests) and inductively generalize stimuli along socially encouraged behavioural responses. This causal argument, which relies on proximate sensory input, explains the genesis of similarities in perception and linguistic behavioural responses among children, native speakers, and other competent speakers of the same language. It also provides grounds for arguing in the following sections for the

evidentiality of observational sentences, supporting Quine's view that "[t]he evidence relation and the semantical relation of observation to theory, are coextensive" (Quine 1990b, 38).

Following Davidson's critique of a proximal interpretation of meaning, Quine shifted (post-1965) toward a middle ground between Davidson's distal approach and his earlier proximal positions. He explored two possible explanations for the intersubjectivity of meaning stimuli: empathy and pre-established harmony rooted in biological evolution. In *Pursuit of Truth*, Quine ([1990] 1992) uses "publicly observable situations" and "empathy" to explain the intersubjectivity of sentences' meaning in early childhood language acquisition and radical translation. For example, "[t]he parents assess the appropriateness of the child's observation sentence by noting the child's orientation and how the scene would look from there" (Quine [1990] 1992, 3). In radical translation, the "[s]uccess in communication . . . [is] judged by the smoothness of conversation, . . . the frequent predictability of verbal and nonverbal reactions" (Quine [1990] 1992, 42–43). In both cases, empathy refers to the ability to imagine oneself in the place of the interlocutor, regardless of physical, physiological, or optical circumstances. Although Quine criticizes Davidson's distal theory of meaning for its lack of precision and "uncertainty" in defining the concepts of events, objects, or situations, Davidson argues that "[t]he distal stimulus now plays a direct and essential role in translation, and therefore in the beliefs we are justified in attributing to agents" (1994, 190).

In *From Stimulus to Science*, Quine (1995) explains perceptual similarity through visual salience and biological evolution, particularly the non-metaphysical notion of pre-established harmony. Visual salience is responsible for the apparent visual similarity despite differences in nerve reception (Quine 1995, 18), implying that "most of the receptors triggered on any occasion are perceptually ineffective" (Quine 1995, 19). Biological evolution explains that this pre-linguistic anticipation, resulting from human interaction with the environment, gives "us better than random success in our expectations" (Quine 1995, 20). As a result, visual salience and biological evolution not only explain why "[i]f two scenes trigger perceptually similar global stimuli in one witness, they are apt to do likewise in another" (Quine 1995, 21) and how both become the basis "of all expectation, all learning, all habit formation" (Quine 1995,

20). This explanation of acquiring a public or intersubjective harmony of private or subjective standards in perception relies on a naturalized and proximal theory of meaning.

6. Semantical Consequences: Helmholtz and Lange on Proximality

Helmholtz and Lange's conception of perceptual standards of similarity aligns with Quine's proximal theory of meaning, emphasizing neuroreceptor homology and non-metaphysical preestablished harmony through natural selection. Both nineteenth-century thinkers and Quine explore how these factors contribute to intersubjective agreement on subjective criteria of similarity in perception, providing a basis for aligning perceptual and conceptual judgments across individuals.

Regarding neuroreceptor homology, Helmholtz and Lange attribute agreement on empirical facts or verifying events for scientific theories to a form of intersubjective agreement that is physiologically conditioned (Lange [1875] 1880a, 326; [1875] 1880b, 204, 216).[8] For example, agreement on the colour of an object in visual space is first provided by sufficiently uniform and shared neuroreceptor structures and cognitive capacities across humans, as suggested by the reference to unconscious inferences (Edgar 2015, 114). However, Helmholtz notes that "a system of signs may be more or less perfect and convenient . . ., more or less easy to employ. . ." (Helmholtz [1867] 1925, 24), meaning the perceptual standard of similarity "does not have to be either perfect or exact" to provide "images of the regular sequence of natural events" (Helmholtz [1867] 1925, 24).

To clarify this alignment between the laws of thought and those of nature, it is relevant to introduce a second concept: pre-established harmony through natural selection. Helmholtz's empiricist arguments for acquiring stereoscopic vision—a theme that Lange also explores in *The History of Materialism*[9]—dismiss any innate harmony between the proximal retinal stimulation and the distal perception of an object

[8] A similar take on intersubjective agreement can be found in Fechner (1877, 276). See also Fullinwinder (1991, 26–27).

[9] See Lange ([1875] 1880a, 192–93), Lange ([1875] 1880a, 198), or Lange ([1875] 1880b, 213–14).

or event. Unlike nativists who attribute spatial properties to inborn physiological dispositions (e.g., direct knowledge of the retina's dimensions or the excitation of specific nerve fibers),[10] Helmholtz advocates for the empirical development of spatial representation. He argues that spatial properties emerge from involuntary associations formed through active engagement with the environment. He criticizes nativists for lacking speculative sobriety and explanatory capacity and accuses them of disregarding empirical investigations (Helmholtz [1878] 1977, 134–35). Conversely, Helmholtz's empirical explanation, based on scientific observations, limits unnecessary speculative hypotheses, predicts the movement of objects in the visual field, and accounts for specific visual phenomena, such as stereoscopic lustre and binocular rivalry. However, as Lange points out ([1875] 1880b, 218–19), this debate on the acquisition of stereoscopic vision ultimately presents a false dilemma as it is impossible to definitively refute the nativist position. Furthermore, both Helmholtz and Lange acknowledge that Darwin's natural selection shapes and refines how physiological organs process information from the environment. The "extraordinary value" of sense organs "depends upon how we use [them]: [their] perfection is practical, not absolute, consisting not in the avoidance of every error, but in the fact that all [their] defects do not prevent [them] from rendering us the most important and varied services" (Helmholtz [1867] 1925, 201). Darwin's natural selection remains a plausible partial explanation for induction's predictive ability, even though Helmholtz and Lange prefer an empiricist hypothesis to explain intersubjective agreement on perceptual similarity standards.

Based on these considerations, I argue that Helmholtz and Lange's proximality explanation better aligns with Quine than Davidson's theory of distal meaning. The cause of possible communication is not in the distal, shared events that provoke assent or dissent, but in the proximal stimulation patterns of nerve endings. Moreover, empathy is not presumed to explain the public harmony of perceptual similarities as conditions that make sentences intersubjectively true or false. Instead, biological evolution and psychophysiology impose an unavoidable constraint, conceptualized through natural sciences, which may be lacking

[10]For Helmholtz's debate against Hering, see Helmholtz ([1867] 1925, 607). For a detailed commentary on the debate, see Hatfield (1990, 179–95) or Bouveresse (2004, 180–222).

in another species but ensures a specific intersubjectivity sufficient to recognize similarity in perception.

7. Epistemological Consequences: Quine on Evidentiality

On the epistemological side, I argue that Quine's naturalized epistemology, like Helmholtz and Lange's, entails both the proximality of stimulation patterns and their evidentiality. Unlike Davidson, who holds that "nothing can count as a reason for holding a belief except another belief" (Davidson 2001, 141), preventing direct confrontation of beliefs with reality or evidence outside the system of belief, Quine allows for an evidential relationship between experience and theory. This relationship is not confined to a system of beliefs, it also includes engagement with sensory evidence while locating the explanation for the relationship between theory and evidence within the conceptual (or linguistic) framework of the scientific inquiry into reality (Quine 1969, 127).[11]

This perspective reflects Quine's rejection of a strict separation between theory and evidence, emphasizing the role of sensory input in revising scientific theories and the broader web of belief. This entwining of theory and evidence stems from Quine's naturalistic redefinition of epistemology, challenging "[b]oth the skeptic and the epistemologist [who] rely on a strict theory-evidence dichotomy in their inquiries" (Verhaegh 2014, 163). The skeptic is concerned with the all-too-limited evidence for an infallible foundation for scientific theories, while the epistemologist's logical reconstruction of science relies on ill-defined sensory data to verify (and provide evidentiality to) the individual propositions of our best scientific theories. Quine avoids the "despair of being able to define theoretical terms generally in terms of phenomena" associated with logical reconstruction by advocating a holistic verification of scientific theories. This holistic approach supports his "unregenerated realism, the robust state of mind of the natural scientist

[11] On naturalized epistemology, see in secondary literature, for Helmholtz (for example, Fullinwider (1990), Hatfield (1990), Patton (2018), de Kock (2014b, 2014a, 2014c, 2016), or Heidelberger (2015); and, for Lange (for example, Edgar (2013, 2015), or Pecere (2021)).

who has never felt any qualms beyond the negotiable uncertainties internal to science" (Quine 1981, 72).

Quine's relaxed use of natural science's results and methods allows him to intertwine theory and evidence through observational sentences. This brings together the configurations of nervous stimuli (responsible for perceiving objects, events, and situations in the world) and linguistic dispositions (accounting for the utterance of observational sentences to which competent members of a linguistic community can assent or dissent). An observational sentence is "Janus-faced" (Quine 2008, 411), meaning that "[a]s a response to neural intake, the sentence is holophrastic: the neural intake is keyed to the sentence as a monolithic whole" whereas "piecemeal, word by word . . .[,] the sentence relates to scientific theory, where its words recur in new combinations and contexts" (Quine 2008, 411).

From a theory-laden standpoint, sensory evidence is part of a scientific theory—"a ponderous linguistic structure fabricated of theoretical terms linked by fabricated hypotheses, and keyed to observable events . . .[. It] predicts future observations based on past ones . . . [and may be revised] when the predictions fail" (Quine 1975a, 71–72). Observational sentences operate "within the inherited world theory as a going concern" (Quine 1981, 72), drawing meaning from "short leaps of analogy" that connect the meager sensory "experimentally controlled input" (Quine 1969, 83) and the torrential linguistically conditioned output—"a description of the three-dimensional external world and his history" (Quine 1969, 83). This theory-ladenness avoids reliance on epistemic foundational principles or the reconstructing an exhaustive and "continuous derivation" (Quine 1975a, 77f) of the relationship between perception, language acquisition, knowledge development, and transmission. Instead, it relies on "the activation of our sensory receptors in the light of previous activations" (Quine 1981, 1). It assigns a uniform ontological status to all concepts within a scientific theory, making two-dimensional retinal stimulation, three-dimensional perception of the visual field, and the psychophysiological theory of unconscious inferences into cultural posits. Observational sentences depend on "the stored collateral information" (Quine 1969, 85) of scientific theories. It is also "by reference to them that the very notions of reality and evidence are acquired. . ." (Quine 2008, 100). As Quine explains, ". . . everything to which we

concede existence is a posit from the standpoint of a description of the theory-building process, and simultaneously real from the standpoint of the theory that is being built" (Quine 2013, 20–21).

From a holophrastic standpoint, Quine views observational sentences as "monolithic whole[s]" that serve as a theory-neutral and evidential base for meaning. First-language acquisition and assessment of a scientific theory's empirical content constitute prime examples that showcase the holophrastic function of observation sentences in the causal explanation of belief (and meaning) acquisition. Observational sentences are "the child's entering wedge into cognitive language" (Quine 2008, 411) consisting of simple grammatically unstructured, phonetical, and ostensive utterances like 'red,' 'mama,' or 'Lo, a rabbit.' These utterances provide an intersubjectively recognizable account of a neural event. The interlocutor (learner, native informant) assesses the initial utterance of the speaker (caretaker, linguist) through symptom-like information about the causal condition of the utterance, which is the neural event.[12] This verbal disposition connects the relevant stimulus (whose neurological underpinnings he may be unaware of) that triggered the statement with the observational sentences that promptly inform others about the neural event. The interaction between observational sentences and observation categoricals allows for evaluating the empirical content of scientific theories. Observation categoricals (e.g., 'Whenever it snows, it's cold') organize observation sentences (e.g., 'It snows,' 'It's cold') into ordered pairs <φ, ψ> and generalized forms (e.g., 'Whenever φ, ψ'). Unlike observational sentences, whose truth values are highly contextual or occasion-dependent, the truth value of observation categoricals is heavily influenced by other statements in a scientific theory. Both remain, "neutral nodes in the logical structure of our total theory of the world" (Quine 2008, 415), since "the logical relations of the implication that connect scientific theory with observation categoricals are unaffected by one-to-one reinterpretation of terms" (Quine 2008, 415). They provide a principle of similarity and difference devoid of physical, semantical, and logical sophistication, unlike observational conditionals, which are standing theoretical sentences.[13] They also "serve as experimental checkpoints for theories about the world. Negative checkpoints" (Quine

[12] On the threshold of evidence, see Lewis and Holdcroft (1997).

[13] On the semantical and ontological implications of 'observational categorials,' see Kemp (2024).

2008, 110–11). Their generality makes them intersubjective evidence capable of falsifying theoretical statements while remaining ontologically neutral, unfettered (or unfragmented) by the regimentation of first-order logic.

As a result, the evidentiality of the holophrastic relationship between observational sentences and categoricals, along with the linguistic conditioning of observational sentences in response to the pattern of stimulation, provides Quine with a *causal* (albeit limited) *explanation* for the intersubjectivity of meaning, fixing the immanent truth conditions for theoretical propositions.

8. Epistemological Consequences: Helmholtz and Lange on Evidentiality

An analogy can be drawn between Quine's causal explanation and Helmholtz and Lange's redefinition of Kant's epistemology within a psychophysiological conceptual framework, both of which bring theory and evidence closer together. From an empirical perspective, Lange's "physical-psychical organization" and Helmholtz's "sense-perception" causally explain how humans recognize external objects and serve as a reference for scientific hypotheses. From a theory-laden standpoint, these notions are always embedded within scientific theories.

Inspired by Kant, Helmholtz and Lange's theory of meaning defines the formal conditions of judgments about nature, sidestepping both the speculative excesses of metaphysics and the skepticism of empiricism. They use Kant's critique method to promote rule-informed knowledge, "to which all objects of experience must therefore necessarily conform" (Kant 2018, BXVII), and to restrain the spatiotemporal form of intuition, against the speculative excursions of dogmatic metaphysicians (Helmholtz [1878] 1977, 117). They also use Kant's critique method to defend rule-driven *a priori* knowledge against empiricists, whose reliance on experience leads to skepticism. However, Helmholtz and Lange move away from Kantian foundationalism, justifying objective judgments through transcendental arguments, in favour of a naturalized framework that acknowledges methodological continuity between epistemology and the natural sciences. For example, Helmholtz explains that "the physiological investigations on sense perceptions ...

[led him] to the ultimate elementary processes of cognition" (Helmholtz [1878] 1977, 75) or that "as soon as it was permitted to assume that true perceptions may be acquired through our senses, the path of future investigation was prescribed by the inductive methods of the natural sciences" (Helmholtz 1995, 394). Similarly, Lange claims that we are "confined in the searching and testing of the universal propositions which do not arise from experience merely to the ordinary means of science" (Lange [1875] 1880a, 195) and that "[n]othing is more easily conceivable than that the *a priori* propositions are only to be discovered by the road of experience; indeed, that the border between really necessary knowledge and between mere assumptions from which we might with increasing experience emancipate ourselves is a vanishing one" (Lange [1875] 1880a, 192).

The application of conceptual resources drawn from natural sciences to describe the "elementary processes of cognition" offers a causal explanation for the relationship between theory and evidence. For Helmholtz and Lange, the stimulation of sense organs becomes an epistemic *tertium* that brings together "signs of *something*, be it something existing or happening" (Helmholtz [1878] 1977, 122), the observation of nomological phenomena in perception, and the resulting beliefs about it (expressed through scientific theory judgments). Thus, Helmholtz's "sense-perception" and Lange's "physical-psychical organization" support the idea of evidentiality as a basis for recognizing external objects and as a negative checkpoint for scientific theories. This is made possible by the subject's conscious and unconscious contribution to experience, characterized as know-how (*können*), which informs both the recognition of an aggregate of sensations as the image of an object (*kennen*) and the accumulation of knowledge (*wissen*) in natural sciences.

Regarding object recognition (*kennen*), the psychophysiological activity of the subject explains how perception (and beliefs about it) "gradually 'tunes in' to the structures of reality as it develops, by small leaps of analogy, cognitive strategies which are progressively more appropriate for dealing with increasingly complex environmental inputs and tasks" (Meyering 1989, 217). For Helmholtz, "the correspondence . . . between the external world and Perception in Sight rests, either in whole or in part upon the same foundation as all our knowledge of the actual world—on experience, and on constant verification of its accuracy by experiments

which we perform with every movement of our body" (Helmholtz [1868] 1995). Helmholtz's sense-perception theory states that signs are "signs of *something*, be it something existing or happening, and . . . can form for us an image of the *law* of this thing which is happening" (Helmholtz [1878] 1977, 122). Despite their underdetermination, the sensible signs can become an image of a law and represent adequately "at a certain place . . . a certain object of a certain character" (Helmholtz [1867] 1925, 4) when submitted to a "constant verification of its accuracy by experiments." This is made possible through previously studied unconscious predictive inferences and a dynamic interplay between the subject's attention, voluntary movements, and nature's resistance to it.[14] Similarly, Lange assumes in his definition of the 'physical-psychical organization' that "the idea that the physical organization, as a *phenomenon*, is at the same time the psychical one" ([1875] 1880a, 193n) or that "our external sense appears to be that part of the physical organization which stands in the most immediate causal relation with the psychical functions. . ." ([1875] 1880a, 195n). This relationship refers to a direct synthesis or an "act of transition from physical multiplicity to psychical unity" ([1875] 1880b, 214) and is expressed using dispositional vocabulary.[15] Lange concludes that "[t]he transcendental basis of our organization remains therefore just as unknown to us as the things which act upon it. We have always before us merely the product of both" ([1875] 1880b, 219). In both cases, the subject psychophysiological activity in recognizing an aggregate of sensations as the image of an object implies learning "to read the signs revealed in these interactions, and . . . test our understanding by engaging in experiments that vary the conditions under which the interactions take place" (Patton 2018, 108).

Regarding accumulated knowledge (*wissen*) in natural sciences, Helmholtz's 'sense-perception' and Lange's 'physical-psychical organization' serve as a theory-neutral and evidential base for the meaning

[14]For more information on the function of visual perspective cues and attention, see de Kock (2011), Hatfield (2018), and Tracz (2018).

[15]On Helmholtz's reference to dispositions as '*Einrichtungen*,' see Helmholtz ([1855] 1896, 93), Helmholtz ([1867] 1925, 499–500, 535, 541–42), and Helmholtz ([1878] 1977, 134). On Lange's similar reference, see Lange ([1875] 1880a, 211–12) or ([1875] 1880b, 222). Lange uses expressions such as '*Naturanlage*' ([1875] 1880b, 224n, 226) and '*Anlage*' ([1875] 1880b, 52–53). On Lange's Theory of Mind, see Pecere (2021). It should be observed that Helmholtz and Lange's handling of the non-metaphysical (or naturalistic) notion of dispositions is not dissimilar to Quine's conception of them.

of judgments. When comparing the unconscious predicting processes and their conceptualization, which allows for communicable shared scientific knowledge, Helmholtz argues that "[i]n neither of these respects can mere familiarity with phenomena (das Kennen) compete with the knowledge of them which can be communicated by speech (das Wissen); and yet it does not follow of necessity that the one kind of knowledge should be of a different nature from the other, or less clear in its operations" (Helmholtz 1995, 200). Lange similarly explains that:

It is as unreliable in point of the method to separate in this case inference and sight ... as two separate acts. We can only do this in abstraction. Unless we give an artificial interpretation to the actual phenomenon, in this case seeing is itself an inferring, and the inference perfects itself in the form of a visual idea, as in other cases it does so in the form of conceptions expressed in language. (Lange [1875] 1880b, 221)

The decision not to distinguish between the representation of things in perception and the scientific explanation of observed events stems from the role of unconscious prediction processes in both. Helmholtz and Lange's emphasis on the subject's verification activity or "goal-directed adaptive mechanisms" (Meyering 1989, 217), of which the subject is not always aware. These mechanisms ensure the *unity* and sharpness of sensory representations and enable successful interaction with the surroundings.

Furthermore, Helmholtz and Lange's naturalized epistemology states that their "sense-perception" and "physical-psychical organization" are always part of a scientific theory (or theory-laden). The meaning of Helmholtz's dispositions for acquiring perceptions of external objects, which disregard "all those parts of the sensations that are of no importance so far as external objects are concerned" (Helmholtz [1867] 1925, 6), arises from the analysis and scientific explanation of psychophysical studies, such as those in Helmholtz's *Handbuch der Physiologichen Optik*. The same applies to Lange's concept of immediate psychical unity, which supervenes on mechanical and physiological processes and should be explained in a way compatible with the explanations provided by natural science (Lange [1875] 1880b, 222).[16] This naturalized interpretation

[16]For an explanation of Lange's perspective on the mind-body problem, see Pecere (2021).

of meaning acknowledges the evidentiality of sensory receptors, retinal stimulations, memorized experiences, and unconscious inferences and treat them as theoretical constructs within a scientific framework. Helmholtz does not separate observed events from methodological hypotheses, viewing both as part of the same interpretation process. He states that "our ideas of things *cannot* be anything but symbols, natural signs for things which we learn how to use to regulate our movements and action" (Helmholtz [1867] 1925, 19). Similarly, he describes "the initial, still insufficiently tested attempts to establish natural law as hypotheses. The consequences of such hypotheses open to observation are pursued and compared under the widest possible manifold changed conditions, with the facts. The possibility of formulating a conjectured law in words has the great and decisive advantage that it is communicated to many and that many participate in testing it. . ." (Helmholtz [1867] 1925, 394). Lange also rejects a radical distinction between experienced phenomena and methodological hypotheses, which is neither required nor beneficial, as "[s]ensation and atomic movement are for us just as 'real' as phenomena, although the former is an immediate phenomenon, atomic movement only a mediate one through thought" (Lange [1875] 1880a, 327). Phenomena do not enjoy an epistemological privilege that distinguishes them from scientific hypotheses, as both are part of a similar interpretative process. Scientific theories deliberately project conceptual models onto experimental information that coherently explains the nomological regularities seen in nature (Patton 2009, 288). However, a scientific theory cannot guarantee it will conceptually and accurately mirror reality, since it represents a phenomenal interpretation of symbols. This is why Lange concludes that "the natural sciences can only find sure ground in relations, while certain bearers of these relations . . . may be hypothetically introduced and treated as actual realities" (396–7).

This theory-ladenness, often overlooked by scholars,[17] explains how the stimulation of sense organs (and its evidentiality) becomes a checkpoint for propositions of a scientific theory. Helmholtz explains that "[t]he enormous superiority of knowledge which has become ripe for expression in language, is sufficiently explained by the fact that, in the first place, speech makes it possible to collect together the experience of millions of individuals and thousands of generations, to preserve them safely, and by continual verification to make them gradually more and more certain and universal" (Helmholtz [1868] 1995, 200).[18] Similarly, in *History of Materialism*, Lange states that Darwin's theory of natural selection called for "the spirit of methodical research into a sphere which promises the richest reward" by providing "scientific hypothesis" with the "confirmation of experiment," or that the acceptance of the theory of the wave theory of light depended "on the evidence of the senses and the calculating understanding" (Lange [1875] 1880a, 342). In both cases, the demand for verification stems from the hypothetical nature of scientific theories and their goal of producing objective judgments. Helmholtz's "sense perception" and Lange's "physical-psychical organization" serve as theory-neutral checkpoints for scientific propositions. These checkpoints arise from the causal processes of object recognition through perception and experience conceptualization, both of which are shaped by practical know-how. This framework supports efficient interaction with the environment, shared representations of external objects, and evidence for evaluating scientific theories. Based on these

[17] This naturalized revision of the theory-evidence distinction highlights the limitations of P. M. S. Hacker's interpretation of Helmholtz's theory of perception. Hacker accuses Helmholtz of confusing the description of sensations (e.g., having any conception of an X) with the visual experience of sensation (e.g., perceiving an X) (Hacker 1995, 203). Hacker's emphasis on this dichotomy, which explains his understanding of sensations as the "raw-material" of the visual process or what is "given" in perception, obscures the reality that Helmholtz and Lange's concepts of sensation are always embedded in a scientific theory (and hence theory-laden). A similar argument can be made against the importance of awareness in sense perception. Hacker claims that Helmholtz allows for sensation to exist without our "being aware of it" (Hacker 1995, 204). Again, awareness of sensations is a rare experience that can be obtained through scientific studies (e.g., the deconstruction of depth perception using a stereoscope, Maxwell's colour wheel). Sensation often manifests as already interpreted perceptions, optimized for the recognition of external objects or dropping out of consciousness due to their irrelevance.

[18] For an in-depth discussion on the hypothesis of Helmholtz's mechanics, see Schiemann (2009).

considerations, I conclude that Helmholtz's and Lange's accounts of evidence align more closely with Quine's perspective than with Davidson's theory of causal explanation.

The meaning of observational sentences relies on the triggering of nerve endings, not their truth conditions in communication. This theory does not locate the *cause* of possible communication in external, shared events, objects, or situations that elicit assent or dissent and strictly limits the notion of meaning to the maximization of coherence of beliefs. Their causal explanation of the stimulation of sense organs implies an empiricist approach to scientific verification and provides it with *evidential significance* rather than merely causal. Sensory evidence becomes an *epistemic* intermediary between perception and judgments, responsible for a naturalized justification of beliefs. Despite a conceptual gap between Quine's emphasis on the holophrastic character of observation sentences and Helmholtz and Lange's emphasis on the subject's psychophysical goal-driven activity, sensory evidence provides a theory-neutral base for scientific theories. It helps acquire conceptual and perceptual representations of reality and serves as a negative checkpoint for scientific theories. However, sensory evidence is also theory-laden, as it is conceptualized within a scientific theory.

9. Conclusion

After evaluating the proximality and evidentiality of nerve stimulation of sense organs, I conclude that Helmholtz and Lange's theory of unconscious predictive inferences aligns more closely with Quine's naturalized epistemology than Davidson's theory of radical interpretation. Hopkins's argument, which combines Helmholtz's unconscious inferences with Davidson's causal theory of action and truth-conditional theory of meaning, is compelling. The truth-conditional theory explains the practical efficiency of the subject-environment interaction, while the causal theory of action accounts for the subject's activity in representing objects in the visual field. However, Hopkins overlooks the significant disagreement between Quine and Davidson about the externality of epistemology, making his attempt to reconcile these theories less successful. This disagreement highlights the similarities in argumentation,

based on epistemology and semantics, between Helmholtz, Lange, and Quine's naturalized epistemology.

On the semantical side, Helmholtz, Lange, and Quine seek proximal explanations for the public harmony of perceptual similarities. Even if Quine was at some point drawn to Davidson's theory of empathy with others' perceptions (Quine 1990a, 42), he, like Helmholtz and Lange, relies on neural network homology and natural selection to construct a naturalized theory of meaning that does not rely on "... your pattern of stimulations and mine ... [being] guaranteed to prompt assent to distally inter-translatable sentences only if those patterns are caused by the same distal events" (Davidson 1990, 77). Despite differences, regarding for example the innate/acquire debate, these writers share a proximal theory explaining the public harmony of perceptual similarities and account for the acquisition of meaning, a crucial aspect presupposed by Davidson.

On the epistemological side, Helmholtz, Lange, and Quine's externalism involves holistic empirical verification of scientific statements, contrasting with Davidson's causal explanation for action. Concepts like 'sense-perception,' 'physical-psychical organization,' or 'triggering of nerve endings' explain causal or lawlike relationships between individual events and serve as a theory-neutral and evidentiary basis for a theory of meaning. Despite Quine's focus on the holophrastic nature of observational sentences and Helmholtz/Lange's reliance on the subject's 'know-how' activity, nerve stimulation of sense organs remains causally accountable for sentence meaning and provides a negative checkpoint for the "... conceptual scheme of science ... a tool, ultimately, for predicting future experience in the light of experience" (Quine 1951, 41). This nerve stimulation of sense organs is also theory-laden because the concepts used to represent and conceptualize it are derived from the method and conceptual resources of a psychophysiological theory. These concepts become posits whose comprehension is gradually enhanced through 'small leaps of analogy.'

This coextension of semantical relation and evidential relations, enabled by a naturalized epistemology, highlights the argumentative closeness between Helmholtz, Lange, and Quine's epistemologies. Their shared emphasis on the biological and psychophysiological underpinnings of perception and meaning, along with the role of empirical

evidence in shaping scientific theories, causally explains an externally informed understanding of epistemology.

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