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Hermann von Helmholtz's Empirico–Transcendentalism Reconsidered: Construction and Constitution in Helmholtz's Psychology of the Object

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Argument

This paper aims at contributing to the ongoing efforts to get a firmer grasp of the systematic significance of the entanglement of idealism and empiricism in Helmholtz's work. Contrary to existing analyses, however, the focal point of the present exposition is Helmholtz's attempt to articulate a psychological account of objectification. Helmholtz's motive, as well as his solution to the problem of the object are outlined, and interpreted against the background of his scientific practice on the one hand, and that of empiricist and (transcendental) idealist analyses of experience on the other. The specifically psychological angle taken, not only prompts us to consider figures who have hitherto been treated as having only minor import for Helmholtz interpretation (most importantly J.S. Mill and J.G. Fichte), it furthermore sheds new light on some central tenets of the latter's psychological stance that have hitherto remained underappreciated. For one thing, this analysis reveals an explicit voluntarist tendency in Helmholtz's psychological theory. In conclusion, it is argued that the systematic significance of Helmholtz's empirico–transcendentalism with respect to questions of the mind is best understood as an attempt to found his empirical theory of perception in a second order, normative account of epistemic subjectivity.

1. Introduction

The broad range of Hermann von Helmholtz's (1821–1894) scientific interests, as well as his numerous contributions to the development of nineteenth-century science, have never ceased to amaze scholars in the exact sciences, as well as philosophers. Helmholtz's pivotal role in the instrumental and laboratory revolution in the nineteenth century has become common knowledge: not only is he widely recognized as “a leading figure in shaping philosophy of science during the second half of the nineteenth century” (Heidelberger 1993, 461), he is furthermore credited as one of “the most innovative experimentalists of his day” (Finger and Wade 2002a, 137), and even as “one of the last great figures of the Aufklärung” (Cahan 1993, 559).

The revolutionary character of Helmholtz's scientific attitude can be highlighted by turning to a lecture the scientist gave in 1877, at the age of 56, in which he looked back at the conditions under which he once studied medicine at the Friedrich-Wilhelm Institute in Berlin from 1838 to 1842:¹

The medical education of that time was based mainly on the study of books; there were still lectures, which were restricted to mere dictation; . . . there were no physiological and physical laboratories. . . . Any of my fellow-students who wished to make experiments had to do so at the cost of his pocket-money. . . . We had, it is true, an almost uncultivated field before us, in which almost every stroke of the spade might produce remunerative results. (Helmholtz [1877] 1995, 319)

With respect to the development and popularization of the experimental method in science, Helmholtz is to be credited with more than one “stroke of a spade.” In the decade after obtaining his doctoral degree in medicine at the Friedrich-Wilhelm Institute in Berlin in 1842, Helmholtz performed groundbreaking experiments on fermentation and putrefaction, heat production, muscular contraction, and nerve conduction, and published his seminal paper *On the Conservation of Force* [Über die Erhaltung der Kraft] ([1847] 1889).² Through these investigations, Helmholtz gathered a body of experimental evidence that supported a physico-chemical approach to living processes, and thus contributed to making the metaphysical concept of life force [Lebenskraft] superfluous (Koenigsberger 1902/03; Meulders 2010; Finger and Wade 2002a). Thanks to these experiments, Helmholtz not only became a renowned member of the Berlin Physical Society [Berliner Physikalische Gesellschaft] (BPS), he was likewise appointed a professorship in Berlin (1848–1849), and later in Königsberg (1849–1855), where he embarked upon an area of research that he would continue

¹ English translations of Helmholtz's popular lectures are from Cahan (1995), except when otherwise indicated.

² In the course of this research, Helmholtz's experimental abilities thrived. For one thing, he developed remarkably refined instruments like the myograph – to measure the velocity of nerve impulses – and other devices that allowed him to objectively measure the chemical and electrical transformations taking place in the muscle during contraction (Koenigsberger 1902/03; Olesko and Holmes 1993; Finger and Wade 2002a; Meulders 2010). Through his myographic experiments on frogs, he not only established that nerve impulse is in fact measurable, but more importantly, that the velocity of nerve transmission is remarkably slow (some 26 meters per second). Helmholtz's 1843 research on putrefaction, furthermore, demonstrated that this process was caused by purely chemical processes (i.e., the breakdown of proteins and glutes), and not by the disappearance of the life force from the organism, as Stahl and Müller presumed (Helmholtz [1877] 1995). In the same vein, Helmholtz demonstrated that metabolic changes and heat production in the muscle during contraction could likewise be ascribed to physico-chemical processes, and that hence, there was no need for invoking the concept of life force to account for both (Koenigsberger 1902/03; Meulders 2010). The programmatic significance of Helmholtz's work is not easily overestimated. Basically, it inserted the human body into the mechanical worldview, and as such, put it within the purview of Newtonian physics, and out of the sphere of mere speculative metaphysics. As interesting and groundbreaking as these researches are, they are outside the scope of this paper, which focuses on Helmholtz's perceptual theory, and not on his physiological experiments on muscle contraction and nerve conduction. As such, we are especially interested in Helmholtz's work on this topic, and not so much in this early research.

until his death in 1894, i.e. the study of the psychophysiological nature of human perception (Koenigsberger 1902/03; Helmholtz [1891] 1995).³

Within the scope of this paper, we are especially interested in Helmholtz's attempt to address the question of *what it is to see* at least from the early 1850s onwards, an endeavor that culminated in his three-volume *Treatise on Physiological Optics* [Handbuch der Physiologischen Optik] (Helmholtz [1856/66] 1924/25).⁴ In the *Preface* of his magnum opus, Helmholtz explains that the *Handbuch* aims in the first place at bringing order and coherence to the wide, disparate field of the study of perception, and in accordance with this goal, the work is primarily encyclopedic in character (ibid. 1, viii). However, the *Treatise* especially earned Helmholtz credit as the architect of the scientific study of human perception, because it introduced a number of new instruments and methods that allow for the objective measurement of physiological states, presented minute observations of physical structures, and furthermore comprised a proto-psychological analysis of the process of objectification. Hence, the work stood out particularly for its attempt at giving a comprehensive, all-encompassing account of perception, with its successive volumes subsequently going into "the *physical* characters of the eye, . . . the *physiological* processes of excitation and conduction . . . and lastly . . . the *psychological* question, how mental apprehensions are produced by the changes which take place in the optic nerve" (Helmholtz [1868] 1995, 128).

Interestingly enough, finishing up the third, psychological, part of his opus magnum seemed to be a real ordeal, at least if we go by Helmholtz's private correspondence with his close friend Emil du Bois-Reymond during the 1860s. From these it is clear that the scientist was really puzzled over the philosophical questions he was confronted with in attempting to articulate his psychological theory, as he was faced with issues that could not be answered on a strictly factual basis, and required him to "persuade people" with "the most superior arguments" (Helmholtz, as quoted in Turner 1994, 74). In the third part of his *Treatise*, Helmholtz could no longer rely solely on facts derived from his experimental practice, and instead had to resort to philosophical arguments to defend and formulate the psychological dimension of his theory of perception (Helmholtz [1856/66] 1924/25, 1: 1).

³ The BPS was famously founded in 1845 by Ernst Brücke, Emil du Bois-Reymond, and Carl Ludwig, and consisted of scientists who allegedly pledged to demonstrate that there are "no other forces than the common physical-chemical ones . . . within the organism" (Emil du Bois-Reymond, in a letter from 1841 to Ludwig, as quoted by Bernfeld 1944, 348). As Helmholtz's 1847 paper basically demonstrated that both animate and inanimate matter can be accounted for in terms of mechanical force transformations, he was welcomed and honored by the society as one of the most prominent ambassadors of the new scientific spirit in physiology, which had long been dominated by vitalism.

⁴ The first volume of the *Treatise* appeared in 1856 (*The Dioptrics of the Eye* [die Dioptrik des Auges]), the second (*The Sensations of Vision* [die Lehre von den Gesichtsempfindungen]) in 1860, and the third in 1866 (*The Perceptions of Vision* [die Lehre von den Gesichtswahrnehmungen]). In what follows, quotations and references are based on the 1924/25 Southall translation.

One of the distinctive features of Helmholtz's philosophical justification for the third volume, that has been keenly discussed ever since the nineteenth century, is his so called "dovetailing" between empiricism and (transcendental) idealism, as Hamner (2003) calls it, or his attempt to reconcile both (Westheimer 2008).⁵ While Helmholtz is frequently identified as one of the earliest representatives of the neo-Kantian movement in Germany, he was as much a defender of methodological empiricism, claiming amongst others that "no other method is possible than that of endeavoring to arrive at the laws of facts by observations; and we can only learn them by induction" (Helmholtz [1877] 1995, 322).⁶ This peculiar state of affairs has inevitably led to very different readings of his work. While some emphasize its empirical dimension, others interpret it mainly against the background of German idealism, while still others have a more mixed reading and rather subscribe to the "dovetailing" or "attempt to compromise" hypothesis.⁷

This paper aims at contributing to the ongoing efforts to get a firmer grasp of the systematic significance of Helmholtz's so-called "dovetailing." However, contrary to existing analyses that commonly focus on Helmholtz's epistemological stance or his philosophy of science, the present exposition takes Helmholtz's proto-psychological work as a point of departure, and more particularly, his psychological problematization of the perceptual object.⁸ To be precise, this paper aims at an in-depth analysis of the nature of Helmholtz's combined adherence to both idealism and empiricism in the context of his treatment of a problem that lies at the heart of his psychology of perception, i.e. the psychogenesis of the object in perception, or the question as to how the idea of "a thing" is generated from a mere "state of excitation" or "functional activity" in the nervous fibers (see, especially Helmholtz [1856/66] 1924/25); [1855] 1896; [1868, 1878, 1892] 1995). In addressing this question, both the negative and positive dimensions of Helmholtz's psychological theory will be considered, i.e. an analysis is presented of (i) the scientist's motive for establishing the problem of objectification as a *psychological* problem, and (ii) his subsequent attempt to address the issue in his theory of perception. The specifically psychological angle taken in this investigation not only prompts us to consider figures who have hitherto been treated as having only minor import for Helmholtz's interpretation (most importantly

⁵ This peculiar characteristic of Helmholtz's theorizing has been discussed extensively in Hatfield (1990), amongst others. Other analyses worth mentioning in this respect include Turner (1977), Lenoir (1993, 2006), Cahan (1993), and DiSalle (2006).

⁶ For Helmholtz's role in the early movement of physiological neo-Kantianism, see for example, Schmitz (1995), Ferrari (1997), Friedman (2001 and 2006), Makkreel and Luft (2010).

⁷ In this respect, a comparison between Schiemann's (2009) mainly empiricist interpretation of Helmholtz's philosophy of science, with Heidelberger's (1993 and 1994) stress on the idealist nature of the latter is especially instructive. In 1850, Boring (1950, 304), even went as far as claiming that Helmholtz was univocally opposed the "German philosophy of Kant and Fichte." A more mixed reading is presented in Hatfield (1990), and Friedman (2009).

⁸ All of the authors mentioned in footnotes 6 and 7, have put forward analyses of Helmholtz's philosophical stance from the perspective of epistemology or philosophy of science.

J.S. Mill and J.G. Fichte), it furthermore sheds new light on some central tenets of Helmholtz's psychological stance, that have hitherto remained underappreciated. For one thing, this analysis reveals an explicit voluntarist tendency in Helmholtz's psychological theory, and as such, it not only restores the continuity with other early psychological theories – most notably Wilhelm Wundt's voluntarist psychology – but likewise offers an alternative perspective on Helmholtz's notorious revision of Kant's transcendental theory of space.

The remainder of this paper is structured as follows. Section 2 presents an analysis of Helmholtz's so-called “dovetailing” in the construction of the problem of perception, against the background of (i) the scientist's own physical and physiological investigations, as well as his adoption and further expansion of Johannes Müller's *Law of Specific Nerve Energies* (section 2.1), and (ii) his defense of methodological empiricism in psychology (section 2.2). In Section 3, Helmholtz's psychological account of the object is outlined, and especially the way in which it combines the empiricist idea of associative construction with the transcendental concept of a priori constitution. To illustrate this multi-layered nature of Helmholtz's psychological approach, the programmatic similarity of Helmholtz's project with John Stuart Mill's 1865 *Psychological Theory of the Belief in an External World* is analyzed (section 3.1.) as well as the Kantian and Fichtean strands of his psychological project (section 3.2). In conclusion, it is argued that the distinctive feature of Helmholtz's work in comparison with strict methodological empiricism lies not so much in the latter's adoption of particular elements of (transcendental) idealism, but rather in the “thick” conception of epistemic subjectivity that is implied in his psychological theory, i.e. in his attempt to found his empirical theory of perception as an associative construction in a second-order constitutive account of *what the mind or subject must be like* in order to associate its way into the external world.

2. Helmholtz's Problematization of the Perceptual Object

To gain insight into Helmholtz's psychological approach to the problem of the perceptual object, two things should be considered, namely (i) the physiological roots of his epistemology, and (ii) his defense of methodological empiricism with regard to the analysis of mental phenomena. Both played a crucial role in Helmholtz's denial of the self-evident, immediate nature of the idea of externality in perception, and as such, motivated his psychological approach to the genesis of the object as presented in the third part of his *Treatise*. In section 2.1., the background to Helmholtz's assumption of a radical “non-isomorphism between the physical and the sensory” realm (McDonald 2003, 182) is outlined. In this context, Helmholtz's physical and physiological research, as well as his further expansion and Kantian interpretation of Johannes Müller's *Law of Specific Nerve Energies* [Gesetz der spezifischen Sinnesenergien] (Müller 1826) should be considered, as they formed the basis of Helmholtz's epistemological views with regard to the subject-object relation in perception. However, Helmholtz's insight

into the discontinuity between subjective states of excitations and the representation of an object, was not in itself enough to motivate his psychological approach (see section 2.2). It is only in combination with his empiricist methodology that the scientist arrives at a non-reductionist view of objectification “an act of apprehension” (Helmholtz [1868] 1995, 127). As is generally known, Helmholtz mainly articulated his empiricism in opposition to nativist or physiologically reductionist theories, which claim that “complete ideas of objects are produced by . . . organic mechanisms” (Helmholtz [1878] 1995, 357). Rather than focusing on the empiricism-nativism debate, however, the programmatic aspects of Helmholtz’s defence of psychological empiricism will be discussed, and especially the way in which they resonate with John Stuart Mill’s philosophical arguments for a psychological (as opposed to a metaphysical or intuitionist) approach to the mind.

2.1. Helmholtz’s Physiological Epistemology

First and foremost, the motive behind Helmholtz’s psychological problematization of the perceptual object derives from his physical and physiological research on the sensory apparatus. After his experimental studies on muscle action and nerve conduction in the 1840s and early 1850s, Helmholtz turned to the investigation of the physical structure and physiological functioning of the sensory apparatus. In accordance with this evolution in his research interest, Helmholtz’s scientific practice was no longer solely dominated by “wet lab” science, but shifted towards the observational study of the nature and functioning of the sensory apparatus and the perceptual process (Finger and Wade 2002b, 234). Through this research, Helmholtz gained thorough insight into what we might call the *natural defectiveness* of both the anatomical and physiological structure and functioning of the perceptual system. In his *Treatise*, Helmholtz not only compiled a vast amount of existing research in this respect – whether or not confirmed through his own experimental practice – his invention of numerous measurement instruments furthermore allowed him to open up new areas of research, and expand the possibilities of empirical research in this area dramatically.⁹

For one thing, Helmholtz famously invented the ophthalmoscope – rather coincidentally, as he would later recall in his *Autobiographical Sketch* (Helmholtz [1891] 1995, 387) – when he was preparing his lectures as a university professor in physiology in Königsberg. The young scientist first presented his invention to the audience of the Berlin Physical Society in 1850, before describing it in detail in a paper published a year later (Koenigsberger 1902/03; Helmholtz [1856/66] 1924/25, 1; [1892] 1995). Thanks to this instrument, Helmholtz could study the inside of a living eye, and carefully examine the blind spot, for example, as well as the numerous blood vessels that caused gaps or distortions in the visual field. In the same vein, Helmholtz’s

⁹ For some interesting overviews of Helmholtz’s experimental practice and invention of measurement instruments, see also Olesko and Holmes 1993; Finger and Wade 2001 and 2002b; and Darrigol 2003.

invention of the ophthalmometer in the same year, enabled him to measure the precise curvature of the cornea, and demonstrate, amongst other things, that the latter “is not a perfectly symmetrical curve, but . . . bent in various directions,” causing refractive error and a degree of astigmatism, even in healthy individuals (Helmholtz [1868] 1995, 140).¹⁰ Furthermore, Helmholtz described dark spots within the eye, irregularities in the structure and surface of the lens, and finally concluded that “the eye has every possible defect that can be found in an optical instrument,” and cannot in itself account for *what it is to see* (ibid., 147).

More importantly however, Helmholtz became convinced of the psychological character of the perceptual process through his appropriation and expansion of Johannes Müller's – Helmholtz's teacher of physiology in Berlin, and supervisor of his doctoral dissertation – epoch-making *Law of Specific Nerve Energies* (LoSNE). Although Müller had sketched the general outlines of LoSNE as early as 1826 (at the age of 25), in his *On the Comparative Physiology of Vision in Men and Animals* [Zur vergleichenden Physiologie des Gesichtssinns], the mature statement of it is to be found in the 1833/1840 *Elements of Physiology* [Handbuch der Physiologie des Menschen]:¹¹

That which through the medium of our senses is actually perceived by the sensorium, is indeed merely a property or change of condition of our nerves; . . . peculiar sensations of the nerves perceived by the sensorium are excited as frequently by internal as by external causes, . . . the feeling . . . is a condition of the nerves, and not a property of the things which excite it. (Müller [1833/40] 1843, 707)

As Crary (1992) aptly described it, Müller's law – which caused nothing less than an epistemological scandal, according to him – led to a complete blurring of the external-internal distinction in perception, or a dismantling of the “referential illusion.” That is to say, LoSNE basically stated the case for what we might call *sensory underdetermination*, i.e. the fundamentally underdetermined nature of sensation with respect to its cause, and as such, for a radical fissure of subject and object in perception. According to *sensory underdetermination*, all that is given in perception is a world of underdetermined nervous energies – *qualities* determined by the specific sense organ involved – that do not inherently refer to anything beyond themselves. Furthermore, it should be noted that this changed conception of the notion of “sensation” correlated with a modified

¹⁰ For a full description of Helmholtz's ophthalmometer (or keratometer), see Helmholtz ([1856/66] 1924/25, 1:7–15). For more recent discussions on Helmholtz's invention of both the ophthalmoscope and ophthalmometer, see Finger and Wade (2001), and Meulders (2010).

¹¹ It should be noted that LoSNE is commonly viewed as the culmination point of a philosophical and physiological tradition, which has been referred to by Crary (1992) as the tradition of *subjective vision*. If we restrict ourselves to physiology, an interesting prologue to Müller's work can be found in the works of the Czech physiologist Jan Evangelista Purkinje on the subjective phenomena of vision, to which Müller referred numerous times throughout his *Elements* (Purkinje [1819] 2001). Furthermore, LoSNE was anticipated quite explicitly in the work of Charles Bell (1811). For recent accounts of the epistemological significance of LoSNE, see amongst others, McCarty (2000), Finger and Wade (2002b), Rachlin (2005), Cassedy (2008).

understanding of the concept of “stimulus,” which has now become a mere generic term referring to “any agent, external or internal, capable of producing an effect on a nerve,” as Cassedy described it, so that “sensation can arise in the absence of truth” and “can be produced by events other than our encounters with external objects or states of affairs” (Cassedy 2008, 424).

Helmholtz’s research into sensory physiology led him to further expand Müller’s insights, in two different ways. Through his work on color vision in the early 1850s, he became convinced that his contemporary Thomas Young’s trichromatic theory of color provided a “further extension of Johannes Müller’s law” (Helmholtz [1868] 1995, 161). In this theory, Young famously hypothesized that the specificity of color sensations must be ascribed to the specific reactivity of retinal receptors to different wavelengths of light. He distinguished three such receptors, respectively sensitive to the wavelength associated with red, green, and violet (*ibid.*). Through his experimental work on color mixing, and his observation of subjects suffering from color blindness, Helmholtz provided further empirical evidence for Young’s theory (Koenigsberger 1902/03; Helmholtz [1856/66] 1924/25, 2). In contrast to the latter, however, Helmholtz did not speak of different “receptors,” but rather of different nerve fibers, and furthermore hypothesized that while each of these fibers has its own wavelength specificity, it would still react faintly when stimulated by the other two (Helmholtz [1856/66] 1924/25, 2:143; Finger and Wade 2002b). This theory of color – which assumed that color vision emerges from three different (although partially overlapping) nerve sensitivities in the retina – would later become known as the Young-Helmholtz theory, and besides giving a good explanation for color blindness and anticipating the modern cone theory of vision, it contained a further extension of Müller’s most fundamental insight, according to Helmholtz:

Just as the difference of sensation of light and warmth depends demonstrably upon whether the rays of the sun fall upon nerves of sight or nerves of feeling, so it is supposed in Young’s hypothesis that the difference of sensation of colours depends simply upon whether one or the other kind of nervous fibers are more strongly affected. (Helmholtz [1868] 1995, 161)

Secondly, Helmholtz developed an analogous hypothesis in the field of acoustics, by means of his experimental research into the origin of tonal specificity, published in his 1863 *On the Sensations of Tone*. In the latter work, the scientist outlined the results of his experimental research on the sensation of tones, which demonstrated convincingly that individual frequencies are associated with the specific receptivity of the nerve fibers in the cochlea (Helmholtz [1863] 1912, 148).¹² In this sense, these sensory elements –

¹² An extensive description of the various measurement instruments developed by Helmholtz in the context of his acoustic research can be found in Meulders (2010). For a recent monograph on Helmholtz’s work in acoustics, and its general relevance, see Steege (2012).

which Helmholtz identified most likely as the arches of Corti – would behave much like piano strings, with each particular element resonating in response to a specific tone (Helmholtz [1863] 1912; Meulders 2010, 170). From this research, Helmholtz concluded that:

The sensation of different pitch would . . . be a sensation in different nerve fibers. The sensation of a quality of tone would depend upon the power of a given compound tone to set in vibration . . . different groups of nerve fibres. . . . This is a step similar to that taken in a wider field by Johannes Müller. . . . The qualitative difference of pitch and quality of tone is reduced to a difference in the fibres of the nerves receiving the sensation. (Helmholtz [1863] 1912, 148)

In contrast to his teacher, who relied heavily on rudimentary self-experimentation and self-observation, Helmholtz took LoSNE into the lab, so to speak, and in doing so, succeeded in extending Müller's case for sensory specificity, by showing there is not only a *modal* difference in sensory qualities – i.e. a difference across sensory systems – as Müller argued, but likewise a qualitative one, that applies to the sensations produced *within* a single sensory system (Helmholtz [1868, 1878] 1995).

If anything, however, Helmholtz's further expansion of Müller's law further deepened the enigma LoSNE created for the theory of perception, namely the question as to how “from the event . . . of neutral stimulation, . . . one concludes to the existence of an objective reality external to our own subjectivity” (Schmitz 1995, 49). “How they [our minds] manage this construction,” Rachlin adds, “became the business of all of psychology for the next hundred years” (Rachlin 2005, 43). Consequently, the latter credits Müller for establishing the basic problem for perceptual psychology.

In addition to his radicalization of LoSNE through his own research, Helmholtz established the epistemological consequences of Müller's (now expanded) insights with regard to sensory specificity as the foundation of the sign-theory of sensation. What LoSNE proves, Helmholtz argued, is that there is no “pre-ordained harmony of the inner and the external world” (Helmholtz [1868] 1995, 220). Helmholtz's theory of perception therefore accepts the thesis that “the nature of sensation depends primarily on the peculiar characteristics of the nervous mechanism; the characteristics of the perceived object being only a secondary consideration” (Helmholtz [1856/66] 1924/25, 2:4). Hence, he conceptualized sensation as a *sign* or *symbol* for (as opposed to an image of) external objects, i.e., as no more than a “changed condition of the nervous fibers which we call the state of excitation or functional activity,” devoid of any intrinsic similarity with “the agent inducing it” (Helmholtz [1868] 1995, 149).¹³ In the end, Helmholtz concluded, “representation and that which is represented [Vorstellung

¹³ For Helmholtz's explanation of the difference between signs and images, see for example (Helmholtz [1878] 1995, 347): “Our sensations are . . . effects produced by external causes in our organs, and the manner in which one such effect expresses itself depends, of course, essentially on the type of apparatus which is affected. Insofar as the quality of our sensation gives us information about the peculiarity of the external influence stimulating

und Vorgestelltes], . . . belong to . . . entirely different worlds, which no more admit of being compared with each other . . . than the letters of a book and the sound of the words they denote” (Helmholtz [1856/66] 1924/25, 3:19).

Furthermore, Helmholtz was one of the first to give Müller’s Law its Kantian interpretation, and is therefore credited by some as one of the earliest figures of so-called physiological neo-Kantianism, i.e., the early neo-Kantian movement – with Helmholtz, Otto Liebmann, and Friedrich A. Lange as its main protagonists – that developed from the physiological interpretation to Kant’s a priori.¹⁴ As early as 1855, Helmholtz claimed that Müller’s insights signified:

one of the most significant advances in sense physiology in recent times. According to it, the quality of our sensations . . . does not depend upon the perceived external objects, but on the sensory nerves which mediate sensation. . . . Just the same what the physiology of the senses has proven in recent times, Kant sought to prove earlier . . . , by pointing out the share that our . . . mental organization [Organisation des Geistes] has in the formation of ideas [Vorstellungen]. (Helmholtz [1855] 1896, 98–99)

Later on in his career, Helmholtz maintained that Müller’s law is “an empirical statement of Kant’s theoretical exposition with regard to the nature of the human faculty of knowledge” and “presented and made evident the nature and meaning of . . . the subjective form of sensation” (Helmholtz 1896, 249). In other words: Helmholtz argued that just as Kant had claimed that every possible experience is necessarily conditioned by the a priori forms of intuition and the categories of thought, Müller had shown that the fundamental material of perception (sensation) is conditioned and determined by our physiological make-up. In this way, LoSNE was an occasion for Helmholtz to call attention to the fundamentally conditioned nature of human experience and knowledge, and to reinstate the critical boundary between the subject and the mind-independent thing.

While LoSNE might be said to state the basic problem for the psychology of perception, Müller’s nativism (or physiological reductionism), however, prevented him from developing a full blown psychological account of the perceptual process. For one thing, Müller argued that the general idea of an external object is acquired prenatally as an “obscure” representation:

The first obscure idea excited could be no other than that of a sentient passive “self” in contradistinction to something acting upon it. The uterus, which compels the child to

it, it can pass for a sign – but not for an image. For one requires from an image some sort of similarity with the object A sign, however, need not have any type of similarity with what it is a sign for.” Also see Helmholtz ([1856/66] 1924/25, 3:19): “Our ideas of things cannot be anything but symbols, . . . signs for things which we learn how to use in order to regulate our movements. . . . there is in reality no other comparison at all between ideas and things . . . any other mode of comparison is entirely unthinkable and has no sense whatever.”

¹⁴ See footnote 6 for an overview of relevant secondary literature in this respect.

assume a determined position, and gives rise to sensations in itself, is also the means of exciting in the sensorium of the child the consciousness of something thus distinct from itself and external to it. In this way is gained the idea of an external world as the cause of sensations. (Müller [1833/40] 1843, 717)

Consequently, “the certainty of the *cogito*, for Müller, is the certainty of the body sensing itself [sich selbst empfindenden Körpers]” as Heidelberger (1997, 41) described it. Furthermore, Helmholtz’s teacher hypothesized that the spatial features of external perception originate from the spatial distribution of the nerve endings in the sensory system itself (Müller 1826, 40; idem [1833/40] 1843, 716–717). Indeed, as Müller confirmed, his theory of perception amounts to the peculiar conclusion that the direct perceptual object is actually the retina itself.¹⁵ In the end, Müller thus escaped the problems created by his LoSNE with regard to the subject–object transition in perception, by resorting to innate mechanisms, by virtue of which a dynamical and geometrical opposition between the self and the not-self is given prior to experience (Schmitz 1995). Müller’s nativism therefore amounted to the following conclusion:

As the doctrine of specific nerve energies establishes the essential subjectivity of all sensations, one could believe, that the question now becomes where these mere subjective experiences derive their objective [gegenständlich-objectiver] nature from. Only, this question does not at all exist for Müller. According to him, sensations are originally [von Haus aus] endowed with a certain degree of objectivity, notwithstanding their complete subjectivity. (Post 1905, 54)

This contrasts sharply with Helmholtz’s methodological empiricism, which compelled him to establish an autonomous, non-reducible psychological level of analysis in the theory of perception.

2.2. Helmholtz’s Methodological Empiricism

In sharp contrast to his teacher (and to his contemporary Ewald Hering), Helmholtz vehemently opposed nativist theories of perception, and instead emphasized the autonomy of psychological investigation *vis à vis* physiology (on this topic see especially Turner 1994). Hence, his work can be understood against the background of the gradual emancipation of psychology in the nineteenth century, as it was finally established as an autonomous discipline with Wilhelm Wundt’s – yet another student of Johannes Müller, and Helmholtz’s assistant in Heidelberg from 1858 to 1864 – instauration of the *Psychologisches Institut* in Leipzig in 1879 (Rieber and Robinson 2001). A decisive

¹⁵ See Müller ([1833/40] 1843, 739): “The retina, of which the affections are perceived by the sensorium, is itself the field of vision . . . for the mind projects the images on the retina towards the exterior. . . . the image . . . which we see, is . . . only its representation in the retina.” Also see Lenoir (1993).

factor in this evolution was the emergence of what Hatfield called (non-materialistic) methodological empiricism or naturalism with regard to the mind, i.e., “the attempt to discover ‘natural’ laws of the mind, where ‘natural’ is cashed out through an *analogy* with the methods and modes of explanation in natural science, instead of by an appeal to ontology” (Hatfield 1990, 17). Wundt’s methodological framework was heavily influenced by John Stuart Mill’s *A System of Logic*, which offered a model for scientific practice and reasoning inspired by chemist Justus von Liebig’s scientific practice, amongst others (Schmidgen 2003; Richards 1980). More particularly, Wundt claimed the latter work inspired his formulation of the psychological method in terms of the “complete decomposition [Zergliederung] of conscious phenomena into their elements” (Wundt 1882, 399, as quoted in Schmidgen 2003, 471). Furthermore, both Helmholtz’s and the early Wundt’s theories of perception as unconscious inference have demonstrable roots in Mill’s theorizing (Richards 1980).¹⁶

Although John Stuart Mill has never written a treatise exclusively on the subject of psychology, he is frequently mentioned as one of the forerunners and inspirers of the development of empirical psychology in the second half of the nineteenth century in Germany (see, for example, Robinson 1995; Schmidgen 2003; Allik and Konstable 2005). In his *System*, Mill outlined a view on scientific methodology and reasoning – “not the science of Belief, but the science of Proof, or Evidence” – based solely upon experimentation and experience, within an inductive framework (Mill [1843] 1882, 21). Furthermore, he explicitly articulated his view in opposition to German, or a priori modes of thought, and common-sense intuitionism.¹⁷

From his *Treatise*, it is clear that Helmholtz had read Mill’s *Logic*, and based certain elements of his own theory on Mill’s account of induction (see section 3.1.). Moreover, one cannot fail to notice a programmatic similarity in the rhetorical strategies used by both authors in defense of an autonomous psychological project. In addition to his rejection of a priori philosophy and intuition, Mill argued against ‘biologized’ psychology – or what we might call materialistic naturalism with regard to the mind –

¹⁶ As Richards points out, Helmholtz and Wundt presented their theories of unconscious inference at around the same time in the 1850s, and there has been some debate over who is to be credited with “inventing” the theory (Richards 1980). Both Helmholtz and Wundt, however, acknowledge their indebtedness to Mill in this respect, who could therefore have mediated both Helmholtz’s and Wundt’s theories. It should be noted that Wundt later abandoned his early theory of unconscious inference, and that with this, the continuity of his thought with Helmholtz’s likewise seemed to have disappeared (see, for example, Araujo 2012).

¹⁷ See for example Mill ([1843] 1882, 579): “Principles of evidence and theories of method are not to be constructed a priori. The laws of our rational faculty, like those of every other natural agency, are only learned by seeing the agent at work.” In engaging with questions pertaining to the mind, Mill stated that he found himself to be entering into the “arena of initial conflict” between “two modes of philosophizing”: “the *a priori* philosophers cataloguing some things as facts, which the others contend are inferences. The fundamental difference relates, however, not to the facts themselves, but to their origin. . . . the one theory considers the more complex phenomena of the mind to be products of experience, the other believes them to be original” (Mill [1859] 1867, 102). As Scarre observed, J.S. Mill seemed to be engaged in “a Manichean struggle between two schools of thought” (Scarre 1989, 204). For a recent account of Mill’s opposition to intuitionism, and specifically to his contemporary Whewell, see Snyder (2006).

and rejected the hypothesis that mental phenomena are “generated through the intervention of material mechanisms” (Mill [1843] 1882, 590). Instead, the English philosopher maintained that “there is a distinct and separate Science of Mind” (ibid., 591).¹⁸ It is well known that for Helmholtz, the great dividing line in theories of perception ran between nativist and empiricist approaches, and indeed, the “dramatic juxtaposition of empiricism and nativism” was one of Helmholtz’s main rhetorical strategies (Turner 1993, 191). As such, both Helmholtz and Mill were later praised in Lange’s *History of Materialism* for asserting “the rights of psychology . . . against the strictly materialistic view” (Lange 1881, 189).

While common-sense intuitionism can give no other proof for the direct givenness of the object (or the idea of the external) in perception than the intuitive “impossibility of getting rid of it,” as Mill called it, the nativist (or reductionist) approach is considered by both as audacious and insufficiently warranted (Mill 1865, 187). The empirical method (as opposed to intuitionism and physiological reductionism), by contrast, establishes the science of psychology as a science in accordance with the canon of *inductive* philosophy as much as possible, i.e., as “the science of the elementary laws of mind” (Mill [1843] 1882, 602).¹⁹ Helmholtz definitely aligned with Mill to a certain extent in thus conceiving of the aim of psychological investigation. In contrast to nativism, he argued that his empirical theory “does not assume any peculiar modes of physiological action in the nervous system, nor any hypothetical anatomical structures” but instead considers the idea of the external in perception to be the result of an “act of our power of realization [Vorstellungsvermögen]” (Helmholtz [1868] 1995, 194, 127).

In itself, however, Helmholtz reluctantly admitted that “in the present state of knowledge it is impossible to refute the intuition theory” on a factual basis. Probably, it is exactly at this point that Helmholtz met the philosophical difficulties he mentioned to his friend du Bois-Reymond (see “Introduction,” Helmholtz [1856/66] 1924/25, 3:17). In what follows two such arguments used by Helmholtz will be explored, as well as the way in which they resonate with John Stuart Mill’s defense of the

¹⁸ For Mill’s criticism of materialistic naturalism in psychology, see for example Mill (1882 [1843], 590–591): “Whether . . . mental states are . . . dependent on physical conditions, is one of the vexatæ questions in the science of human nature. . . . Many eminent physiologists hold the affirmative. These contend . . . that some particular state of our nervous system, . . . in particular . . . the brain, invariably precedes, and is presupposed by, every state of our consciousness. According to this theory, one state of mind is never really produced by another: all are produced by states of the body. . . . that every mental state has a nervous state for its immediate antecedent and proximate cause, . . . can not . . . be said to be proved, . . . and even were it certain, yet everyone must admit that we are wholly ignorant of the characteristics of these nervous states . . . the successions therefore, which obtain among mental phenomena, do not admit of being deduced from the physiological laws of our nervous organization. . . . therefore . . . there is a distinct and separate Science of Mind.”

¹⁹ Mill ([1843] 1882, 590) defined the concept of a ‘Law of Mind’ as follows: “When a state of mind is produced by a state of mind, I call the law concerned in the case a law of Mind. When a state of mind is produced directly by a state of body, the law is a law of Body.” Mill’s laws of mind mainly coincide with the laws of association (see section 3.1).

psychological method, namely the latter's (i) lack of metaphysical commitment, and (ii) its parsimonious nature.

(a) *Nativism's (metaphysical) audacity.*

One of Helmholtz's main arguments against nativism was that to the extent that it accepts that "complete ideas of objects are produced by organic mechanisms," it "assumes a pre-established harmony between sensations and their objects" (Helmholtz [1878] 1995, 357; [1868] 1995, 202; also see Helmholtz [1856/66] 1924/25, 3:17–18, 252). Consequently, Helmholtz considered the nativist hypothesis to be a naturalized version of absolute idealism, since it is founded upon the presupposition of a fundamental representative similarity between subject and object, i.e., the thesis that the subjective consciousness of externality is somehow represented on the level of physiological organization prior to experience (Helmholtz [1856/66] 1924/25, 3:18; Lenoir 1993). Both the idealist claim of an essential identity of subject and object, and the famous Leibnizian thesis of an original correspondence between subject and object (like "two clocks or watches which perfectly agree"), amount to an unjustified a priori assimilation of internal and external states (Leibniz [1695] 2004, 77). Contrary to nativism, Helmholtz's empirical theory accepted that "congruence rests upon a fact which is obtained from experience only" (Helmholtz [1870] 1995, 229), and therefore avoids metaphysical commitment:

The reader will see how the subject of our present enquiry involves the consideration of that far-reaching opposition between the system of philosophy which assumes a pre-existing harmony of the laws of mental operations with those of the outer world, and the system which attempts to derive all correspondence between mind and matter from the results of experience. (Helmholtz [1868] 1995, 177)

In the same vein, Mill argued that those who take certain mental phenomena to be simple and immediate, do so "not as psychologists, but as ontologists." He wrote that with regard to questions pertaining to the mind, philosophers stand over and against each other if it comes to their ontological superstructure:

That the constitution of the mind is the key to the constitution of external nature – that the laws of the human intellect have a necessary correspondence with the objective laws of the universe . . . – is the grand doctrine which the one school affirms and the other denies But this question is beyond the compass of psychology. (Mill [1859] 1867, 101)

As will be outlined in section 3.1., this perspective prompted Mill to oppose intuitionist theories of the origin of the belief in an external world, as represented prototypically in Sir William Hamilton's 1859 *Doctrine of the Natural Duality of Consciousness*. For both Mill and Helmholtz, the question as to the origin of the perceptual object, and

specifically the question of whether or not it is viable for psychological analysis, thus had a metaphysical significance.

(b) *Nativism as a redundant hypothesis.*

Another objection Helmholtz repeatedly raised against nativism is that it violates the “general . . . rule of scientific examination, not to build new hypotheses as long as known facts seem adequate for the explanation” (Helmholtz [1856/66] 1924/25, 3:17). The empirical theory, he argued, is not only less “audacious and dubious” (Helmholtz [1878] 1995, 357) than nativism, but also more economical, as it appeals only to the “the known laws of thought” (Helmholtz [1868] 1995, 194). To be sure, Helmholtz acknowledged that these laws might be somewhat mysterious, and that there is scarcely any hope that their existence will ever be established on a factual basis, as they remain deeply hidden in the human mind (Helmholtz [1856/66] 1924/25, and [1868] 1995). Still, he maintained that “these [mental] operations actually exist, . . . these mysteries of the laws of thought cannot be regarded from a scientific point of view as constituting any deficiency in the empirical theory” (Helmholtz [1868] 1995, 194). A similar argument was presented by Mill in defense of the psychological theory of externality against the intuitionist alternative, when he stated for example that “the first of the laws laid down . . . for the interpretation of consciousness, [is] the law . . . of parsimony” (Mill 1865, 242–243).²⁰

It could be doubted however, whether this is a pressing argument at all, as methodological empiricism replaces one hypothesis (the self-evident nature of the idea of externality), by another (the genetic nature of the idea of externality). The nativist could indeed wonder why he would consider quality and intensity of sensation to be primitive, and not external reference, as Liebmann (1869) argued. In the end, the empiricist is bound to fall back upon his principled decision for a particular mode of psychological explanation, and his anti-metaphysical argument, that prescribes that nothing can be accepted as a primitive fact, if it can be accounted for in genetic terms in principle. In itself, the genetic approach invokes as much auxiliary hypotheses as its alternative.

3. Helmholtz's Psychology of the Object

From what has been said thus far, it is clear that Helmholtz's motive for establishing the problem of the object as a psychological problem, derived partially from his

²⁰ More specifically, Mill (1865, 242–243) argued that the law “forbids [us] to suppose an original principle of our nature in order to account for phaenomena which admit of possible explanation from known causes. If the supposed ingredient of consciousness be one which might grow up . . . and if, when it had so grown up, it would, by known laws of our nature, appear as completely intuitive . . . [then] we are bound . . . to assign to it that origin.”

expansion and neo-Kantian interpretation of LosNE on the one hand, and his methodological empiricism on the other. In turning to Helmholtz's psychology itself, however, the peculiar entanglement of philosophical perspectives becomes even more apparent. In what follows, the focus will shift to Helmholtz's psychological account of objectification, i.e., his investigation of "the conditions underlying the genesis of perceptions," with the latter being defined as "conceptions [Vorstellungen] as to the existence, form and position of external objects" (Helmholtz [1856/66] 1924/25, 3:1).

On the one hand, this investigation involves a further exploration of the way in which Helmholtz's theorizing is historically embedded in *methodological empiricism*, or *non-materialistic naturalism* with regard to the mind. While it has been suggested that Helmholtz's theory of perception as unconscious inference is remarkably similar to Mill's *Psychological Theory of the Belief in an External World*, this hypothesis has remained largely unexplored (Mill 1865, 234–250; Boring 1950; Hochberg 2007). As this could provide valuable insight into Helmholtz's position as a proto-psychologist, however, section 3.1 will present a comparative analysis of Helmholtz's psychology of perception and Mill's empirical psychology of objectification. For one thing, this should put us in a better position to understand why Hochberg for example, talks explicitly of the "Helmholtz–Mill theory of object perception" (quoted in Peterson, Gillam, and Sedgwick 2007, 331).

In contrast to Mill, however, Helmholtz denied that the genesis of the perceptual object can be accounted for exhaustively by means of "nothing but a mechanically acquired association of ideas," and instead founded his empirical theory on elements that resonate with Kant's and Fichte's transcendental analyses of experience (Helmholtz [1855] 1896, 114–115), as will be outlined in section 3.2. In contrast to the ongoing debates on Helmholtz's allegiance to Kant's critical philosophy, the continuity of important aspects of his thought with Fichte's philosophy has received rather minimal scholarly attention.²¹ Amongst the few who have pointed out a certain allegiance of Helmholtz's psychological theory of perception to Fichte's ego-doctrine are Turner (1977), Scheerer (1989), Schulz (2004), Meulders (2010) and especially Heidelberger (1993 and 1994). With the exception of the latter, however, these interpretations remain fragmentary and vague, with comments on the matter being restricted to no more than a few tentative statements. Heidelberger is to be credited with putting the matter of Helmholtz's allegiance to Fichte's Ego-doctrine on the agenda as an area of interest in its own right, by convincingly arguing that the appreciation of Fichte's work forms "the essential key to understanding Helmholtz's philosophy of science" (Heidelberger 1993, 495).²²

²¹ For nineteenth-century discussions on the indebtedness of Helmholtz's theorizing to Kant's critical system in general, see Schwertschlager (1883), Krause (1878), Goldschmidt (1898). For more recent analyses, see especially Hatfield (1990), Cahan (1993), Disalle (2006), Schiemann (2009), Meulders (2010), and Neuber (2012).

²² More particularly, Heidelberger (1993, 494) argued that: "the inner core of Helmholtz's philosophy of science had its roots in Fichte's philosophy. . . . From Fichte Helmholtz appropriated the view that our consciousness

3.1 Perception as Unconscious Inference

In attempting to get a firmer grasp of the empirical dimension of Helmholtz's psychology of the object, Mill's 1865 *Psychological Theory of the Belief in an External World* provides an excellent starting point, not only because it provides a prototypical example of a strict empiricist account of the perceptual object, but moreover (and more importantly) because of the parallels with Helmholtz's theory of perception as unconscious inference.

First and foremost, Mill's psychological theory was meant to provide an alternative to common-sense philosopher William Hamilton's *Doctrine of the Natural Duality of Consciousness*, which stated that "we may . . . lay it down an undisputed truth, that consciousness gives, as an ultimate fact, a primitive duality; – a knowledge of the ego in relation and contrast to the non-ego . . . The ego and non-ego are, thus given in an original synthesis" (Hamilton 1859, 202–203). On the basis of the arguments presented in section 2.2., Mill, in his turn, set out to show that (i) it is possible to analyze the belief in an external world in terms of its formative history in the mind, and (ii) that this empirical analysis could furthermore account for the apparent intuitive nature with which the idea of the object emerges in the mind. In Mill's own formulation, his psychological theory of the object aims at demonstrating that:

there are associations naturally and even necessarily generated by the order of our sensations and of our reminiscences of sensation, which, supposing no intuition of an external world to have existed in consciousness, would inevitably generate the belief, and would cause it to be regarded as an intuition. (Mill 1865, 236)

Only two general presuppositions are needed, according to Mill, for his psychological account, namely (1) that "the human mind is capable of expectation," i.e., that it can conceive of future possibility, and (2) the laws of association (Mill 1865, 234).²³ Based on these two postulates, Mill hypothesized that the notion of the *object* as an independent existence in perception, arises from the recognition of a difference between *present* and *possible* sensations. He gives the following example:

comes to shape its conception of the outer world through the limitations we experience in our practical actions. Only by actively interfering with the world of external objects can we interpret our sensations as due to external causes and thereby distinguish them from the free acts of thinking inside our consciousness."

²³ Mill specifies these laws as follows:

- (i) Similar phenomena tend to be thought of together.
- (ii) Phaenomena which have either been experience or conceived in close contiguity to one another, tend to be thought of together. The contiguity is of two kinds; simultaneity, and immediate succession.
- (iii) When two phaenomena have been often experienced in conjunction, . . . there is produced between them what has been called Inseparable, or . . . Indissoluble Association. . . it is impossible for us to think the one thing disjoined from the other.
- (iv) Things which we are unable to conceive apart, appear incapable of existing apart; and the belief we have in their co-existence, though really a product of experience, seems intuitive. (Ibid., 234–235)

I see a piece of white paper on a table. I go into another room. . . . though I have ceased to see it, I am persuaded that the paper is still there. I no longer have the sensations which it gave me; but I believe that when I again place myself in the circumstances in which I had those sensations, that is, when I go again into the room, I shall again have them; and further, that there has been no intervening moment at which this would not have been the case. . . . The conception I form of the world existing at any moment, comprises, along with the sensation I am feeling, a countless variety of possibilities of sensation. (Ibid., 237)

In other words, if we say that consciousness contains the belief in objective existence, we are saying no more than that apart from the flow of actual sensations, we recognize *a permanent possibility of sensation as a conditional certainty*. Or in short: the object itself is no more than the permanent possibility of sensation (ibid., 249). Later, Mill adds, we come to identify these permanent possibilities with the idea of *cause*, and hence the conception of the possibility of sensation *as* the notion of the object, is hypostasized as the external cause of subjective modifications. In conclusion, Mill argued:

the very idea of anything out of ourselves is derived solely from the knowledge experience gives us of the Permanent Possibilities. Our sensations we carry with us wherever we go, and they never exist where we are not; but when we change our place we do not carry away with us the Permanent Possibilities of Sensation: they remain until we return, or arise and cease under conditions with which our presence in general has nothing to do. . . . and when the idea of cause has been acquired, . . . nothing can be more natural than that the Permanent Possibilities should be classed by us as existences generically distinct from our sensations, but of which our sensations are the effect. (Ibid.)

To account for the direct, intuitive nature with which this belief emerges in consciousness, Mill introduced “the principle of obliviscence,” which states that not all the elements of an associational chain leading up to the generation of an idea need to appear in consciousness.²⁴ By virtue of this principle, “we see, and cannot help seeing, what we have learned to infer,” i.e., the idea of the permanent possibility of sensation (the object), that has been acquired through associational learning, will appear to be intuitive, although it is actually acquired (ibid., 236).

If we now compare Helmholtz’s theory with Mill’s, the parallels are striking at first. Take for example the following statement from 1878:

Let us call the entire group of aggregate sensations induced . . . by a certain definite and finite group of the will’s impulses the “current presentables”; by contrast, let us call “present” the aggregate of sensations from this group which is just coming to perception.

²⁴ In Mill (1865, 317), the principle is explained as follows: “when a number of ideas suggest one another by association with such certainty and rapidity as to coalesce together in a group, those members of the group which remain long without being specially attended to, have a tendency to drop out of consciousness” (see also Allik and Konstabel 2005).

Our observer . . . can make each individual presentable present to himself at any moment through execution of the relevant movement. In this way it seems to him that each individual from this group of presentables exists at each moment during this period of time. . . . Thus the idea of a simultaneous and continuous existence of different things alongside one another will be achieved. (Helmholtz [1878] 1995, 350)

From this passage, it seems that for Helmholtz too, the idea of external existence was entirely derived a posteriori from the recognition of something like Mill's "permanent possibilities," based on the learned association between the coming into being of certain "circles of presentables" and voluntary movement. Once this kind of knowledge is acquired, Helmholtz added, the perceptual process takes the form of an unconscious inductive syllogism, with the current sensation as a minor premise, acquired knowledge of lawlike covariation between movement and sensation as a major premise, and the object as a conclusion (Helmholtz [1868] 1995, 199). Based on the tacit knowledge expressed in the major premise, the perceptual process is thus entirely regulated by the rule that "such objects are always imagined as being present . . . as *would have to be there* in order to produce the same impression on the nervous mechanism" (Helmholtz [1856/66] 1924/25, 3:2; emphasis added). As such, the perceptual process takes the form of a continuous process of hypothesis testing, based on expectations generated by previous experience. Consequently, Helmholtz called his theorizing a *projection* theory: throughout the perceptual process, expectations are constantly being projected onto the visual field, and give rise to perceptual images of the form, position, and existence of objects.

With respect to this particular conceptualization of perceptual experience, Helmholtz actually acknowledged his indebtedness to Mill's *Logic*, which, according to him "gave the best explanation" of the nature of inductive conclusions [*Inductiven Schlüsse*], in conceiving major premises not as universal truths, but as a collection of acquired knowledge derived from similar cases (Helmholtz [1856/66] 1924/25, 3:24). Furthermore, Helmholtz's notion of the unconscious fulfilled the same systematic role as Mill's principle of obliviscence, i.e., accounting for the seemingly intuitive and direct nature of perception. In the *Treatise*, Helmholtz summarized his account as follows:

we can never emerge from the world of our sensations to the apperception of an external world, except by inferring from the changing sensation that external objects are the causes of this change. Once the idea of external objects has been formed, we may not be concerned any more as to how we got this idea, especially because the inference appears to be so self-evident that we are not conscious of its being a new result. (Ibid., 2:32)

In conclusion, there is no doubt that there is a certain degree of similarity between Mill's and Helmholtz's psychological approaches, and that Helmholtz certainly appears to be a "disciple of the English empirical philosophers," and more particularly of Mill, if it comes to his analysis of the object (Meulders 2010, 143). This is an observation that

prompted Hochberg to talk of the Helmholtz–Mill theory of perception (Peterson, Gillam, and Sedgwick 2007, 331). However, a complete reduction of Helmholtz’s theorizing to Mill’s psychological theory does not do justice to the complexity of his psychological project in general, and to the way in which his empiricism is embedded in reflections on the a priori constitutive (as opposed to constructive) elements of experience, inspired by the transcendental tradition.

3.2 Helmholtz and the Transcendental Tradition

In sharp contrast to Mill – who never ceased to contrast his program for an empirical approach to mental phenomena with a priori philosophy – Helmholtz was never hostile towards the German transcendental tradition as such, but on the contrary, related his own work on sense perception explicitly to the theories of Kant and Fichte.²⁵ Some of the most valuable insights in Helmholtz’s intellectual relation to the German transcendental tradition, are to be found in the correspondence between him and his father Ferdinand, who had studied philosophy and philology, was personally acquainted with Schopenhauer, and close friends with Immanuel Hermann Fichte, the son of Johann Gottlieb. It is interesting to note that the latter was furthermore Helmholtz’s godfather and namesake.²⁶ In his *Autobiographical Sketch*, Helmholtz testified:

The interest for questions of the theory of cognition, had been implanted in me in my youth, when I had often heard my father, who had retained a strong impression from Fichte’s idealism, dispute with his colleagues who believed in Kant or Hegel. (Helmholtz [1891] 1995, 390)

Although Helmholtz endorsed an explicitly anti-metaphysical position, he likewise emphasized that “philosophy, if it gives up metaphysics, still possesses a wide and important field, the knowledge of mental and spiritual processes and their laws” (Helmholtz [1877] 1995, 325). As such, he considered his psychological project to be in alignment with “Kantian philosophy, that aimed at . . . investigating the sources of knowledge and the degree of their justification” (Helmholtz [1855] 1896, 88).²⁷

²⁵ For Mill’s opposition to the German a priori school of philosophy, see footnote 17.

²⁶ For Helmholtz’s letters to his father, see Cahan (1993), and Koenigsberger (1902/03). With regard to the influence of Helmholtz’s father Ferdinand on the former’s philosophical stance, see Helmholtz ([1891] 1995) and Koenigsberger (1902/1903).

²⁷ More specifically, Helmholtz stated: “From the entire chain of my argument it follows that what I have said against metaphysics is not intended against philosophy. But metaphysicians have always tried to plume themselves on being philosophers, and philosophical amateurs have mostly taken an interest in the high-flying speculations of the metaphysicians, by which they hope in a short time, and at no great trouble, to learn the whole of what is worth knowing. . . . I compared the relationship of metaphysics to philosophy with that of astrology to astronomy. . . . philosophy, if it gives up metaphysics, still possesses a wide and important field, the knowledge of mental and spiritual processes and their laws” (Helmholtz [1877] 1995, 325).

In the early 1850s, when Helmholtz was appointed a professorship in anatomy and physiology in Bonn, and had just started his extensive research on the nature of human perception, Helmholtz wrote to his father:

It seems to me a favorable moment for voices of the old school of Kant and . . . Fichte to obtain a hearing once more. . . . Philosophy finds its great significance among the sciences as the theory of the source and functions of knowledge, in the sense in which Kant, and, so far as I have understood him, the elder Fichte, took it. (Letter from December 31st, 1855, as quoted in Koenigsberger 1902/03, 284)

Later on in his career, Helmholtz likewise took on every occasion to stress the way in which his research confirmed or continued aspects of Kant's and Fichte's philosophy (see for example Helmholtz [1868, 1878, 1891, 1892] 1995). However, it is sufficiently clear that he read both authors more as pure psychologists, than as epistemologists, and that hence, he transformed their formal investigations into hypotheses with regard to the necessary psychological hardware underlying the capacity to perceive (see below).

Nevertheless, from a systematic viewpoint, Helmholtz's "decisive intellectual leap" to the transcendental tradition in the context of his psychological investigation is hardly surprising (Helmholtz [1892] 1995, 410). A particular hallmark of Mill's psychology of the object, for example, is that the question as to the origin of representation is dissociated from that of the representing subject. Hence, his theory was soon criticized for not taking into account the active subject that was actually presupposed in his theory of the object as a permanent possibility of sensation (see for example Bradley 1876; James 1890). Helmholtz, on the other hand, credited Kant's first *Critique* as reflecting an epochal shift in thinking about human experience, as it demonstrated the constitutive role of "pure thinking a priori," and the way in which all of our perceptions are "conditioned by the peculiar ability of our mind [eigenthümlichen Fähigkeiten unseres Geistes]" (Helmholtz [1856/66] 1924/25, 3:35). Furthermore, he added: "according to this view perception is recognized as an effect [Wirkung] produced on our sensitive faculty . . . this effect . . . being just as dependent on what causes the effect [dem Wirkenden] as on the nature of that on which the effect is produced [dessen, auf welches gewirkt wird]" (ibid., 3:35–36). Hence, Helmholtz described his theory of perception as constituting a borderland [Grenzgebiet] between the exact sciences and philosophy, in which the latter "considers . . . that which belongs to the mind's own activity. . . . that which is definition, designation, form of representation and hypothesis" (Helmholtz [1878] 1995, 344).

If we take Helmholtz's 1855 statement that "*seeing is understanding sensation*" as a point of departure in the shift from an empirical to a transcendental level of analysis, his theorizing can be understood as a shift from the interrogation of the structure of perceptual comprehension (unconscious inference), to an inquiry into the conditions of *comprehensibility* (Helmholtz [1855] 1896, 99–100; also see Helmholtz [1878] 1995; and 1896). Or put more generally: as a shift from an inquiry of the mental realm as

a “theatre” for empirical construction, to an interrogation of *what the mind or subject must be like* a priori in order to be able to associate its way into the external world. In analyzing Helmholtz’s psychology of the object from this perspective, two such “transcendental” questions – respectively associated with the Kantian and the Fichtean dimension in Helmholtz’s psychology of the object – are especially prominent, that can be denoted as the problem of reference on the one hand, and that of difference on the other (discussed in sections 3.2.1 and 3.2.2 respectively):²⁸

- (i) The problem of reference, or the question as to the ground of the signaling function of the sensation–sign: given the physiologically underdetermined nature of sign–sensations with regard to their origin, unconscious inference based on previous experience alone does not explain “what *first* enables us to pass from the world of nervous sensations into the world of actuality [Welt der Wirklichkeit]?” (Helmholtz [1855] 1896, 115–116; emphasis added). In other words: unconscious inference in itself does not account for the signaling function of the sign, or for the way in which a perceiver comes to interpret sensations as signs for something that is not contained in the sensation itself.
- (ii) The problem of difference, or the ground of the dual structure of perceptual consciousness: the perceptual process presupposes a differentiation between those sensations referring to external objects or events, and those that are endogenous in origin. Therefore, Helmholtz investigated what “*first* makes the distinction between thought and reality possible [Scheidung von Gedachtem und Wirklichem erst möglich wird]?” (Helmholtz [1878] 1995, 362; emphasis added). One might say that this problem is even more fundamental than the previous one, as it pertains to the conditions of possibility underlying the ability to differentiate between those sensations that signify objects, while others originate from the mind or body of the perceiver.

3.2.1 HELMHOLTZ, KANT, AND THE PROBLEM OF REFERENCE

In the context of discussions regarding Helmholtz’s intellectual indebtedness to German philosophy, a much debated topic is the former’s appropriation of Kant’s a priori view with respect to the causal law. As early as 1855, Helmholtz rejected the empiricist regularity view of causality, and claimed instead that the causal structure of understanding is an a priori condition for experience:

we have to presuppose the presence of external objects as the cause of nerve excitation, since there can be no effect [Wirkung] without a cause. How do we know that there can be no effect without a cause? Is it a law of experience [Erfahrungssatz]? According to some, it is. But . . . we use the law to arrive . . . at the insight that there are objects in space in the first place Can we get it from the internal experience of our self-

²⁸ For my distinction between the problem of reference and that of difference in Helmholtz’s theory of perception, also see De Kock 2014.

consciousness? No; since we conceive of self-conscious acts of volition and thought as free; i.e., we deny that they are the necessary effects of sufficient causes. In this way, the inquiry into the nature of sense perception leads us to the insight that Kant had already revealed: that the law . . . is a law of thought, given prior to experience. (Helmholtz [1855] 1896, 116; see also Helmholtz [1856/66] 1924/25, 3:33; [1878] 1995, 363; 1896, 590)

Hence, Helmholtz held causality to be an a priori form of thought [Denkform], rather than a content derived from experience, and the scientist explicitly rejected Mill's regularity view of causation, that claims that "the law of cause and effect, is itself an instance of induction" (Mill [1843] 1882, 401).²⁹ Later on in his career, Helmholtz maintained that "the causal law is really an a priori given, a transcendental law. It is not possible to prove it by experience" (Helmholtz [1878] 1995, 363).

In Helmholtz's psychological theory, the transition of "the world of nervous sensations" to that "of external objects," is crucially mediated by the a priori rule that every effect has a cause, and hence, Helmholtz's Kantianism in this respect, provided a way out of the problem of reference. That is to say: without the assumption that "there is no effect without a cause [keine Wirkung ohne Ursache]," sensation would refer to nothing but itself, and hence, perception would be utterly impossible (Helmholtz [1855] 1896, 116).

Although Helmholtz was quite explicit about the Kantian pedigree of his conception of the causal law, the purport and soundness of his self-professed Kantianism is (and has been) a notorious apple of discord in secondary literature. For starters, Helmholtz considered the law to be a priori in a fairly outspoken psychological sense, describing it, amongst others as an "urge [Trieb] of our intellect [Verstandes]" (Helmholtz [1856/66] 1924/25, 3:34), later defining "Trieb" as "the inborn effect of our organization" (Helmholtz 1894, 96). The causal law in Helmholtz's theory of perception expresses a *psychological disposition*, and more particularly, the subjective urge to objectify underdetermined sensory modifications by assigning them an origin. Through this interpretation, however, the Kantian a priori apparently ceased to be a merely formal (logical) condition of experience, but instead expressed a necessary presupposition regarding a perceiver's psychological hardware. In this sense, it seems reasonable to presume that "Helmholtz reinterpreted the Kantian a priori as something that Kant never intended it to be: a species of psychological adaptation" (Disalle 1993, 505).

²⁹ See, for example, Helmholtz ([1856/66] 1924/25, 3:32–33: "The law of causation, . . . has to be considered . . . as being a law of our thinking which is prior to all experience. . . . The law of causation was supposed to be a law of nature arrived at by induction. Recently it has been again interpreted in that way by J.S. Mill. . . . As opposed to that view, I shall merely say, for what it is worth, that that there is good reason to think that the empirical proof of the law is extremely doubtful."

Furthermore, although Helmholtz never abandoned his view on causality as psychological necessity, he did emphasize its epistemological contingency.³⁰ In a posthumously published note, for example, Helmholtz claimed that the law is “a mere hypothesis, and not otherwise demonstrable” (Helmholtz as quoted in Koenigsberger 1902/03, 247). In addition to his psychological interpretation of the law, Helmholtz thus diverged from Kant at the point where he dissociated the questions of necessity and objectivity, which were inextricably linked in the latter’s critical project (Fullinwider 1990, 48). From this, Schiemann concludes that Helmholtz’s conception of causality in his later years “no longer deviated much from Mill’s standpoint on the issue” (Schiemann 2009, 240). In the same vein, Riehl and Schlick argued earlier in a footnote added to his translation of Helmholtz’s *The Facts in Perception*, i.e., that the latter “took the path of David Hume” with regard to causality, since its validity never rises above its status as a mere hypothesis (Riehl 1904; Helmholtz 1921, 163). If we restrict ourselves to Helmholtz’s mature insistence on the hypothetical character of causal inference – and thus on the epistemological status of causality in Helmholtz’s work – this might indeed be a viable hypothesis. It remains, however, that Helmholtz maintained that causal understanding is a necessary a priori ingredient of experience that is not derived from induction, but rather forms its very condition of possibility. Furthermore, the scientist reiterated his Kantian stance on the matter in 1878 as well as in the second, revised version of the *Treatise* (Helmholtz [1878] 1995, 363; 1896, 590). These observations complicate and challenge readings of Helmholtz’s statements in this respect as testifying of a strict empiricist viewpoint, although it cannot be denied that Helmholtz’s reduction of the a priori to a psychological necessity diverges significantly from Kant’s conception.

It is important to note that the aprioricity of the causal law can be invoked to solve the problem of reference, but it does not account for the way in which internally and externally generated sensible effects are differentiated in perception, or for the question as to the origin of differential consciousness. This is a problem for which, according to Helmholtz, even Kant’s system is of “virtually no help” (Helmholtz [1892] 1995, 394).

³⁰ With regard to the evolution in Helmholtz’s thought on causality, his 1847 paper, and especially the 1881 appendix added to it, are especially telling. As is well known, Helmholtz comes back to the philosophical introduction of his 1847 lecture in 1881, and writes that: “The philosophical discussion in the Introduction was more strongly influenced by Kant’s epistemological perspective, as I would now consider to be correct. It is only later that it became clear to me . . . that the principle of causality is . . . nothing but the presupposition of lawfulness in all natural phenomena. . . . the law posits conditions for every effect” (Helmholtz [1847] 1889, 53). However, the scientist reiterated that the law is an a priori psychological necessity in later lectures (see Helmholtz [1878] 1995, and 1894). A complete discussion of the way in which Helmholtz’s thoughts on causality evolved over the course of his career falls outside of this discussion, for which it suffices to point out the differences between Helmholtz’s initial position, and his later take on the matter, which testified to a gradual dissociation of the concepts of psychological and epistemological necessity. For a full discussion of the evolution of Helmholtz’s thought in this respect, see especially Hatfield (1990), and Schiemann (2009).

3.2.2 HELMHOLTZ, FICHTE, AND THE PROBLEM OF DIFFERENCE

As already suggested, the limits and scope of Helmholtz's indebtedness to the transcendental tradition cannot be assessed properly, without taking into account the continuity of his theorizing with the philosophical system of the post-Kantian J.G. Fichte. A compelling argument *against* any interpretation of Helmholtz's psychological theory along the lines set out by Fichte, would be that the scientist's anti-metaphysical attitude was irreconcilable with the quite robust metaphysical and speculative character of post-Kantian philosophy in general, and Fichte's system in particular. This objection cannot be dismissed, but as Turner pointed out, Helmholtz apparently distinguished between "two aspects of Fichte's thought," and accepted Fichte's philosophy to the extent that it "represented a phenomenology of consciousness" although it can hardly be denied that he "resolutely rejected Fichte's . . . attempts to build an idealist metaphysics on that basis" (Turner 1977, 57). This aligns with Helmholtz's claim that in contrast to Hegel, Fichte's philosophy "does not . . . contradict the natural sciences, but rather . . . corresponds precisely to . . . the conclusions . . . of physiology" (Helmholtz [1855] 1896, 89).

Helmholtz's lectures, as well as the correspondence with his father, provide some further clues on this matter. When writing to his father on the topic of his 1855 lecture On Human Vision, he confided:

Last Tuesday . . . I gave another lecture upon Human Vision, in which I tried to put forward the correspondence between the empirical facts of the physiology of the sense-organs and the philosophical attitude of Kant, and also of Fichte, although I was somewhat hindered in my philosophical exposition by the need of making it popular. (Helmholtz in a letter to his father from February 27th 1855, as quoted in Koenigsberger 1902/1903, 242)

In yet another letter, Helmholtz even went as far as claiming that his theory can be read as "an empirical statement of Fichte's fundamental views of sense-perception" (*ibid.*, letter from September 1852, 92). Furthermore, Helmholtz referred approvingly to Fichte's 1817 paper on *The Facts of Consciousness* [Die Thatsachen des Bewusstseins] in the second, revised version of his *Treatise*, and claimed that it contains "a lot of right, strongly worded" insights on sense perception (Helmholtz 1896, 2:248).

To understand the possible relevance of Fichte's philosophy for Helmholtz's psychology of the object, we should first turn to the latter's research on eye movements, performed mainly between 1862 and 1865, when Helmholtz was a professor in physiology in Heidelberg (Koenigsberger 1902/03). As was explained in section 3.1., Helmholtz conceived of the perceptual process as crucially mediated by acquired knowledge on the lawlike covariation between voluntary movement and the coming into being of certain "circles of presentables," or in short, by anticipative procedures. Hence, this knowledge [*Kennen*], entails what Helmholtz in turn called *Können* [being able to], i.e., it requires that a perceiver is "acquainted with the particular

innervation of muscles, which is necessary in order to produce any effect we intend” (Helmholtz [1868] 1995, 198). In his *Treatise*, Helmholtz further developed this physiological understanding of the nature of voluntary movement, by hypothesizing that every voluntary act is represented on the level of sensibility as a complex of three sensations, that, when taken together, constitute what he calls the “muscular feeling” [*Muskelgefühl*]:

This term includes . . . several different sensations that have to be distinguished . . . :

1. The intensity of the effort of will [*Intensität unserer Willensanstrengung*], whereby we endeavor to bring the muscles in action,
2. The tension of the muscles . . . ,
3. The result of the effort, which . . . makes itself felt in the muscle by a contraction which actually takes place. (Helmholtz [1856/66] 1924/25, 3:243)

While the last two sensations denote afferent (or centripetal) physiological markers for agency, the first sensation is a centrifugal, efferent signal that precedes the action. As such, Helmholtz’s theorizing is crucially founded in the assumption that actions are known by the subject “otherwise than by their effect,” as Jeannerod once put it, i.e., that the feeling of activity or spontaneity is generated centrally, preceding the actual muscle movement (Jeannerod et al. 1979, 241). Although Helmholtz called the awareness of *Willensanstrengung* a sensation, strictly speaking, it is not *sensed* in the same way as other sensible events, i.e., it is not produced, but rather presupposed by the sensations associated with muscle contraction and its results. Based on this physiological operationalization of the concept of voluntary action, the scientist hypothesized that a particular malfunctioning in either one of the sensations related to voluntary movement, could cause subnormal perceptual experiences (illusion and hallucination) (Helmholtz [1856/66] 1924/25, 2:§29). One of the most significant observations Helmholtz described in this respect, are the perceptual phenomena experienced by subjects suffering from a partial or total paralysis of the eye muscles, in which the complex of muscular feeling is reduced to the sensation of the effort of will only:

if the external rectus of the right eye is paralyzed, or the nerve leading to it, this eye can no longer be pulled around to the right. . . . the moment he tries to turn his eye outwards, that is, to the right, it ceases to do his bidding, and remains standing in the middle, while the objects appear to move to the right. . . . we fancy that the visual axis has been shifted to the right; and since no change has taken place in the positions of the images on the retina of the paralyzed eye, we get the impression that the objects shared the supposed movements. (Ibid., 245)

In these cases, the perceptual process is guided only by a psychological intention, that, however, remains unrealized due to paralysis, and thus leads to anomalous projections onto the visual field. But Helmholtz likewise described the opposite case: if the eye is moved to the right by some external force – and hence none of the

sensations mentioned above would be produced – an illusory perception of motion is experienced.³¹ In this latter case, the shifting retinal image cannot be ascribed to self-induced movement, and hence, is externalized, although no actual movement is taking place (*ibid.*, 31). Through these observations, Helmholtz grew increasingly convinced of the indispensable role of intentions – physiologically described in terms of the efferent sensation of *Willensanstrengung* – in object perception on the one hand, and the physiological irreducibility of voluntary movement to muscular contraction on the other.³²

The crucial role of the awareness of the effort of will in Helmholtz's theorizing, is, however, not restricted to the important share it has in judgments about the spatial position of external objects, but on the contrary, is constitutive of the ability of objectification itself, and more precisely: of perceptual differentiation. The process of unconscious inference, through which sensations are relegated to their supposed external causes, is based upon the more fundamental experience of a dynamical opposition between “those changes which are cause by act of our will, from those that cannot be ascribed to our will” (Helmholtz 1896, 592–593). Without the immediate sensory awareness of “the intensity of the feeling of effort [*Intensität unserer Willensanstrengung*],” Helmholtz wrote, no distinction is possible between internally and externally generated sensory modifications:

it is clear that the separation of thought and reality first becomes possible after we know how to complete the separation of that which the ego can and cannot change. This however, only becomes possible after we recognize which law-like consequences the will's impulses have at that time. (Helmholtz [1878] 1995, 362)

This is the way in which Helmholtz's theory of agency provided an answer to what was previously described as the problem of difference: the object in perception first appears first as a *negation* of that which can be ascribed to the self; the “self” in turn being a function of the autonomous, and immediately perceived will's impulse. As such, differentiated consciousness is first generated according to the scheme of will and resistance. Crucially, Helmholtz added that this account is founded on two foundational assumptions. First of all, “the impulse to movement . . . is something directly perceivable. We feel that we do something . . . We do not know directly

³¹ See Helmholtz ([1856/66] 1924/25, 3:45): “In a case of this kind when a muscle is paralyzed, there is no movement of the eye, no contraction of the muscles that should be contracted nor even any increase in the tension in these muscles, as the result of the exertion of will-power. The latter has no effect whatever beyond the nervous system; and yet our judgment as to the direction of the visual axis is formed as if the will had produced its normal effects.”

³² See Helmholtz ([1856/66] 1924/25, 3:245): “Our judgment as to the direction of the visual axis is not formed either by the actual position of the eyeball or by the actual elongation or contraction of the ocular muscles These phenomena prove conclusively that our judgments as to the direction of the visual axis are simply the result of the effort of will involved in trying to alter the adjustment of the eyes.”

what we do” (Helmholtz [1878] 1995, 348). Secondly, Helmholtz maintains that it is an “essential assumption . . . that our will’s impulse has neither already been influenced by physical causes, . . . and not itself psychically influenced the succeeding perceptions (ibid., 358–359). Hence, Helmholtz’s theorizing was founded on the directly perceivable, and autonomous nature of the *Willensanstrengung*, which he furthermore described as a psychical (not a physiological or physical) act of will (ibid., 359). To summarize, Helmholtz maintained that it is only through *the voluntary act* that we learn to distinguish:

those changes which we can bring forth and annul by conscious impulses of the will . . . from those which are not consequences of the will’s impulses and cannot be overcome by such. The latter finding is negative. Fichte’s appropriate expression for it is that a Non-Ego forces recognition of itself vis-à-vis the Ego. (Ibid., 351)

In the end, this voluntarist tenet in Helmholtz’s theory prevents a complete reduction of the perceptual process to mechanical law-like cognitive mechanisms. In fact, Helmholtz claimed that “in ascribing to ourselves free-will . . . we deny in toto the possibility of referring at least one of the ways in which our mental activity expresses itself to a rigorous law” (Helmholtz [1862] 1995, 85). Furthermore, it suggests that a theory of experience should necessarily take an active, goal-oriented subject as a point of departure. Indeed, the scientist stated, “the efforts of the philosophical schools to establish belief in the existence of reality must remain unsuccessful so long as they proceed only from passive observations” (Helmholtz [1892] 1995, 410).

As the above quoted passage from Helmholtz – as well as the fragments from the letters written to his father as presented in the beginning of this section – makes clear, the scientist related this dimension of his theory explicitly to Fichte’s philosophical system. Most generally, the latter had grounded his transcendental analysis of experience in the concept of the I as a pure self-relating activity [*Tathandlung*], and claimed that it is only for an I thus conceived, that an object can be posited as a *Gegenstand* or resistance: “no object can be posited without the presence of an activity [*Tätigkeit*] of the I, that is opposed to the activity of the object” (Fichte [1794] 1997, 177). In this sense, the object or Not-I in Fichte’s system, first becomes intelligible as a negation of the I’s unconditioned centrifugality, i.e., as resistance: “The object [*Gegenstand*] is posited, in so far as an activity of the I is resisted; if there is no such activity of the I, there is no object” (ibid., 259). Consciousness is thus said to be constituted as a dual structure, through the reciprocal determination of I and Not-I, dialectically related to each other as reality and negation, posited through the awareness of limitation or resistance. For Fichte, the subject’s centrifugal activity was the alpha and omega of experience, as is testified by his definition of the intellectual intuition that underlies the possibility of external consciousness:

the immediate consciousness that I act I can take no step, cannot move a hand or a foot, without the intellectual intuition of my self-consciousness in these acts; it is only by virtue of this intuition, that I know, that I am doing this, it is only by virtue of this [intellectual intuition] that I distinguish my act . . . from the . . . object of my act. (Fichte 1798, 43; emphasis in the original)

Notwithstanding compelling evidence suggesting that Fichtean philosophy was actually central to Helmholtz's thought, Heidelberger (1993, 1994) is the only one to have analyzed this interesting continuity, although the latter focused specifically on the Fichtean dimension in Helmholtz's philosophy of science.³³ This perspective differs from the psychological angle taken in this exposition, although it could be said that Helmholtz's view on the constitutive role of experimentation unites his epistemological and psychological stance, as is clear for example from the following statement:

The same great importance which experiment has for the certainty of our scientific convictions it has also for the unconscious induction of the perceptions of our senses. It is only by voluntarily bringing our organs of sense in various relations to the objects, that we learn to be sure as to our judgments of the causes of our sensations. (Helmholtz [1856/66] 1924/25, 3:30–31; see also McDonald 2003)

It is interesting to note that Helmholtz's definition of truth or objectivity, was likewise derived from the pivotal role he assigned to voluntary action: "We call those ideas of the external world true," the scientist wrote, "which inform us in a sufficient manner about the consequences of our actions in the external world, and allow us to judge correctly on what changes to expect" (Helmholtz 1896, 590). Or at another point in time, he stated that "there can be no possible sense in speaking of any other truth of our ideas" than that which allows us to "regulate our movements and actions" (Helmholtz [1856/66] 1924/25, 2:19). Hence, the experiment has become a constitutive element not only for the perceptual process, but likewise for the notion of objectivity itself. This challenges Daston and Galison's claim that objectivity in the modern era arose from a negation of subjectivity, and more specifically, as an attempt to counterbalance the "willful self . . . perceived as endangering scientific knowledge" (Daston and Galison 2007, 37).³⁴ Quite the contrary, what this analysis has pointed

³³ More particularly, Heidelberger (1993, 494) argued that: "the inner core of Helmholtz's philosophy of science had its roots in Fichte's philosophy. . . . From Fichte Helmholtz appropriated the view that our consciousness comes to shape its conception of the outer world through the limitations we experience in our practical actions. Only by actively interfering with the world of external objects can we interpret our sensations as due to external causes and thereby distinguish them from the free acts of thinking inside our consciousness."

³⁴ The way in which Daston and Galison treat the notion of objectivity especially in relation to Helmholtz's work has been criticized earlier by Hallet (2009), who likewise opposes the sharp distinction the authors make between the concept of objectivity and the active self, and more particularly, contends that it is not at all the case that Helmholtz's epistemological notion of truth is to be understood against the background of attempts to neutralize the willful subject.

out, amongst other things, is that Helmholtz's views on the object and objectivity did not so much attempt to neutralize the willful subject, as it established the latter as a condition of possibility for object constitution.

To conclude this section, it should be noted that the foregoing analysis might shed some new light on the much debated issue of Helmholtz's rejection of Kant's transcendental theory of space. It is well known that Helmholtz, in contrast to Kant, argued that the axioms of geometry are empirical.³⁵ More particularly, Helmholtz contended that Kant deemed spatial determination to be irreducible to a mental process, while it can in fact be fully accounted for in terms of (a posteriori) psychological construction, mediated by voluntary movement:

It is easy to appreciate that by moving the . . . finger along the objects, the sequence in which the impressions of the object are presented becomes known; that this sequence shows itself to be independent of whether one feels with this or with that finger; . . . and different tangible surfaces require different motions in order to glide along them In such a way may knowledge of the spatial ordering of things existing beside one another be acquired. . . . This observed spatial order of things originally derives from the sequence in which the qualities of the sensation present themselves to the moved sensory organ. (Helmholtz [1878] 1995, 351–352)

Helmholtz thus accounted for the metric determination of space in terms of an “unconscious mathematics” (Cassirer 1944, 18). It is important, however, to understand that Helmholtz argued specifically against the apriorism with regard to the (Euclidian) *structure* of space, while he maintained that the Kantian hypothesis of space as the general form of external intuition, emptied from its structural specifications, is “completely inoffensive”:

Kant's theory of the a priori given forms of intuition is a very apt and clear expression of the relations of things; but these forms must be without content and sufficiently free The axioms of geometry . . . limit the form of intuition of space in a way such that if geometry is to be generally applicable to the real world, then no longer can any imaginable content be included in it. If we eliminate the axioms, then the theory of the transcendental [sic] of the form of intuition of space is completely inoffensive. Kant has here, in his Critique, not been critical enough. (Helmholtz [1878] 1995, 380)

Hence, Helmholtz specified that “space can be transcendental without there being any axioms” (*ibid.*, 369). In other words, according to Helmholtz, Kant erred not so

³⁵ For Kant's transcendental theory of space, see Kant ([1781/87] 1998, A22–30/B37–45). In that section, Kant famously established the sensible determinability of the object in general, qua external object, to be dependent upon (Euclidian) space as the a priori form of the outer sense: “Space represents no property at all of any things in themselves,” Kant [A26/B42] wrote, but rather is “nothing other than merely the form of all appearances of the outer sense, i.e., the subjective condition of sensibility, under which alone outer intuition is possible.” For Helmholtz's refutation of Kant's a priorism, see especially Helmholtz ([1870, 1878] 1995).

much in assuming that space in general is the necessary a priori form of intuition – i.e., in assuming the apriority of a “purely formal scheme” – but rather in including “certain peculiarities of the scheme” in his transcendental theory (Helmholtz [1870] 1995, 226). The latter claim can be better understood when placed against the background of Helmholtz's psychology of the object. Helmholtz articulated the basic structure of perceptual consciousness primarily in terms of a geometrical opposition, stating for example that “we understand as the external world precisely what we perceive as spatially determined. That which has no perceptible spatial relation, we conceive as the world of inner intuition, as the world of self-consciousness” (Helmholtz [1878] 1995, 349). As such, the problem of space, for him was inherently related to what we called the problem of difference, and in that sense, Neuber is quite right in arguing that Helmholtz's theory of space was essentially *a theory of space perception* (Neuber 2012, 168–169). Upon closer analysis the transcendental element in Helmholtz's theory of space is not so much eliminated, as it is shifted to the constitutive role of the *possibility of free mobility of rigid bodies* (Helmholtz [1870] 1995; Neuber 2012).³⁶ Specifically within the context of his perceptual theory, Helmholtz stated that:

space would be a . . . form of intuition priori to all experience insofar as its perception would be tied to the possibility of the will's motoric impulses, and for which the mental and corporeal ability must be given us through our organization before we can have spatial intuition. (Helmholtz [1878] 1995, 349)

As such, one could hypothesize that Helmholtz, after relocating the possibility of spatial construction from the (a priori) form of external intuition to its (a posteriori) content, identified the apriority of space in general (as the necessary form of external perception) with the possibility for voluntary movement. In this sense, Helmholtz's theory was as much a criticism and refutation of Kant's a priorism with respect to spatial structure, as it is a *rethinking* of the meaning of the general concept of space as a transcendental form. To be more precise, in the end, the necessary condition of external intuition in Helmholtz was not space, but the capacity for voluntary movement that is claimed to found the possibility of spatial construction and objectification.

4. Discussion and Conclusion

The investigation of the scientific and philosophical background of Helmholtz's psychology of perception has provided further evidence for the profound entanglement of empiricism and idealism in Helmholtz's work, which has aroused scholarly interest

³⁶ See Helmholtz ([1870] 1995, 344): “Thus the axioms of geometry are not concerned with space-relations only but also at the same time with the mechanical deportment of solidest bodies in motion. The notion of rigid geometrical figure might indeed be conceived as transcendental in Kant's sense, namely, as formed independently of actual experience.”

ever since the nineteenth century. On the one hand, this paper aimed at broadening the scope of these discussions by pointing out the important continuity between Helmholtz's theorizing and the philosophy of J.S. Mill and J.G. Fichte, figures who had hitherto been treated unjustly as having only minor import for the interpretation of Helmholtz's work. More importantly, Helmholtz's "dovetailing" between, or attempting to reconcile empiricism and idealism has been examined specifically from the perspective of his psychological project, which has allowed us to grasp the systematic significance of Helmholtz's empirico-transcendentalism specifically from within the context of his attempts to address questions pertaining to the mind.

In focusing on the systematic place of Helmholtz's empirico-transcendentalism within his psychological project, one could hypothesize that his inclination towards transcendental philosophy correlated with a concern for the epistemic subject of perception, and a correlative interrogation of *what the subject must be like* in order to be able to construct an external world – or to address the questions of reference and difference – from the chaos of underdetermined sensations. Most generally, it is exactly at the point where Helmholtz supplemented his psychological investigation into the genesis of objective representation, with a transcendently inspired interrogation of the representing subject, that his psychology overstepped the limits of the strict empiricist framework. Helmholtz's empirical theory of perception as unconscious inference hinged on assumptions that are not in any way derived from experience – i.e., the causal structure of understanding and the autonomous, undetermined will's impulse – but on the contrary, are to be presupposed to account for the empirical construction of the world.

An appreciation of the voluntarist dimension in Helmholtz's account could help restore the continuity of his psychophysiological project with early psychological theories, and most notably with Wilhelm Wundt's voluntarist psychology (see especially Wundt 1862). Although both Helmholtz and Wundt studied with Johannes Müller, and furthermore worked together for some years in Heidelberg, it has become quite common to stress the irreconcilable intellectual and scientific differences of opinion between the two scientists (see for example Rieber and Robinson 2001). After Wundt abandoned his early theory of perception as unconscious inference, which was strikingly similar to Helmholtz's, it appeared as if both scientists took radically different intellectual paths. For one thing, the idealist tenets in Wundt's psychological theory – and especially his emphasis on the centrality of volitional processes in accounting for our mental life – are all too often contrasted with Helmholtz's experimental, and according to some even positivist and anti-idealist stance (for a recent example, see Kohls and Benedikter 2010). The analysis presented above, however, that points to a definite voluntarist tendency in Helmholtz's thought, could help attenuate this view somewhat, and restore the continuity between the two psychologists. Some decades ago, Leary even hypothesized that Wundt's voluntarism, and his relation to Fichtean philosophy specifically, might even have been mediated to some extent by his contact with Helmholtz, although this remains an altogether tentative hypothesis (Leary 1980; also see Richards 1980). It

remains, however, that Helmholtz's and Wundt's theories are more in alignment with each other than is commonly assumed, especially when it comes to their emphasis on the central place of the will in their psychological theories. Consequently, the discussion of Helmholtz's indebtedness to Fichte as presented above does not only have a philosophical significance, but could likewise help bridge some important gaps in the historiography of psychology.

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