# Part 2

# Science

## Introduction

*Martin Kusch*

In this day and age, (cognitive) relativism is often regarded as anti-scientific. For instance, the main "whipping boy" of the 1990s "Science Wars" was the relativistic sociologist who (allegedly) sought to downgrade natural science by treating it as on a par with myth or magic.

Interestingly enough, this association between relativism and disrespect for science was not prominent in debates over relativism during the "long nineteenth century" in the German-speaking world—roughly, from Georg Wilhelm Friedrich Hegel (1770–1831) to Adolf Hitler (1889–1945). On the contrary, in this time period and geographical region, relativism was often seen as an *obvious consequence* of natural-scientific attitudes and theorizing. Philosophers were divided on how to assess this consequence. Some saw relativism as an essential element of the modern scientific worldview; others attacked relativism by portraying it as the result of what we today might call "scientism" or "scientific imperialism."

To understand this intellectual constellation, we need to remember four important features of the natural sciences in the long nineteenth century. First, the time period in question witnessed numerous scientific advances that were perceived as "revolutionary" by many contemporaries. Moreover, Charles Darwin (1809–1882), Ernst Haeckel (1834–1919), Hermann von Helmholtz (1821–1894), Bernhard Riemann (1826–1866), Wilhelm Wundt (1832–1920), Ernst Mach (1838–1916), or Albert Einstein (1879–1955)—to mention just a few—were scientists whose names were familiar to readers of highbrow newspapers and popular weeklies. This was due, in no small measure, to these scientists' own efforts in popularizing their findings.

Second, in the German-speaking world natural scientists, philosophers, historians, linguists, and economists still belonged to the same faculties. This made for close interactions across disciplinary boundaries: thus, one finds historians trying to learn from biology or psychology (e.g., Karl Lamprecht (1856–1915), Friedrich von Hellwald (1842–1892)); philosophers engaging closely with sense-physiology (e.g., Alois Riehl (1844–1924]); logicians and epistemologists seeking to integrate their investigations with the psychology or biology of reasoning (e.g., Benno Erdmann (1851–1921), Mach);

physiologists presenting their results in a Kantian garb (e.g., von Helmholtz); or physicists highly sensitive to epistemological debates (e.g., Einstein).

Third, during the long nineteenth century, the classification and institutional division of the sciences and humanities underwent substantial and often conflictual re-organization. The first chairs for physiology were introduced in the 1850s, and psychology began its long and painful separation from philosophy in the 1890s. Sometimes such re-organizations created "split identities," that is, authors who could claim to have substantive expertise in more than one field. Thus, Wundt was both a psychologist and a logician; von Helmholtz a physiologist, physicist and philosopher; or Mach a physicist, epistemologist, and psychologist. New institutional boundaries frequently led to fierce competition over academic chairs; for instance, universities and ministries of education tended to create chairs in experimental psychology by cutting positions in traditional fields of philosophy. The traditional philosophers ultimately responded with a petition.

Fourth, for much of the long nineteenth century, philosophy struggled to recapture the cultural capital it had lost when the systems of Friedrich Wilhelm Josef Schelling (1775–1854) and Hegel fell into disrepute. The struggle was difficult not least because some scientists (e.g., Haeckel) published widely circulating books in which they declared much of traditional idealistic philosophy obsolete.

The last four paragraphs can help us appreciate why in the long nineteenth century, relativism and natural science were seen as closely intertwined. To begin with, many important natural-scientific results were presented by their proponents as undermining traditional philosophical beliefs in absolutes: mathematicians showed that Euclidean geometry was not without alternatives; physicists rejected Newtonian conceptions of absolute space and time; biologists replaced eternal and immutable species with contingently evolving species; statisticians supplanted human essence with the fiction of *l'homme moyen*; sense-physiologists argued that perceptions are structured in good part by needs of the organism; and cognitive, developmental and social psychologists endlessly displayed different forms of "apperception," that is, the influence of background information on belief formation.

The scientific challenging of absolutes was sometimes influenced by earlier or contemporaneous work in philosophy or politics. John Stewart Mill (1806–1873) and Herbert Spencer (1820–1903) were particularly important here. But the scientific rejection of absolutes in turn also had a substantive impact on philosophy and stimulated forms of philosophical cognitive relativism. Clear cases in point were some of the logicians and epistemologists whom Gottlob Frege (1848–1925) and Edmund Husserl (1859–1938) would later attack as "psychologistic." One particularly striking self-proclaimed relativist was the philosopher Georg Simmel, who assembled his "relativistic worldview" out of scientific insights from Darwin to von Helmholtz, Riemann to Einstein. Simmel was a student of Berlin philosophers, early social psychologists (e.g., Moritz Lazarus), and von Helmholtz.

Of course, many influential philosophers—from Wilhelm Windelband (1848–1915) to Heinrich Rickert (1863–1936), from Paul Natorp (1854–1924) to Ernst Cassirer (1874–1945), Frege to Husserl, Wilhelm Dilthey (1833–1911) to Vladimir Lenin (1870–1924)—soon disagreed with these relativistic uses of natural-scientific results and attitudes. These philosophers sought to refute "biologism," "naturalism," "materialism," or "psychologism"—all taken as so many species of relativism or even skepticism. At the same time, the critics were careful not to appear anti-scientific; they were objecting to what they regarded as a mistaken over-extending of natural science into the domains of the humanities in general and philosophy in particular. The attacks were often combined with the lament that too many philosophical chairs had already been taken over by scientists posing as philosophers. Frege's and Husserl's arguments against psychologism are today the best-known contributions to this genre. For both men, logical laws were ideal and outside of space and time. Thus, these laws could not be studied with the methods of empirical science. Indeed, all scientific work always already presupposed logical laws.

The argument did not end there. In response to Husserl and other critics of relativistic naturalism, a number of authors proposed non-relativistic ways of overcoming a strict separation of the empirical and ideal domains. Such proposals flourished first and foremost in and around psychology and especially in the Weimar period.

The four papers published in this section selectively highlight four key junctures of the development sketched above in broad outline.

Lydia Patton focuses on how the pioneers of psychophysics, Ernst Weber (1795–1878) and Gustav Fechner (1801–1887), as well as their most important interpreter, von Helmholtz, developed the idea that perception is physiologically, psychologically, and perspectivally relative to the human observer. Patton also shows that this idea had important consequences for how these authors thought of scientific knowledge.

Richard Staley studies the relationship between "physical relativity" and philosophical relativism in Mach and Einstein. He argues that both men's uses of the term "relativism" was influenced not only by debates in physics but also by their reflections on science and politics and views of absolute and relative across disciplines from history to physics.

Dermot Moran discusses Husserl's life-long engagement with relativism from the *Logical Investigations* to the late *Crisis* writings. Relativistic naturalism and historicism were the central targets throughout Husserl's *oeuvre*. Moran's paper is also significant for other sections of this book: e.g., Husserl's attack on Dilthey and historicism is important for the "history" section, and his attack on Lucien Lévy-Bruhl (1857–1939) for the "society" section.

Finally, Paul Ziche discusses various attempts in the period around 1900 of steering a middle path between absolutist idealism and psychological empiricism. The central theme was that philosophy and the natural sciences could live in harmony as long as the latter (and their philosophical interpreters) gave up on naturalistic reductionism.

# 4 Perspectivalism in the development of scientific observer-relativity[1]

*Lydia Patton*

## Enlightenment perception

The history of early modern empiricism and idealism in philosophy is entwined with normative accounts of rationality and perception.[2] When René Descartes, John Locke, and David Hume are faced with the objection to their theories of perception that not all human beings experience things in the same way, they appeal to the "healthy" adult human, free of "disease," "sane" of mind, and without any perceptual differences such as colorblindness. "Normal" human beings are able to engage in acts of perceiving and reasoning that follow, or become, normative standards. Those whose perceptions do not meet these normative standards are considered to have an overactive imagination, which is associated with mental illness in the writings of Locke, Descartes, and Malebranche.[3]

The "Enlightenment ideal of rationality" may be a myth of the scholars. But it has a basis in the texts, and, as Hatfield (1990) has emphasized, it has a counterpart in normative standards for human perception. To reason competently about the world, it is not sufficient to be able to make correct inferences: one must also be able to *perceive* the phenomena "correctly." In many authors of the seventeenth and eighteenth centuries, the standard of correct perception is relative to the perceptual capacities of human beings.

There is an important limitation to this claim, in both the Cartesian and Lockean traditions. A competent perceiver of Lockean ideas is able to perceive not only the primary qualities of things that are features of the mind-independent world but also those qualities that are secondary: qualities of our perceptions that arise in an interaction between the perceiver's sensory capacities and her environment and that depend constitutively on both. But arguably, for Locke, the perception of primary qualities does not *depend* on the perception of secondary qualities, and so we do not need to give an account of observer-relative qualities when giving an account of how knowledge is obtained through perceptual experience.[4]

The Cartesian knower shuts her eyes to all unclear and indistinct physical perceptions in order to see the true ideas by the natural light of reason—and these ideas are not relative to the perceiver.[5] In this sense, Descartes and

Locke agree: True ideas do not depend on properties of the perceiver or of her sensory capacities.

They disagree about whether sensation can reveal real qualities of things. Descartes denies that veridical perception of sensible qualities, whether primary or secondary, reveals the true qualities of the world as it is. As Ott (2017) reads the text, in *The World, or Treatise on Light*, Descartes argues against the Scholastic view that "the sensible qualities that we experience either just are or resemble the sensible qualities that exist in the world" (1664, §2.3.1). Instead, as Descartes remarks:

> Words, as you well know, bear no resemblance to the things they signify, and yet they make us think of these things, frequently without our even paying attention to the sound of the words or to their syllables … Now if words, which signify nothing except by human convention, suffice to make us think of things to which they bear no resemblance, then why could nature not also have established some sign which would make us have the sensation of light, even if the sign contained nothing in itself which is similar to this sensation? Is it not thus that nature has established laughter and tears, to make us read joy and sadness on the faces of men? (1664, 79)

Cartesian sensible qualities do not directly reflect the qualities of mind-independent objects. Instead, they stimulate us to think of *other* things, as when we think about the taste of pie when we see an advertisement for pie. A flat, odorless picture of a pie does not have any resemblance to the taste of lemon meringue, but it is "natural" to make a mental association between one and the other. Similarly, in Descartes' and Locke's accounts, the particles streaming from the pie and impinging on the subject's senses do not resemble the pie. But they stimulate the mind to form an idea of the pie. In Malebranche's elaboration of the Cartesian philosophy, there is divine guidance of the mental process of inference from sensation to idea.

## Psychophysics: Qu'est-ce que c'est?

To a physiologist of perception, that is, to someone interested in the experimental and physical basis of the act of perception, Descartes' and Locke's accounts leave parallel questions unanswered. Descartes argues that there is a "natural" relationship between sign and thing signified, but he does not explain—in *The World*, at any rate—how that relationship can be investigated experimentally. Locke argues that the sensible, primary qualities of objects are real qualities of those objects, but he does not provide a physiological *explanation* of this claim. Physiologists of perception seek an experimentally verifiable, or at least an empirically well-founded, explanation for any relationship between sensed and objective qualities. From the perspective of the physiology of perception, both Locke and Descartes appeal to a natural

or pre-established harmony between sensation and idea. The difference is in the ground they postulate for the inference from one to the other: Cartesian "natural geometry" or Malebranchian divine natural judgments, or Lockean habitual inference from experience.

From this perspective, the Critical philosophy introduces a twist on the explanation of visual experience, by emphasizing the role of sensibility, perception, and representation in epistemology. In the *Critique of Pure Reason* (1781/1787), Immanuel Kant asks how knowledge can be relative to human sensibility, how our acquisition of knowledge may depend constitutively on purely subjective features of our experience, and yet how knowledge can be universal, necessary, and objective. What Descartes saw as a "natural" harmony between subjective signs and ideas is a problem for Kant: the problem of how to interpret subjective sensations as evidence for inferences that support objective knowledge.[6] These two ideas are not inconsistent. In fact, one could see Kant as responding to the Cartesian problem.[7] How are we to find a logic of perception: a formal account of how nature and reason lead us from sensation to knowledge? Hatfield (1997) proposes that we understand the "the development of philosophy from Descartes to Kant … as a series of claims about the power of the intellect to know the essences of things, with resulting consequences for ontology and for the role of sensory cognition in natural philosophy." On Hatfield's reading,

> Kant entered his critical period when he realized that human cognizers do not have available the 'real use' of the intellect or understanding to know an intelligible world of substances; at the center of his critical (theoretical) philosophy was his new theory of the human understanding as a faculty limited to synthesizing the materials of sensory representation but unable to penetrate to things in themselves.
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> (1997, 22)

One can note as well that, in the move from Descartes to Kant, the *idea* is no longer a standard derived from our knowledge of essences. The standard for knowledge in Kant comes via proofs of the validity and objective reality of a set of rules of synthesis of representations, which ground knowledge from experience. Locating the ground of objective knowledge in a *relation* between the subject and the object, rather than in the subject's knowledge of ideal essences, has a well-known and profound effect on natural philosophy.

The epistemic relation between sensation, perception, inference, and knowledge came to the forefront in physiological neo-Kantianism, and in the closely entwined tradition of empirical psychology, from the beginning to the end of the nineteenth century.[8] Kant's focus on the conditions for objective judgments put an emphasis on how to determine the relationship between subjective and objective in perception and in knowledge.[9]

Much of the research in German psychology done at the time, including that of Johann Friedrich Herbart and Wilhelm Wundt, focused increasingly

on what could be investigated empirically. In which circumstances, if any, can we consider a subjective perception to be evidence of the properties of things-in-themselves? If it is not possible to have knowledge of things-in-themselves, as Kant and many neo-Kantians argue, we may decide instead to delineate the contributions of the subjective and the objective, and to show how each operates in phenomenal experience.

An explanation of phenomenal experience along these lines will allow us to identify those aspects of experience that are objective, stable, and manipulable, which is sufficient for a scientific account. But it is not necessarily the case that identifying what is "objective" requires disentangling the objective part of experience from the part that is relative to the observer. To the post-Kantians, knowledge can be "objective," "scientific," and "relative to the observer" simultaneously.

The tradition of "psychophysics" established by Ernst Weber and Gustav Fechner set the stage for mid-nineteenth century work in this area.[10] Psychophysics establishes quantitative relationships between qualitative sensations and their stimuli, and investigates the dynamics of these sensations, including how they arise and recede, and how they are heightened or dulled in response to stimulus. Researchers in psychophysics must rely on results from physiology of perception to establish standards of measurement for sensation, and on results from physics to establish differential equations describing the variation of sensation with respect to stimuli.

The contributions of the tradition of psychophysics go beyond the quantitative analysis described above, however. Influenced by the questions described above, which developed in the tradition of natural philosophy including the work of Descartes, Locke, Leibniz, and Kant, the founders of German physiology of perception and psychophysics explicitly set up their research to answer *epistemological* questions.[11]

In *The Sense of Touch and the Common Sense*, Ernst Weber was concerned to establish which elements of sensation were objective and which subjective. Gustav Fechner (1859) and Weber established the well-known Weber-Fechner law, which is a quantitative stimulus-response relation. But the epistemological investigations of psychophysicists went well beyond the mathematical establishment of a stimulus-response curve. Fechner's *On a Fundamental Law of Psychophysics and its Relationship to the Estimation of Stellar Size* analyzes the difference between the apparent and the real diameter of stars.[12] According to optical theories, that is, theories of light itself and of our perception of it, we should see the stars as they are. Light emanating from the stars has a certain wavelength. The light strikes our retinas, and the optic nerve transmits the resulting impulses to the brain. As far as this physical system is concerned, there should be no difference between the "phenomenal" and the real diameter of stars. But that is not the case: there are real, measurable differences between the apparent and the real diameter of stars. Nonetheless, these differences are not random. They are stable among the

population of human perceivers. Weber begins *The Sense of Touch* with a variant of Fechner's astronomical example:

> We must distinguish, in all sensations, between pure sensation and our interpretation of [sensations]: the sensations of darkness, light, and of colors are pure sensations; that something dark, light, and colored either is in us, or is in space before us, and has a form, is resting, or is moving, is an interpretation of [sensations]. *This interpretation is so closely associated with sensation that it is inseparable from it and we take it for a part of sensation, whereas, in fact, it is a representation that we make for ourselves from sensation*. Not only veridical, but also false interpretations of sensations are mixed in with [sensations], in some cases so closely that one cannot separate [false interpretations] from [sensations], even when one is aware of the error and of the cause of the error. To everyone, even astronomers, the rising and setting sun and the rising and setting moon seem to have a larger diameter than when either of them are high in the sky… the visual angle under which we see these celestial bodies in the two cases is, as measurement proves, exactly the same, but it [the illusion] rests on *a false interpretation that anyone in these circumstances would be forced to make*, so possibly no one yet has been able to be free of it.
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> (Weber 1905, 4–5, emphasis added)

Mathematical perspective and judgments of distance influence perception, as much earlier theorists including Al-Haytham and Plato recognized. Weber and Fechner take an inferentialist perspective on this phenomenon, arguing that sensations are interpreted to yield perception, and that this perceptual interpretation may be in conflict with independent measurements.

## Helmholtz's epistemology

The physiologist of perception and physicist Hermann von Helmholtz was among the first, if not the first, to recognize the novelty and potential of Weber and Fechner's approaches. Helmholtz spent much of his early career investigating perceptual phenomena including stereoscopic vision and the horopter effect. Stereoscopic vision is the phenomenon that humans with two eyes see a single visual image, which is made up of two independent retinal images combined into one. Of course, the retinal images are also upside down, and the brain interprets them as right side up. For Helmholtz, the vast majority of our perceptual experience is an *effect*, caused by the interaction between external objects and our sensory and nervous system.

But this conclusion raises a striking question for epistemology: what is the epistemic status of propositions *about* perceptual experience? Fechner and Weber had argued that many inferences made from sensation are inescapable, even to those who know that they are illusions. In that case, Helmholtz asked,

are there regularities in our inferences—even in the incorrect ones—that can be the source of knowledge *about perceptual experience itself*?

There might be three sources of such knowledge, at least:

(1) A description of the *physiological* facts about perceptions, explaining how sensations arise and interact.
(2) A *psychological* account of how concepts and inferences may contribute to perceptual experience.
(3) A *perspectival* theory of how the subject's situation in space, time, and history influences her experience. For instance, being born on a planet with no gravity might influence the inferences from sensation that a subject would make.

Helmholtz provides detailed accounts of the first two of these sources. In the case of the perspectival theory, he does defend the view but does not give a detailed account of how it will work.

The elements (1), (2), and (3) above are combined in Helmholtz's epistemological account of knowledge via perception. For Helmholtz, the spatial and temporal order of sensations is the ground of a "remarkable effect," namely, that objects appear to have sensible qualities—even though we do not perceive those qualities directly. In his lecture "The Facts in Perception," Helmholtz writes:

> Thus, that this intuited spatial order of things originally arises from the sequence in which the qualities of the sensations of the moved sense organ are presented ultimately remains a remarkable effect, even in the accomplished representations of the experienced observer. That is to say, the objects present in space appear to us clothed with the qualities of our sensations. They appear to us red or green, cold or warm, smell or taste etc., while in fact these sensory qualities belong only to our nervous system and certainly do not reach out to external space. Even if we know this, the appearance[13] does not cease, for this appearance in fact is the original truth; it is the sensations themselves, which primarily present themselves to us in spatial order.
>
> (1878, 21)

All qualities are qualities of bodies that are constituted by the properties of our sensory nerves and nervous system.[14] The qualities of perceived objects are the qualities of our sensations, and yet they "clothe" the objects present to us in observation. Helmholtz refers to the fact that we experience perceptual qualities, and not just mechanical sensations, as a *Folge* (effect or consequence).

But this "appearance" is the "original truth." Our perceptual experience is caused by physical and physiological regularities, which includes the stable

features of our interaction with our environment.[15] If I perceive an object as red, that quality does not "reach out to external space." We do not have definitive reason to believe that redness is a mind-independent property of the object that caused the sensation. But that does not mean that my perception of redness is an error. It is possible to know what Helmholtz calls *Thatsachen* (facts) about our experience of redness, without ascribing those facts to an object that is independent of the sensing body or mind (Helmholtz 1879). That is the sense of Helmholtz's title *Die Thatsachen in der Wahrnehmung:* the facts *in* perception. Facts can include the claim that "Vermilion is red:" for Helmholtz, this claim can be factual as perceived, but not an "objective" truth in Kant's sense of valid for all perceivers. This will be discussed in more detail below.

Helmholtz defends a second thesis influenced by psychophysics: features of our perceptual experience are constituted by unconscious inferences, which in turn are based on prior experience. Perceptual experience thus is *situated*: perceptual experience can be captured fully only by giving a historical account of previous perceptions, inferences from those perceptions, and their *logical* and *occurrent* impingement on present perceptions and representations. Recall the passage from Weber that analyzes the illusion of the setting sun and moon: "not only correct, but also false interpretations of sensations are mixed, in some cases so closely that one cannot separate [the false interpretations] from [the sensations] at all." Even experienced observers—and even astronomers!—*experience* the setting sun as larger than the sun at high noon, even though they *know* it is not. This is a result of an inference, but an inference that takes place very swiftly and without our noticing it.

To use another example that Helmholtz gives, I perceive objects that are farther away as smaller than identical objects that are closer to me. This is a mere appearance. If I measure the objects, I will discover they are identical. But it is also an appearance that is forced on me, not just by the nature of my sensory processing system, but by unconscious inferences I am constrained to draw by the nature of my previous experience. The passage from the *Handbook of Physiological Optics* in which Helmholtz describes these inferences is significant to anyone who has been reading Weber and Fechner:

> The mental operations through which we come to the judgment that a particular object in a particular state in a particular place outside us is present, are in general not conscious operations, but unconscious. In their results, they are similar to an *inference*, insofar as we achieve from the observed effect (*Wirkung*) on our senses the representation of a cause of this effect, whereas, in fact, we can only perceive directly the nerve stimulations, that is, the effects, never the external objects. However, they appear to be distinguished from an inference—this word taken in its usual sense—because [an inference] is an act of conscious thought. Such actual conscious inferences are, for instance, when an astronomer calculates the position in outer space, its distance from the Earth, and so on from the

> perspectival images that are given to him of the stars at different times and in different positions of the Earth's orbit. The astronomer supports his inferences with a conscious knowledge of the theorems of optics. Such a knowledge of optics is missing in the usual acts of sight. However, it is permissible to describe the mental acts of usual perception as *unconscious inferences* ….
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> (1867, 430)

A human being moving among the objects she experiences is an earthly astronomer. She eyeballs the measurements of objects in her visual field, and makes comparisons between them, in order not to step into a busy street or to fall off a cliff. This requires complex calculations about spatial relationships, relationships that, according to Helmholtz, are inferred. Those inferences are inferences on the basis of sensations, which are just the stimulations of nerves in a certain sequence, to the size, configuration, and position of external objects.[16] Weber's astronomer still sees the setting sun as bigger than the sun at noon, like the rest of us. Helmholtz's earthly astronomer, the human observer, cannot stop making unconscious inferences in perceptual experience. Even if you *know* that two ships are exactly the same size, you will still *perceive* one that is much farther away as smaller. The inference that grounds this element of our perceptual experience is not a free act, it is an effect of a cause.

In his essay "The Facts in Perception," Helmholtz raises the question: "What is truth in our representations?" This question relates truth or epistemic justification, not to bare sensation but to our representation of external objects on the basis of that sensation. Helmholtz argues that it is possible to explain how we construct representations of objects and processes on the basis of sensations that are experienced in a time order. In the *Handbook of Physiological Optics* and in *On the Sensations of Tone*, Helmholtz develops theories of sound and color. There, Helmholtz gave significant attention to the problem of distinguishing subjective from objective,[17] and to the problem of giving a "physiological" and "psychological" account of the phenomena encountered in conscious experience.

Helmholtz argues that complex qualitative and quantitative features of phenomenal experience, including separation in space, shades of color, and gradations of sound, are not sensed but inferred from sensation. We must make inferences from our sensations, and from the sequence in which they present themselves to us, to have access to a set of qualitative and quantitative features of perceptual experience (Helmholtz 1868, 175–176). We do not perceive the external objects that cause our sensations directly. Rather, we infer from the assumption of a causal interaction between the subject and the object, and from the sensations via our nerve endings, that external objects are present:

> The mental operations through which we come to the judgment that a particular object in a particular state in a particular place outside us is present, are in general not conscious operations, but unconscious. In their

> results, they are similar to an *inference*, insofar as we achieve from the observed effect on our senses the representation of a cause of this effect, whereas, in fact, we can only perceive directly the nerve stimulations, that is, the effects, never the external objects.
>
> (Helmholtz 1867, 430)

Helmholtz's account blocks the appeal to direct "confirmation" or "verification" of beliefs about objects via observation. Perception of external objects is always mediated by inference.[18] Thus, as Hatfield notes, Helmholtz rejects the direct scholastic and Lockean inference from perceived qualities to real qualities of objects. Helmholtz argues that we must *discover* the relationship between sign and object by investigating the stable relationships between sequences of perceptions and changes in the stimuli that produce them, whether these changes are artificially manipulated for experiment's sake, or natural.

Those relationships must be discovered and analyzed within experience itself. Helmholtz does not allow for a standpoint outside experience that serves as a standard. The subject's experience is experience *of* objects, and also reflects the subject's physiology, psychology, and perspective. It is not the case that we must restrict ourselves to introspection when studying experience: all the scientific tools of investigation can be brought to bear, including experiments on how subjects perceive and stimuli to which they respond. By analyzing experience in this way, we can come to have increasingly better knowledge of what is subjective, and what is objective, relative to a particular subject's perceptual experience. "Subjective" and "objective," in this case, are not absolute categories as they are in Kant's sense: there is no "pure" subjectivity in Helmholtz. Rather, Helmholtz's "subjective" and "objective" are explanatory categories, used to construct explanations of processes and elements in perceptual experience that can be ascribed to the subject or to the object. When constructing these explanations, one *a priori* assumption is necessary: that objects outside us exist and that they cause our sensations of them.[19]

## A scientific analysis of perceptual experience as observer-relative

There are three senses in which perceptual experience, as described by German empirical physiology and psychophysics, is relative to an observer. One is *physiological:* human perceptual experience depends on human sensory capacities. Another is *psychological:* since habitual judgment impinges on experience, human perceptual experience depends on, and must be analyzed relative to, human psychological and inferential capacities. Yet another is *perspectival*: Again, since habitual judgment impinges on experience, the historical, environmental, and physical conditions for the formation of a subject's *habitual inferences* have a constitutive influence on perceptual experience.

The traditions of psychophysics and of the physiology of perception were entangled over the nineteenth century with long-standing problems from

Cartesian and Lockean natural philosophy, and from the physiological and epistemological strands of neo-Kantianism. The history of psychophysics illuminates possible approaches to these questions. According to the methods used by this tradition, observation is a natural interaction with, and adaptation to, the environment, which should be analyzed as a process. Knowledge gained from experience is always relative to the human observer.

For Helmholtz, that knowledge gained through experience is relative to the observer is precisely *why* the observer-knowledge relation can be analyzed scientifically. The natural process by which humans obtain knowledge is itself subject to a rigorous, experimental analysis, the scientific basis for which grew stronger over the nineteenth century.[20]

The availability of facts about the physiology, psychology, and perspectival basis of perceptual experience is the ground for claims of knowledge from perception that is not independent of the context in which it arises. Such claims are the basis of what is now known as "contextualist knowledge," according to which "A sentence is true for X if and only if it is true as uttered by X, true relative to a context in which X is the speaker" (Williamson 2005, 92). Propositions about sensory and perceptual experience are contextually true for Helmholtz. For instance, the proposition "The mountains look far away" is true for someone who is far away from the mountains, and false for someone close to them. But Helmholtz's position goes deeper than this. He even argues that the statement "Vermilion looks red" is not true in an absolute sense, but only relative to our sensory faculties—even to the faculties of a *particular* observer:

> To ask whether vermilion is actually red, as we see it, or whether this is a sensory illusion, is … senseless. The sensation of red is the normal reaction of normally formed eyes to the light reflected by vermilion. A colorblind person would see vermilion as black or dark grey-yellow; this too is the correct reaction for a different eye … In itself the one sensation is not more correct or more false than the other.
>
> (Helmholtz 1867, 445)

This is a classically contextualist position. "This vermilion looks red" is true for observer A, who is not colorblind, but not for observer B, who *is* colorblind.

The contextualist reading of Helmholtz, strongly supported by the passage above and by many of Helmholtz's remarks, raises the question: If Helmholtz is a contextualist, what does this mean for Helmholtz's epistemological account of knowledge from perception? We might try to situate Helmholtz's view within contemporary positions on color realism, for instance. Here, I would advise caution. Among the positions taken in the contemporary context are realism (Byrne and Hilbert 2017), relationalism (Cohen 2009), and relativism. Relationalism is the view that, for certain properties like being poisonous or having a certain color, "There is no such thing as [having

that property] simpliciter. Rather, there is a family of relational properties," defined in relation to a subject: something can be poisonous to humans but not to snakes, and something can appear green to me but not to you (Byrne and Hilbert 2017, 173). Relationalism, as Byrne and Hilbert observe, "multiplies perceptible properties" (2017, 175). There are a number of perceptible properties in the world: green-to-Lydia is a distinct property from green-to-Hermann, for instance.

We might, then, try to locate Helmholtz within the spectrum of "relationalist" theories of color, as against realist theories, according to which there is a property, "redness," that exists independently of human observers. Tracz (2018) is a cogent defense of such a reading. While the relationalist reading of Helmholtz is certainly defensible, it is not the end of the story: restricting ourselves to an argument according to which Helmholtz *only* is defending contemporary relationalism would risk losing some of the force and complexity of Helmholtz's view.

Tracz (2018) makes a convincing case that Helmholtz defends a view close to Cohen's relationalism about perceptual properties. The relationalist view is intended to answer questions about "the metaphysical status of the properties that we perceive" (Tracz 2018, 66). Relationalism is the view that there are families of relational properties, as Byrne and Hilbert put it, in terms of which we can explain the metaphysical status of perceptual properties.

Contemporary relationalism seeks to define a set of *stable* relational properties. While it is true that one can become blind, or one's sense of smell and thus taste can change, it is also the case that, for Helmholtz, *habit* and *inference*—and even deliberate interference—can change the relational properties involved, and thus change my perceptual experience. For Helmholtz, humans are detectors of a certain kind: human ears can perform Fourier analysis, and human eyes detect radiation at specific wavelengths.[21] But for Helmholtz, Fechner, and Weber, perceptual experience of complex phenomena like music and colored objects is not reducible to the ground-level sensory response to physical stimuli. Inference is inextricably involved in human perceptual experience. Helmholtz took from psychophysics the idea that my previous experience impinges on my perceptual experience, and Helmholtz argues that the impingement happens through a series of inferences that can be manipulated experimentally.

Certain judgments and perceptions are stable features of our perceptual experience. We perceive objects that are farther away as smaller than identical objects closer to us. We perceive the setting sun as larger than the sun at noon, but it is the same sun. We reliably can produce stable perceptual illusions by manipulating sensory and motor responses to stimuli (Helmholtz 1867, 429, 436–437).

More recent research supports the idea from Helmholtz, Weber, and Fechner that some sources of the processing that results in perceptual experience arise from changing experience, not just from stable—or even relatively stable—properties of a perceiving subject. The psychologist Diana Deutsch

details the activity of tonal processing (1999), including illusions that arise in the recognition of music (1969) and auditory illusions in general (1974, 1975). Auditory illusions arise that can be associated with right- and left-handedness: right-handed persons perceive certain pitch combinations differently from left-handed persons. Deutsch's research supports the view from Helmholtz, Weber, and Fechner that experience, in conjunction with physiological and psychological factors, can influence perceptual processing.

As I have argued throughout this essay, Helmholtz allows for not only physiological facts and psychological inferences but also perspectival reasoning, to influence perceptual experience and knowledge gained from perception. But Helmholtz also defends a version of the view according to which there can be a kind of "perspectival truth" revealed in scientific research and investigation. Helmholtz argues that the relationships between subjective and objective, real and actual, actual and illusory, must be analyzed scientifically, within experience. There is no standpoint outside experience from which we can reason, no extra-sensory knowledge of the constitution of the "ideal subject" or of the properties of "real objects." Instead, we reason using the "sign system" of our sense impressions, which allow us to form representations of objects. Those representations are always physiologically, psychologically, and perspectivally relative to the observer. However, precisely for that reason, they can be used as scientific evidence, provided that relativity to the observer *itself* can be analyzed scientifically. In the tradition of psychophysics inherited by Helmholtz, we can arrive at a kind of perspectival analysis of perceptual experience, which embeds an account of that experience within the context of the history and situation of the perceiving subject.[22] That analysis is *relative to* the perceiving subject, but the perspectival explanations Helmholtz constructs are not thereby *relativist*: in fact, for Helmholtz, the more squarely the perceiving subject is placed in a scientific, perspectival context, the more facts we are able to learn about her experience and the objects with which she interacts.

## Notes

1 I would like to thank Martin Kusch, Katherina Kinzel, Johannes Steizinger, and Niels Wildschut for the opportunity to contribute to this volume, and for substantive comments on an earlier draft, which have influenced the project of the chapter much for the better. Walter Ott has provided valuable contributions to the chapter's account of Locke, although, of course, he is not responsible for the details of the interpretation that I have given here.

2 Hatfield (1990) is a classic reference in this context.

3 These remarks are familiar to those who study this period. They occur in Descartes' *Meditations* 4 and 6, in Malebranche's *The Search after Truth* (for instance, 2.3.1.4, 3.1, and 3.2), and in Locke's *Essay Concerning Human Understanding* (for instance, 2.11.13). See Hume (1739), especially the editorial material from the Nortons on p. 751 and p. 771.

4 As Walter Ott conveyed in personal communication, Locke's "simple" account of the perception of primary qualities can be found in the *Essay* (Locke 1689), especially II.v and II.ii.1. The first eight chapters of Book II of that work present Locke's theory of visual experience. As Ott notes, chapter nine complicates the picture by adding judgment: "Because Sight, the most comprehensive of all our Senses, conveying to our minds the *Ideas* of Light and Colours, which are peculiar only to that Sense; and also the far different *Ideas* of Space, Figure, and Motion, the several varieties whereof change the appearances of its proper Object, *viz.* Light and Colours, we bring ourselves by use, to judge of the one by the other. This in many cases, by a settled habit, in things whereof we have frequent experience, is performed so constantly, and so quick, that we take that for the Perception of our Sensation, which is an Idea formed by our Judgment; so that one, viz. that of Sensation, serves only to excite the other, and is scarce taken notice of it self; as a Man who reads or hears with attention and understanding, takes little notice of the Characters or Sounds, but of the *Ideas,* that are excited in him by them" (Locke 1689, II.ix.9, 146–147). It may seem *prima facie* as if this passage supports a reading of Locke that is closer to Descartes: that our perceptions are a language we must read, not direct evidence of the properties of bodies. However, on Ott's reading, Locke introduces judgment into his account of visual experience to correct for mistakes in the original experience that cloud our understanding of that experience. And the passage above bears this out: the rhetorical force of the passage is to argue that when we begin to habitually associate ideas of light and color with ideas of space, figure, and motion, ideas from one place (judgment) are being *wrongly* used to judge ideas from another (sensation). Unlike Descartes, Locke believes that an analysis *of sensation* can clear up any confusion between judgment and sensation and can reveal the evidence of primary qualities that is given in perceptual experience. On a different subject, several ideas resembling those in this passage are discussed by Helmholtz in §26 of his *Handbook*.

5 In *Madness and Civilization*, Foucault writes memorably: "the Cartesian formula of doubt is certainly the great exorcism of madness. Descartes closes his eyes and plugs up his ears the better to see the true brightness of essential daylight; thus he is secured against the dazzlement of the madman who, opening his eyes, sees only night, and not seeing at all, believes he sees when he imagines. In the uniform lucidity of his closed senses, Descartes has broken with all possible fascination, and if he sees, he is certain of seeing that which he sees" (1961, 102).

6 The reading of Kant here owes much to Hermann Cohen and the Marburg School. For an early version of my reading of the Marburg School, see Patton (2004).

7 To be sure, Descartes was far from the first to pose this problem. Plato's *Timaeus* contains a beautiful statement of a similar question. In classical Indian philosophy, we find a fascinating debate between Buddhist and Hindu thinkers of the Vasubandhu and Nyāya traditions, on the question of how perception can become veridical cognition, and on the status of perception and sensation themselves (see Chadha, 2016).

8 For more on the tradition of "physiological neo-Kantianism," see Patton (2004) and Beiser (2014), including references there to others' work. As Hatfield details (2018, §4.1), the question of the relation between the subjective and the objective in perception arose even for empirical physiologists of perception, like Johann Georg Steinbuch and Caspar Theobald Tourtual.

9 See Edgar (2013, 2015).

10 Fechner's psychophysics owes a debt to the earlier work of Johann Friedrich Herbart. Michael Heidelberger has written the definitive work on Fechner with *Die innere Seite der Natur* (*The inner side of nature*). In 1863, Ernst Mach delivered lectures on psychophysics, which are published in German; an appreciation of the lectures in English is in Titchener (1922).
11 While recent interpreters of Helmholtz's work disagree on the influence of Fichte on Helmholtz, they appear to agree on *this* point: that Helmholtz was concerned to use the methods of empirical physiology to answer epistemological questions, and even to dissolve metaphysical questions that turn out to be empirical questions in disguise. Compare, for instance, de Kock (2015) and Heidelberger (2015) to Hatfield (2018).
12 Original title: *Über ein psychophysisches Grundgesetz und dessen Beziehung zur Schätzung der Sterngrössen* (1859).
13 The word *Schein* has been translated as "illusion" in the past, but I now believe this translation to be misleading.
14 Helmholtz discusses the example of the setting moon in §30.
15 This includes features of our voluntary motions with respect to objects, as de Kock emphasizes (2014, 2015).
16 "Now, the described unconscious inferences from sensation to their causes are congruent in their results to the so-called *inferences from analogy*. Because in a millionfold majority of cases, stimulation of places on the retina on the outer corner of the eye originates from external light that falls on the eye from the area of the bridge of the nose, we judge that it will be so as well in each newly encountered case in which the stated places on the retina are stimulated, just as we assert that each single human now living will die, since experience has revealed that all humans living in the past are dead. Further, these unconscious inferences from analogy arise with compulsory necessity, since they are not acts of free conscious thought, and their effect cannot be reversed through better insight into the connection of things" (Helmholtz 1867, 430).
17 Emphasized by Ernst Weber in *The Sense of Touch* (1834) and in *The Sense of Touch and the Common Sense* (1846).
18 "We use the sensations that light stimulates in our apparatus of sensory nerves, to form for ourselves representations from them [the sensations] concerning the existence, the form, and the location of external objects. We call such representations *visual perceptions*. … Since perceptions of external objects thus belong to the representations, and representations always are acts of our mental operation, perceptions can come about only in virtue of mental operation, and thus the doctrine of perceptions in fact already belongs to the domain of psychology" (Helmholtz, 1867, 427).
19 See Patton (2009) for a discussion of Helmholtz's reasoning on this score.
20 For accounts of the development of research in nineteenth-century physiology of perception in the labs, see Finkelstein (2013), Otis (2007), and Sulloway (1992).
21 Lenoir (2006) illuminates Helmholtz's experimental practices in testing these views, building material objects like Helmholtz resonators to stand in for human sensory apparatus.
22 The most recent and compelling argument for "perspectival truth" is presented by Michela Massimi (2018). Massimi argues for perspectival realism as a version of scientific realism. It is possible that the work of Grete Hermann provides an early version of this (see Banks 2017). See also Brogaard (2010) for an argument in the case of color.

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