

# Unconscious inferences in perception in early experimental psychology: From Wundt to Peirce

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## Funding information

Andrew W. Mellon Foundation

## Abstract

What are unconscious inferences in psychology? This article investigates their journey from the early philosophical psychology of Wilhelm Wundt (1832–1920) to the experimental psychology of the American pragmatist Charles S. Peirce (1839–1914). Peirce's reception of Wundt's early works situates him in an international web of 19th-century experimental psychologists and its reconstruction opens new perspectives on the relation between philosophy, psychology, and epistemology. Moreover, this reception testifies to a heretofore overlooked strand of influence of Wundt on North American experimental psychology. The notion of unconscious inferences, of which Hermann von Helmholtz is usually considered the chief exponent, becomes the backbone of Peirce's theory of perception mostly because of the affinity between Wundt's early philosophy of mind and Peirce's logic-mediated approach to psychology.

## KEYWORDS

Charles S. Peirce, classical American pragmatism, history and philosophy of science, history of psychology, inferentialism (history of), unconscious inferences, Wilhelm Wundt

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## 1 | INTRODUCTION

This article provides a new perspective on the influence of Wundtian psychology in the United States. It is a roundabout influence, in that it takes the back route of unconscious inferences and walks in with a figure whose role in North American psychology is still relatively unexplored: Charles S. Peirce (1839–1914).<sup>1</sup> I say “Wundtian” because, while this influence does come from works of Wilhelm Wundt (1832–1920), it resulted in the incorporation of an element of psychological explanation—the theory of unconscious inferences—that Wundt rejected even *before* reaching Leipzig and institutionalizing his laboratory. While Wundt was not the only one to endorse unconscious inferences in the 1860s, it is his work which inspired the psychological and philosophical investigations of Peirce.

Peirce is generally known today by philosophers as the founder (with William James) of pragmatism. Son of the Harvard mathematician Benjamin Peirce, Charles was a chemist by training who spent a considerable part of his professional life working for The Coast and Geodetic Survey.<sup>2</sup> In spite of this and other occupations, Peirce conducted research in experimental psychology throughout his career, and even managed to combine it with his other scientific pursuits. In 1873, while working on a new catalogue of stars for the Harvard Observatory, Peirce tested the relation between color and perceived luminosity in stars and ended up adopting the Weber–Fechner law (which relates an increase—or decrease—in a stimulus to the intensity of the corresponding sensation) to adjust his photometric scale.<sup>3</sup> The results of his investigations would appear in 1878 under the title of *Photometric Research*.<sup>4</sup> In 1875, “Peirce received two grants [...], one to study color (\$1,200) and another to compare sensations (\$500)” (W3, p. 524). In the same year (1875), he was promoted to “Assistant” at the US Coast Survey, where he had worked as “temporary aide” since 1859. His main interest, however, was logic, and this has to be taken into consideration to understand Peirce's reception of Wundt.

Peirce's career culminated in 1879 with his appointment as a part-time lecturer in logic at Johns Hopkins University, the first doctoral school in the United States. In his Johns Hopkins years (1879–1885), a period of overwork and near-breakdown, Peirce completed some of his finest published research in logic and psychology: *Studies in Logic* (1883), which collects works of his students such as Christine Ladd (later Ladd-Franklin, 1847–1930) and Oscar H. Mitchell (1851–1889);<sup>5</sup> and “On Small Differences in Sensation,” a paper written with Joseph Jastrow (1863–1944) which questioned Fechner's notion of a threshold in sensation.<sup>6</sup> Peirce also founded and run a “Metaphysical Club” which discussed papers in logic, psychology, mathematics, and biology (Pietarinen & Chevalier, 2015).<sup>7,8</sup> In spite of these academic achievements, Peirce's position was not made permanent, and the vacant professorship of philosophy went to psychologist G. Stanley Hall (1846–1924) instead. This event derailed Peirce's academic life and deeply influenced the subsequent development of psychology in the United States (Green, 2007).

In spite of Peirce's academic failure, a small but consistent group of scholars has been trying to make his work better known among psychologists and historians of psychology alike. As mentioned, Peirce took an active interest in psychology. He was aware from early on of the publications of leading figures of experimental psychology of the time, such as Wundt and Gustav Theodor Fechner (1801–1887) (Fisch, 1965/1986; pp. 119–120). In 1973, Thomas C. Cadwallader claimed that Peirce was “the first American experimental psychologist” (Cadwallader, 1974) on the ground of Peirce's early experiments on color perception. Ian Hacking (1988) famously presented Peirce's 1885 experiment “On Small Differences of Sensations” as the first in which blinding and randomization were systematically applied. This classical and much-quoted scholarship often plays the card of Peirce's forgotten “firsts” to stress his importance as a scientist and as a thinker, yet part of Peirce's relevance lays in the ways in which he adopted theories of his time or held on to notions that were being discarded. Most recently, Murphy and Lilienfeld (2021) argue for the continuous influence of Peirce's thought in psychology, however, their account remains at a theoretical level and does not engage with nuanced historical developments.

Taking a step back from the complex question of Peirce's influence, my aim is to show how Peirce's thought in psychology built on Wundt's lesser-known “young” essays. The result of this inquiry is an increased awareness of the connections between Peirce's research and the broader context of experimental psychology, as well as a more complex picture of Wundt's influence in the United States. In particular, Wundt's early logical approach to the

mechanisms of thought had a strong appeal to the logically minded Peirce, who went on to integrate the inferential theory of perception with his theory of knowledge more broadly. To illustrate this point, I focus initially (Section 2) on Wundt's legacy in the North American context, briefly reviewing our current understanding and highlighting Peirce's own reception of Wundt. In Section 3, I expand on Wundt's early writings of 1862 and 1863, in which unconscious inferences make their first official entry. I then illustrate Peirce's early theory of perception (Section 4), showing how Peirce incorporated unconscious inferences in his broader theory of knowledge. Last (Section 5), I complicate the picture by adding distinctions to the theory of unconscious inferences with reference to Wundt, Helmholtz, and Peirce respectively, and address the question of Helmholtz's apparent lack of influence on Peirce.

## 2 | WUNDT: A COMPLICATED LEGACY

In his classic *A History of Experimental Psychology* ([1950] 1957), Edwin G. Boring introduced Wundt as the first psychologist of modern times: "Before him there had been psychology enough, but no psychologists" (Boring, 1950/1957, p. 316). However, debates around the meaning of Wundt's work polarized the community of experimental psychologists from early on. The often-quoted derogatory statements of William James (1842–1910) and of G. Stanley Hall (1844–1924), first president of the American Psychological Association, testify to this ambiguity. William James, who was called in 1896 "the psychological pope of the New World" by "a Berlin paper" (Perry, 1936, v.2, p. 145), was generally doubtful of the insights that Wundtian introspection or Fechner's psychophysics may give to psychology. In a letter to Stumpf (February 6, 1887), James famously wrote:

Whilst they [Wundt's critics] make mincemeat of some of his views by their criticisms, he is meanwhile writing a book on an entirely different subject. Cut him up like a worm, and each fragment crawls; there is no *noeud vital* in his mental medulla oblongata, so that you can't kill him all at once. (Perry, 1936, vol. 2, p. 68).

While James may not have been sympathetic to Wundt's project, he never used such a tone in his published writings, and he would in fact recognize Wundt's importance. This one statement is more famous than the many he published probably because it was repeated by Boring (1950/1957, p. 356). Different is the case of G. Stanley Hall, who framed his dissatisfaction with Wundt's psychology as a personal attack on the man in the book *Founders of Modern Psychology* (1912). Wundt himself described Hall's account as "von Anfang bis zu Ende erfunden" (invented from the beginning to the end) (Wundt, *Erlebtes und Erkanntes*, 1920, p. 155).

The response of leading North American psychologists to the work of Wundt and other German psychologists (such as Fechner) is particularly noteworthy if one considers the prestige of German higher education in the 19th century. Growing up in a country with no established research-oriented institutions, "between mid-nineteenth century and World War I, approximately 50,000 [North] Americans sought higher degrees in German (and Austrian) universities" (Blumenthal, 1980, p. 36). In spite of these numbers, Blumenthal claims that, with regard to psychology, little came back to the US besides "laboratory apparatus and the floor plan of Leipzig's laboratory" (Blumenthal, 1980, p. 37). The reference here is to the laboratory that Wundt opened in Leipzig in 1879, the conventional birth date of experimental psychology. Blumenthal lists several factors—from different philosophical orientations to language barrier—to explain the perceived lack of influence of Wundt's psychology in the United States. Indeed, the double nature of Wundt's figure, at the same time historical persona and foundational myth, and the fact that historians of psychology were often psychologists themselves, may explain the selective appropriation of his texts and the tendency to read them in accordance with one or the other "school."

Wundt's incredibly vast scientific production and the fact that it mostly remains untranslated<sup>9</sup> naturally encouraged a partial reception of his thought. While Saulo de Frejta Araujo (2016) provides the most recent attempt at systematically reconstructing Wundt's development and the intertwinement of his philosophical and

experimental research, previous studies tended to privilege an aspect or a specific moment of Wundt's thought. Thus, according to Kurt Danziger, "an appraisal of something that can justifiably be called 'Wundtian psychology' has to be based largely on the work he produced at the height of his influence during the last two decades of the nineteenth and the first decade of the twentieth century" (Danziger, 2001, p. 92). While this statement may be true of most Wundtian legacy in the United States, it should not make us overlook the plurality of interpretations of what was relevant in Wundt's production at his time.

Peirce remained attached to Wundt's early conception of psychology and to his methodology, which involved the use of logic and philosophy in addition to experiment. Already in 1869, Peirce publicly praised Wundt's inferential theory of perception as the best available explanation of the otherwise mysterious "association of ideas" (Peirce, 1869/1984, W2, p. 307). In Section 4, I come back to the context of this claim. For now, it is enough to note it, together with the fact that in the same year Peirce asked and obtained permission from Wundt to translate his 1863 *Vorlesungen über die Menschen- und Thierseele* (Lectures on Human and Animal Psychology) into English (Fisch 1965/1986, pp. 119–120)—a project which unfortunately never came to fruition.

That for Wundt was not a passing infatuation. In retrospective remarks, made at a time when Wundt had long abandoned the theoretical stances of his first period, Peirce reiterated the importance of those early writings for the discipline as well as for his own engagement with psychology. For example, in the opening paragraph of his MS *Telepathy* (1903), which contains his mature theory of perception, Peirce stated:

...ever since Wundt *inaugurated the modern science of psychology about 1862* (the date of the collected publication of his *Beiträge zur Theorie der Sinneswahrnehmung* [Essays on the theory of sense-perception],) I have pursued that study both experimentally and speculatively... (CP 7.597; emphasis added).

In MS 606 (written probably after 1903), Peirce, speaking of himself in the third person, stated that the "new method" of experimental psychology eclipsed to his eyes the greatness of discoveries in physics and medicine, and that "nobody could have been more deeply or intensely enthusiastic about this new movement in science than h[imself]" (Peirce, MS 606, 1903 p.q., p. 22–3).<sup>10</sup> In a footnote, Peirce added that "[t]he writer's own acquaintance with modern psychology began with the two important German works [“the *Psychophysik* of Fechner [and] Wundt's *Vorlesungen über die Menschen und Thierseele*, 1863]” (MS 606, p. 26).<sup>11</sup> Again, in MS 326, not dated, Peirce declared: “The *Vorlesungen über die Menschen und Thierseele* caused me to fully expect that the opening of the twentieth century would already find the profession of the psychologist recognized as quite as useful as that of civil engineer.”

Peirce's appreciation of the early Wundt was not without regret for the direction that the latter's research had actually taken. In MS 798, undated, Peirce returned to the fundamental role of inference in cognition and connected this insight to the early Wundt:

... *inference is the essential function of the cognitive mind*. I know that psychologists will protest against this, and that even Wundt, who in the first edition of his lectures in the *Menschen und Thierseele* [Lectures on Human and Animal Psychology, 1863] made the process of formation of a percept to be of the general nature of inference, has since retracted from that position. [...] Wundt, in denying, as he now does, that there is any real affinity between perception and inference may be physiologically right but logically and philosophically he is wrong. (Peirce, MS. 798, n.d., pp. 4–5).

Peirce, while commenting on Wundt's change of opinion on the inferential structure of perception, evaluated its implications on three fronts: physiology, philosophy, and logic. This does not amount to saying that psychology could be reduced to these three disciplines. Nonetheless, for Peirce results in each of these disciplines were relevant for an empirical theory of the mind. Peirce saw the inferential structure of perception as something more than a suggestive analogy, and useful enough to inform his successive practice in experimental psychology as well

as his epistemology. However, Peirce conceded that Wundt “may be physiologically right” in denying an inferential structure to perception, that is, perhaps the mechanisms according to which perception works have little to do with inferences and syllogisms. To understand this apparently contradictory stance, I now turn to the content of Wundt’s early works in sensation and perception.

### 3 | THE PSYCHOLOGY OF THE EARLY WUNDT

This account of early Wundt’s psychology is based on the two early works mentioned above: the *Beiträge* (Essays on the theory of sense-perception) (1862) and his *Vorlesungen* (Lectures on Human and Animal Psychology) (1863). The *Beiträge* are in fact a collection of essays, some of which were issued as early as 1858, but rearranged in a systematic fashion. In the *Vorlesungen*, the essential components of our psychical life (to which he refers in general as “thought” [das Denken]) are concepts, judgments, and inferences (Wundt, 1863, p. 42). However, it is inference, as a process, that we rely on to pull together judgments and concepts:

The only way known to us to tie together [Verknüpfungsweise] judgements consists in inference. Therefore, if there is an activity of the mind [Denkthätigkeit], which builds concepts out of signs [Merkmalen], this activity cannot be anything but an inference. (Wundt, 1863, p. 55; emphasis added).<sup>12</sup>

The inferential notion of perception had already been present in Wundt’s 1862 *Beiträge* [Essays]. There, Wundt saw three main advantages to adopting inferences as the underlying logical structure of conscious and unconscious processes alike, namely: (1) *economy*—one hypothesis accommodates all kinds of perception, including perceptual illusions (Wundt, 1862, pp. 437–438), (2) (provisional) *generality*—because of the significant number of cases in which it is exemplified (Wundt, 1862; p. 441), and, lastly, (3) *simplicity*—since it only requires one structure (i.e., the inferential one) to explain both conscious and unconscious processes (Wundt, 1862, p. 438). In Wundt’s own words:

Thus, the presupposition that perceptual processes have a logical foundation is a hypothesis, entirely appropriate for each perception individually, at the same time suitable for all perceptual occurrences [...]. [This presupposition] meets the essential requirement of each well-grounded theory, namely that it is the easiest possible and at the same time the most fitting description under which the facts of observation can be subsumed. (Wundt, 1862, p. 437).<sup>13</sup>

Since we do not have the ability to directly observe unconscious processes, the thesis that they develop following an inferential structure cannot but remain a hypothesis. However, it is a hypothesis that reaches the status of theory as it finds constant corroboration in explaining past psychical events and predicting future ones. Moreover, for the Wundt of 1862, this hypothesis is almost required by the absence of a fixed boundary between consciousness and unconscious, disclosed in ordinary experience. Wundt portrayed the relation between consciousness and unconscious as a fluid one, in which the perspicuity of one of the terms (the conscious side) contrasts with the obscurity of the other (the unconscious). The experienced continuity between conscious and unconscious processes leads to suppose a similar structure underlying the two processes. This is reasoning by analogy from the known to the unknown, that is, the attribution to the unconscious of a structure similar to the one that can be observed in the conscious domain, and it is precisely this kind of “philosophical” reasoning that Wundt will later reject as bad methodology in psychology (Araujo, 2016, pp. 97–98) For the time being, however, unconscious processes are modelled in analogy with conscious ones:

In the case of conscious thought, the logical form is not a hypothesis; it is rather, as noticed already, a fact of observation. But we see that it is never possible to establish a clear-cut boundary between

consciousness and unconscious. Even if, from a scientific standpoint, consciousness can be clearly defined, still in reality both states (conscious and unconscious) overlap without boundary. Such a continuous passage is only thinkable when both states are essentially similar, when consciousness appears only as the further development of one and the same fundamental state. This perspective fits perfectly with the assumption of a logical development of unconscious life (Wundt, 1862, p. 438).<sup>14</sup>

Wundt first describes as a fact the continuity of consciousness and the unconscious, only to characterize this continuity as a “hypothesis” (albeit a very plausible one) when another assumption, which quickly acquires the weight of a fact, is introduced: that inference is the logic of psychical phenomena, conscious and unconscious alike.

Wundt further explained the unconscious activity of stimuli reception and their organisation as a constructive process which, in its results, appears as the outcome of a series of inferences:

Through a more careful research on the outcomes of perceptual processes we notice, first, that these outcomes are very often mutually interconnected with each other, that particularly within the same sensory domain the realized perceptions (i.e., those perceptions which have become real for consciousness) build themselves up from easier perceptions. This building up activity, no matter how different it can be in the individual cases, still agrees in presenting itself as the outcome of a series of inferences, that is as a logical process. So far, no other hypothesis was found equally well placed to satisfy the appearances. (Wundt, 1862, p. 437).<sup>15</sup>

Wundt supported with methodological considerations the scientific validity of his observations on perception. The latter is seen as an activity, which can be modeled hypothetically in analogy with a better-known activity, namely, conscious thought processes; this hypothesis is subsequently adopted as the best possible explanation of known facts. Wundt presents his theory of unconscious inferences in perception as the best available hypothesis to explain unity in our psychical life. The unity of structure between conscious judgments and unconscious perception returns in Wundt's 1863 *Vorlesungen*, where Wundt states that “also sensory perception [sinnliche Anschauung] grounds itself on a series of inferences. As we perceive colours or sounds, we are drawing inferences” (Wundt, 1863, p. 57).<sup>16</sup> According to Wundt, unconscious inferences did not have a psychological content but rather a merely “material” one, which remained inaccessible to psychological investigation (Wundt, 1863, p. 57–58). However, because of their supposed inferential structure, they could still be modelled in analogy to the conscious processes, and their outcome could be tested experimentally. This was a crucial element for Wundt's ambitions in psychology, and another aspect that would meet Peirce's interests.

From the opening pages of his *Vorlesungen*, Wundt stressed that what was needed for psychology to become a science was that it be *experimental*. Wundt underscored that the concepts that we use in our everyday experience are in fact developed through that very experience, at every level of it:

When we do not ask how concepts are used logically, but rather research how they build themselves empirically [erfahrungsgemäß], we find that they grow only through experience. Such is the teaching of everyday observation as well as of the history of science's development. (Wundt, 1863, p. 10).<sup>17</sup>

If concepts grow through experience, experience itself could be properly understood if we gave an account of its construction. Such an account would make most sense if we supposed an (unconscious) inferential structure of perception. Thus, the inferential and the experimental aspects of psychology were strictly related in Wundt's imagined articulation of psychology.

To characterize unconscious inferences in more detail, Wundt drew from contemporary methodological authors in natural philosophy such as John Stuart Mill and William Whewell,<sup>18</sup> although their influence should not

be seen in isolation from his experimental endeavours.<sup>19</sup> Chapter 28 of the *Vorlesungen* is dedicated to the analysis of judgment from a logical standpoint. Wundt wrote:

Induction starts with the activity of tying together [verknüpfen] Facts, which are abundantly given in experience either at the same time or in regular succession. *Colligation* [die Kolligation], *the tying together of facts* [die Verknüpfung der Thatsachen], *is therefore the first step of induction.* (Wundt, 1863, p. 434. Emphasis added).<sup>20</sup>

While sharing a somehow logical structure, the first steps of perception were nonetheless unconscious and thus, in a sense, “out of control.” Cases such as common perceptual illusions offered arguments in support of such an interpretation of perception, and Wundt did exploit them. Because of the lack of consciousness in the processes that brought them about, Wundt maintained, sensory illusions cannot be dismissed at will, nor is the conscious awareness of their illusory character able to counter the impression of those perceptions. Wundt wrote:

...it is apparent that, from time to time, our feeling [Empfindung] reaches the wrong conclusion. Despite our best knowledge, such conclusion cannot be corrected, no matter the amount of commitment we put in it. This is because feeling's inferences [Empfindungsschlüsse] have nothing to do with consciousness or commitment. (Wundt, 1863, pp. 225–226).<sup>21</sup>

Sensory illusions have a long history of serving as examples in support of an inferential theory of perception. Peirce too will refer to them to illustrate the irrational “insistence” of the percept (i.e., what appears in perception) and its independence from the real or illusory character of the phenomenon causing it (Peirce, 1903; CP 7.647). Sensory illusions were such a good example because thanks to them the phenomenon of perception, which otherwise feels as an immediate impression, becomes apparent as a mediated, tentative, inferential process. In the following, I illustrate how Peirce argued for this thesis in his early theory of perception and knowledge more generally.

#### 4 | PEIRCE'S EARLY THEORY OF PERCEPTION

I claim that Peirce had a “logical approach” to psychology. This has become particularly apparent in the comparison between his psychology and William James' (Girel, 2003). In his *Principles of Psychology* (1890), James famously declared that “The attempt at introspective analysis [of thought] is in fact like seizing a spinning top to catch its motion, or trying to turn up the gas quickly enough to see how the darkness looks” (James, 1890, p. 224). In an unpublished series of objections to the text, Peirce rebuked that logic offered the tools to analyze the movement of thought, and that this was not a novel discovery either: “To cut a thought across and look at the section requires no introspection. It is one of the principal methods in mathematics, which is in no degree introspective” (Peirce 1896?, R1099; quoted in Girel, 2003, p. 186). How could Peirce be so confident that “to cut a thought across” would be a straightforward operation? It is—I claim—thanks to the inferential approach to thought borrowed from Wundt (1862, 1863).

Very early in his career, Peirce adopted the idea that perception is an inferential process happening unconsciously. He would support this theory from both an epistemological and a psychological standpoint: unconscious inferences would confirm, on the one hand, his overarching theory of knowledge as mediated and symbolic, and on the other hand, they would inform his practice as an experimental psychologist. Moreover, by being an integral part of experimental psychology, the theory of unconscious inferences in perception enabled Peirce to use results from psychology to corroborate his epistemological claims. In the following, I examine Peirce's “very acute and original *psychologico-metaphysical articles*” (Perry, 1936, p. 534. Emphasis added), to use James' words, also known as the “cognition” or “anti-Cartesian” essays; Peirce's 1865 Harvard lectures on the logic of science; an 1877 manuscript leading up to the more famous 1877–1878 essays *Illustrations of the Logic of Science*;

and Peirce's 1869 review of the second edition (edited by James Stuart Mill and Alexander Bain) of James Mill's *Analysis of the Phenomena of the Human Mind*.

The "cognition" papers are "Questions Concerning Certain Faculties Claimed for Man" (1868a); "Some Consequences of Four Incapacities" (1868b); and "Grounds of Validity of the Laws of Logic" (1869), all published in the *Journal of Speculative Philosophy*. The first two (and some of their preparatory drafts) are particularly interesting for our purposes, because they show how Peirce was using Wundt's inferential theory of perception to refute the claim that knowledge is based on "intuition," or that there is such a thing as immediate knowledge. Indeed, the inferential structure of perception goes hand in hand for Peirce with another important epistemic claim, that is, that there is no privileged "internal" standpoint from which to observe the unfolding of thoughts and sensations.

Already in a manuscript from 1866, Peirce challenged the idea that sensation is something immediate, directly intuited by arguing that even what appears as most fundamentally immediate—such as a color sensation—is in fact the result of a complex process:

Colour is sometimes given as an example of an [immediate] impression. It is a bad one; because the simplest colour is almost as complicated as a piece of music. Colour depends upon the relations between different parts of the impression; and, therefore, the differences between colours are differences between harmonies; and to see this difference we must have the elementary impressions whose relation makes the harmony. So that colour is not an impression, but an inference. (W1, p. 515–516).

This conclusion shows how Peirce's notion of perception was in line with Wundt's; moreover, the choice of the example—the sensation of color, and its dependence on comparison between different "parts of the impression"—makes Peirce's theory of perception resonate with that of another important physiologist: Hermann von Helmholtz. Although Helmholtz's full-blown inferentialism is contained in the third book of his *Handbuch der Physiologischen Optik* (Treatise on Physiological Optic), which will only appear in 1867, already in the second book (1860), Helmholtz used the concept of unconscious inferences (without naming it) to explain the phenomenon of contrast between colors. According to Helmholtz, when the perceived intensity of two colors is enhanced by their being next to each other, this perception is the product of an *unconscious judgment* of comparison. I address some of the questions connected with attributing unconscious inferences in psychology to Wundt or to Helmholtz in the next section (Section 5).

For Peirce, if so-called "simple" sensations, like seeing a color, or hearing a tone, were shown to be the outcome of a much more complex process of analysis, comparison, and inference, then they could no longer be taken for granted as first premises of our knowledge. In fact, sensations may now appear to us as *conclusions* of chains of inferences, of which we cannot have any knowledge but indirectly, through scientific research and experiment. In "Questions Concerning Certain Faculties," the theory of inferential perception is illustrated with an example from ordinary experience, such as recognizing the texture of a certain cloth by feeling it:

A man can distinguish different textures of cloth by feeling; but not immediately, for he requires to move his fingers over the cloth, which shows that he is obliged to compare the sensations of one instant with those of another. (Peirce 1868a/1984, W2, p. 197).

We are normally unaware of the need to compare different stimuli to perceive a distinct quality but—Peirce argued—we can come to see this inferential structure at work in perception when reflecting upon it. In the succeeding paper "Consequences of Four Incapacities" (1868b), Peirce supported his argument against the immediacy of visual perception with an example from physiology:

[We] often think that something is presented to us as a picture, while it is really construed from slight data by the understanding. [...] That the picture is not painted on the nerves of the retina is



absolutely certain, if, as physiologists inform us, these nerves are needle-points pointing to the light and at distances considerably greater than the minimum visible. [...] If, then, we have a picture before us when we see, it is one constructed by the mind at the suggestion of previous sensations. (Peirce, 1868b/1984, W2, p. 235).<sup>22</sup>

Perception and reasoning are seen as sharing their fundamental structure, being differentiated only by the fact that in cognition inferences are accompanied by consciousness, while in perception they are not. Consciousness itself, in the end, can be seen as a type of sensation, which is the result of a series of inferences. In "Questions Concerning Certain Faculties," Peirce claimed that "self-consciousness may easily be the result of inference" (Peirce 1868a/1984, W2, p. 204). This also was a thesis shared by the early Wundt and by Helmholtz.

Richards (1980, p. 53) already points out that, "According to Wundt's early theory, consciousness results from a series of unconscious inferences of continually greater complexity and comprehension. Initially, the infant suffers a confusion of sensations...." Wundt indeed referred to the thought experiment of the baby to illustrate how, precisely through this activity of organizing sensations, the idea of one's own body gradually emerges:

For the child, their own body is firstly only an object among all the other objects of their experience. It must be distinguished from all other experiences by very precise signs (Wundt, 1863, p. 288).<sup>23</sup>

A similar example connecting child development with scientific reasoning can be found in Helmholtz. The latter's emphasis is on the pervasiveness of experimentation, which grounds the inferences with which the senses establish the existence and reliability of external objects:

In fact, we see that children too experiment this way with objects. They turn them again and again in all directions, they grasp them with hands and mouth, they repeat this day after day with the same objects, and this way they get the impression of the objects' form, i.e., of the different visual and tactile impressions that the same object provokes when considered and felt from different sides. (Helmholtz, 1867, p. 452).<sup>24</sup>

All these examples speak to the way in which individual knowledge—of oneself and of the outer world—is gradually built from (unconscious) experiments, hypotheses, inferences. In 1865, in his first series of lectures on logic, Peirce introduced twice (second and tenth lecture) the example of a "hypothesising baby" with the purpose of illustrating hypotheses' pervasiveness and usefulness in science. While talking about the logic of science, however, Peirce brought to the audience unconscious inferences as an established fact, since the behavior of the baby is portrayed as an instance of reasoning just as obvious (in fact, more so) as Isaac Newton's (1643–1727) research method:

*Hypotheses non fingo*, said Newton; striving to place his theory on a firm inductive basis. Yet provisionally we must make hypotheses; we start with them; *the baby when he lies turning his fingers before his eyes is testing a hypothesis he has already formed, as to the connection of touch and sight.* (Peirce 1865, W1, p. 186. Emphasis added).

The gist of this example in the context of Peirce's lectures is that hypotheses are an inevitable step of any kind of cognition, including the perceptual schemes that we elaborate unconsciously as little babies; therefore, it is unimaginable to build scientific knowledge without hypotheses.

In a later text, Peirce touched on the implications of this theory for personal knowledge, or knowledge of oneself. If every sensation—even the simplest one—is constructed inferentially, every sensation is in principle hypothetical and fallible. But if this is the case, then the feeling of our own existence, which may seem at first a

most certain and indubitable fact of immediate perception, is also a kind of mediated knowledge. Our dependence on inferences puts our knowledge of ourselves on the same level as all other kinds of knowledge, and this also explains, according to Peirce, the power of other people's accounts on our own perception of ourselves: "testimony will convince a man that he himself is mad" (Peirce, 1868a/1984, W2, p. 202).

The inferential theory of perception thus brings in a notion of knowledge as testimony, a term that emphasizes its mediateness and fallibility. With it, Peirce rejected the possibility of an absolute foundation of knowledge: no alleged impression or intuition could be allowed to have a definitive "authority" on our beliefs (Peirce, 1868a/1984, W2, p. 194). Because of the inferential theory of perception, testimony constitutes the key to understand some themes which will become prominent in Peirce's later epistemology, such as his fallibilism, his anti-individualism, his emphasis on the collective nature of knowledge production. Specifically, if perception and scientific knowledge are both inferential, neither can be warranted at the level of the individual and both are in fact a collective enterprise.<sup>25</sup>

Besides the anthropological implications detailed above, the inferential theory of perception also entails important consequences for our understanding of concepts and their relations: instead of singular, disconnected sensation on one side and general ideas on the other, Peirce envisaged a situation in which ideas would be comprised of a sensational element and sensations would be, to a level, general: "It follows from this doctrine that we have no pure sensations, but only sensational elements in thought" (Peirce, 1877; W3, p. 325). This for Peirce opens up not just more research paths, but a radically new way of conceiving objects of research in the first place, including the objects of psychological research. His commitment to understanding knowledge processes comes full circle when the implications of inferential perception are used to direct further study of perception:

Now I say that a red and green can be compared in intensity with a considerable degree of accuracy. [...] So with a light & a sound. They can also be compared in intensity. [...] Consider the light of the sun, & the sound of a falling pin. In the laws of these relations of intensity between different sensations there is an immense research, a branch of science. (Peirce, 1877; W3, pp. 236-237).

Finally, to the question of Wundt's influence—I showed elements in Peirce's early accounts of perception and cognition that closely resemble Wundt's early essays (Section 3). I also argued that Peirce always characterized Wundt's early psychology in very positive terms, even after Wundt had abandoned his theory of unconscious inferences in perception (Section 2). However, did Peirce take an explicit stance in favor of Wundt and his theory in the same years in which he was writing those texts? The answer is yes.

In his 1869 review of James Mill's *Analysis of the Phenomena of the Human Mind* (2nd edition, with John Stuart Mill and Alexander Bain as editors and commentators), Peirce rejected the methodology of the "English psychologists" (with the partial exception of Alexander Bain) as grounded in "desultory experience" rather than "systematic [...] observations and measurement" (Peirce, 1869/1984, W2, pp. 303–304). According to Peirce, the "chief point of English psychology" was the Lockean thesis that "every idea is a copy of a sensation" (W2, p. 304). However, such opinion would find no warranty in experimental psychology, and its adoption by the English school would be dogmatic: "The doctrine that an idea is the copy of a sensation has obviously not been derived from exact observation. It has been adopted because it has been thought that it *must be so*..." (W2, p. 306; emphasis of the text). Like for the notion of sensations as immediate "facts" of experience, so the notion of sensations as true copies of outer objects erases the interpretative and constructive component of perception.

The problem becomes more intricate once one moves beyond the question of how the basic unit of cognition is structured, to consider the rich and varied cognitive processes that usually constitute our inner experience. John Locke (1632–1704) had introduced the doctrine of association of ideas as an empiricist explanation for the formation of more complex conceptions. However, the association of ideas—according to Peirce—could not be explained from the perspective of a purely representational account of cognition. "Association" cannot add much by itself when the only function of the mind is to represent images of the objects outside. Peirce believed that Wundt

offered the possibility to explain association's mechanism with his theory of perception as an unconscious inference:

At present, the doctrine [of the association of ideas] has received a transformation at the hands of Wundt of the most fundamental description. *He has solved the perplexing questions concerning the principles of association by showing that every train of thought is essentially inferential in its character* and is, therefore, regulated by the principles of inference. But this conception is also found in Aristotle. (W2, p. 307; emphasis added).

In a footnote, Peirce added: "This idea is fully explained in his very important and agreeably written *Vorlesungen über die Menschen- und Thierseele*" (W2, p. 307). Thus, by 1869 Peirce had absorbed Wundt's inferentialism to the point of claiming that Wundt had "solved" the problem of thought association. In contrast, the "literary" epistemology of the English school, which proposed a theory of perception as immediate representation of an object in the observer's mind, remained a "simplified hypothesis" without value for furthering inquiry.

## 5 | UNCONSCIOUS INFERENCES' INFLUENCES: WUNDT, HELMHOLTZ, AND PEIRCE

In his influential *A History of Experimental Psychology* ([1950] 1957), Boring made the decision to treat the topic of unconscious inferences while discussing Helmholtz's contributions to psychology, and justified his choice thus:

There is no doubt, however, that the theory belongs more to Helmholtz; Wundt admitted that Helmholtz was the senior, had the theory first and kept it; Wundt was the younger, took up the view later and presently abandoned it. Nevertheless, there may have been mutual interaction: Helmholtz's thorough discussion of 1866 [in the *Handbuch der Physiologischen Optik*, v. 3] is four years after Wundt's in the *Beiträge [zur Theorie der Sinneswahrnehmung]*, 1862].

While Boring's statement made room for Wundt's role in the story, the successive generation of psychologists mostly remembered the first part of the paragraph. More recent scholarship challenges this view, either by attributing more weight to Wundt's original introduction of the term "unconscious inferences" in psychology (Araujo, 2016), or by showing the long history of unconscious inferences dating as far back as the Middle Ages, to the work of the Arab mathematician Alhazen (965-1040) (Hatfield, 2002). Without further rehearsing this controversy, my purpose here is to see whether Helmholtz appears in the picture of Peirce's reception of unconscious inferences, and if yes, in what capacity. To complicate the picture, I show that the notion of unconscious inferences was present in the mind of experimental psychologists who could read it into Helmholtz's writings even before it was separately defined by Wundt (1862). Nonetheless, Peirce never discussed unconscious inferences in relation to Helmholtz and kept attributing it to Wundt even long after the latter had abandoned it.

In analyzing Peirce's use of examples of color perception to argue for the mediated origin of our sensations, I hinted to the similarity of this line of reasoning with Hermann von Helmholtz's analysis of the perception of contrast (see Section 4). In the second volume of his *Handbook*, which appeared in 1860, Helmholtz stated that two colors (such as white and black) appear more intense when seen next to each other because our sensation is the result of an underlying (unconscious) comparison between the two (Helmholtz, 1867, pp. 392.). While Helmholtz did not mention unconscious inferences explicitly in the context of the perception of contrast (i.e., the second volume of his *Optik*), Fechner managed to draft a criticism of Helmholtz's implicit theory and to append it to his *Elemente der Psychophysik* [Elements of Psychophysics], which appeared in the same year (1860). Fechner casted doubt on Helmholtz's conclusions by asking "whether the increase of the impression through contrast is due to an *act* of

*judgment* or to a *modification of the sensibility*<sup>26</sup> (Fechner, 1860, p. 568; emphasis added); that is, Fechner maintained that it was not clear how an act of comparison would lead to the perceptual result of increased intensity in the colors at hand, unless the colors had previously affected the sensibility.

In 1868, Wundt too reviewed Helmholtz's *Optik* and commented on the theory of unconscious inferences. In some passages, already noted by Araujo, 2016, p. 85), Wundt compares his theory of unconscious inferences with Helmholtz's, highlighting the differences between the latter's empirical approach and his own, described by Araujo as "logical theory of the mind" (Araujo, 2016, p. 43). The main difference between Helmholtz's theory of unconscious inferences and Wundt's, according to Araujo's reconstruction, is that the former only envisaged unconscious inferences as a form of reasoning by analogy, while Wundt would have granted them the full range of inferential forms deployed in ordinary (i.e., conscious) logical inferences. In fact, Helmholtz's take on unconscious reasoning is not strictly logical, in that it refers to an empiricist view of regularity as constructed by the repetition of occurrences:<sup>27</sup>

The described unconscious inferences from the sensations to their causes [i.e., objects of the external world] coincide thus in their results with the so-called inferences from analogy. This is because, if in more than a million times the stimulation of that area of the retina situated in the corner of the eye is due to outer light that falls into the eye from the bridge of the nose, we judge that this is also the case for every new stimulation of the area mentioned above; [this phenomenon happens] in the same way in which we believe that every single living man will die, since the result of experience so far is that all men who lived before are now dead. (Helmholtz, 1867, p. 430).<sup>28</sup>

Such a view, if it is partially in agreement with Wundt's early characterization of all laws (including mathematical ones) as "facts of experience" [Thatsachen der Erfahrung] (Wundt, 1863, p. 48), does not reflect Peirce's position on the role of logical analysis in perception. For the early Peirce (whose thought we broached in Section 4), logic is not constructed by experience, rather it is instantiated by the activity of the living organism:

But does the mind in fact go through the syllogistic process? It is certainly very doubtful whether a conclusion – as something existing in the mind independently, like an image – suddenly displaces two premises existing in the mind in a similar way. But it is a matter of constant experience, that if a man is made to believe in the premises, in the sense that he will act from them and will say that they are true, under favorable conditions he will also be ready to act from the conclusion and to say that that is true. *Something, therefore, takes place within the organism which is equivalent to the syllogistic process.* (Peirce 1868b/1984, W2, p. 214; emphasis added).

Thus, for Peirce, logic gives to the psychologist an added tool to investigate the process of thought. Peirce undoubtedly saw unconscious inferences in a different way than Helmholtz or even Wundt; however, for Wundt's early psychology Peirce had only praise (Section 2). The same cannot be said of Helmholtz's; in fact, Peirce never explicitly recognized or discussed Helmholtz's version of the theory of unconscious inferences in perception. Could it have been on account of the latter's empiricism? Or because Peirce did not want to limit unconscious inferences to the model of reasoning by analogy? To the best of my knowledge, there are only two pieces of evidence of Peirce's awareness of Helmholtz's theory and neither answers those questions. The first piece of evidence of Peirce's awareness of Helmholtz's contribution to perception comes from his review of Frazer's edition of the *Works of Berkeley* (Peirce, 1871/1984); the second is indirect, and due to G. Stanley Hall (1879). I analyze each one in turn.

In the first one, Helmholtz appears in the context of Peirce's discussion on the relevance of Berkeley's thought. Peirce described Berkeley's theory of vision as "an extraordinary piece of reasoning and might have served for the basis of the modern science" (Peirce, 1861; W2, p. 484; emphasis added). But what constituted the modern science that Berkeley's theory seemed to anticipate so closely? The "empiricist hypothesis," which Peirce attributed to

Berkeley and to the “best authorities” of his day alike, is striking in its similarity to Helmholtz's theory of perception. Helmholtz's *Optik* had recently been issued in full (1867), and Peirce even inserted a quote from it in his review. However, the quoted passage only reports Helmholtz's endorsement of pluralism in scientific theories of vision. More relevant is Peirce's rejoinder, which shows that he was aware of Helmholtz's view according to which “sensations [...] are signs of the relations of things whose interpretation has to be discovered inductively” (Peirce, 1871/1984, W2, p. 484). Conceiving sensations as signs of relations means to reject the idea of sensation as copy of an outer object and implies endorsing an inferential theory of knowledge. Given the context, this theory could well have been Helmholtz's.

In 1879, G. Stanley Hall wrote a piece on the state of “Philosophy in the United States,” in which he reviewed, among other things, Peirce's *Illustrations in the Logic of Science* (1877–1878). Hall praised the work as something that “promises to be one of the most important American contributions to philosophy” (Hall, 1879, p. 101–102). Indeed, the first two papers of the *Illustrations* are, still today, the most read of Peirce's texts: the second one, “How to Make our Ideas Clear,” contains the first version of his pragmatic maxim.<sup>29</sup> After summarizing it, Hall inserted a direct reference to Helmholtz: “Cf. Helmholtz, *Physiol. Optik*, ss. [pp.] 431–443” (Hall, 1879, p. 102). Those pages belong volume 3, Chapter 26, “On Perceptions in General,” where Helmholtz theorized the unconscious and inferential structure of perception. This reference obviously does not prove that Peirce was directly inspired by Helmholtz in coming up with his rules for clarifying ideas. Nonetheless, it is striking to see that it could have been perceived as such by one of his contemporaries—especially since Peirce did not mention Helmholtz anywhere but in the Berkeley review. Eventually, choosing to disregard Helmholtz and to quote Wundt is another interesting feature that sets Peirce's experimental psychology apart from the canonical, Boring-informed history of psychology in the United States. Even before Boring, psychologists seemed to associate unconscious inferences more to Helmholtz than to Wundt.

## 6 | CONCLUSION

This article argued that Charles S. Peirce's inferential theory of perception is not a philosophical oddity of the “first American experimental psychologist” (Cadwallader, 1974), but rather constitutes an important heritage linking Peirce to the tradition of 19th-century German psychology in general and to the specific formulations of Wilhelm Wundt in his early writings on psychology in particular. While Wundt may have been the first to attribute a specifically psychological meaning to the notion of unconscious inferences in perception, such a notion was shared among philosophers, physiologists, and psychologists. I discussed those notions in which Peirce and Wundt are closer, highlighting how the inferential model of perception informs Peirce's epistemic essays on the origins of knowledge, be it of ourselves or of the outer world. With the notion of unconscious inference, both lay and specialist knowledge are further connected to perception, in that all three instantiate the same (inferential) structure. Thus, building on the work of Wundt, Peirce was able to conceive an anthropology of the self as a social animal, in which both perception and reason share the same inferential and hypothetical structure.

Of course, in spite of all these similarities, the work of Peirce is distinct from Wundt's and would become more and more distant with time. As mentioned, Wundt in the 1870s retracted from his early inferentialism, which he then saw as too philosophical and not psychological enough. Peirce, while pursuing experimental psychology in different contexts, never abandoned his logical assumptions. While eventually admitting that perception may not be exactly an inference, still Peirce maintained that the inferential model had the unmatched advantage of making perceptual processes understandable.

If Peirce clung to the inferential model of perception, this does not mean that he pursued a purely philosophical, “armchair” psychology. As mentioned in the *Introduction*, Peirce conducted research in experimental psychology throughout his career, on color perception (Peirce, 1877/1986) and unconscious perception (Peirce & Jastrow, 1885). Unconscious inferences were not, for Peirce, purely a formal description of mental processes, but rather an

open-ended program of inquiry. His legacy on the development of American psychology still needs a comprehensive assessment.

Wundt rejected both the unconscious and the inferential model of perception, but this did not make his psychology less philosophical. In fact, striving toward a more empiricist approach to perception, Wundt would adopt the method of analysis and the technique of introspection to investigate the contents of the mind. In a sense, Wundt changed his philosophical banner, moving away from a theory that was perceived as too close to applying an a-priori, subjective structure to our experience, and trying instead to investigate "objectively" how the contents of our mind are formed.

Eventually, both Wundt and Peirce's influence on the development of American psychology was mediated and questioned (as seen in Section 2). Nonetheless, their work retains value for understanding the development of American psychology. Like Titchener in the beginning of the 20th century, Peirce too made a choice about which parts of Wundt to promote. This choice was guided by (and at the same time contributing to) a less individual-centric theory of the mind. Developing the historical and philosophical implications of this theory would be a significant contribution to the history of psychology and to our understanding of the scope and limitations of contemporary research practices.

## CONFLICT OF INTEREST

The author declares no conflict of interest.

## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study. Please see the reference list for primary sources that were analyzed.

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## ENDNOTES

- <sup>1</sup> In the following, I adopted the current citation practice of Peirce's works: CP, followed by volume and paragraph number, stands for *Collected Papers of Charles Sanders Peirce*; W, followed by volume and page number, for *Writings of Charles S. Peirce: A Chronological Edition*; MS, followed by the manuscript number and page number, for the unpublished manuscripts in the Houghton Library of Harvard University, as catalogued in Richard Robin's *Annotated Catalogue of the Papers of Charles S. Peirce* and "The Peirce Papers. A Supplementary Catalogue" (Peirce, 1971). To facilitate historical understanding, I integrate those abbreviated references with their first publication date and mention their extended title in the text (Peirce, 1932-195, 1982-2009).
- <sup>2</sup> For a Chronology of Peirce's life and works Joseph Brent's (1993) biography of Peirce is at the moment the only complete biographical work on Peirce. Of note, the US Coast Survey changed its name to The Coast and Geodetic Survey in 1878.
- <sup>3</sup> As suggested by Fechner himself: Fechner (1860), Zusatz [Appendix] B, "Anwendung der Unterschiedsmassformel auf die Schätzung der Sterngrößen" [Application of the formula for the measurement of differences to the estimation of stars' magnitude].
- <sup>4</sup> It is interesting that the book was published in Leipzig by Engelmann, who soon became Wundt's main publisher. I wish to thank an anonymous reviewer for drawing my attention to this point.
- <sup>5</sup> Christine Ladd-Franklin, the first woman to earn a PhD in the United States (although she had to wait 1926 to have it awarded), also distinguished herself in psychology for her contributions to color theory. See Ladd-Franklin (1929); Furumoto (1994); Pietarinen (2013).
- <sup>6</sup> See also Jastrow (1888). Jastrow is known today mostly for his work on illusions. He founded the first experimental psychology laboratory at the University of Madison, Wisconsin, although his career was hampered by a lack of pay rise and by anti-semitism (Petit, 2007).

- <sup>7</sup> A “first” Metaphysical Club was started probably around 1872 in Cambridge, MA, and featured William James, Chauncey Wright, and C. S. Peirce among its members (Fisch, 1981, p. 129). In later recollections, Peirce mentioned that it is in this context that pragmatism was born; see Fisch, 1986 [1964–1965].
- <sup>8</sup> This date also has been the source of controversy; as Araujo, 2016; 7, footnote 12) notes, “it was Wundt himself, not Titchener or Boring, who fixed the date of 1879 for the beginning of the psychological experiments in Leipzig.”
- <sup>9</sup> Titchener translated into English the second (and much shorter) version of Wundt's *Vorlesungen*, (Wundt, 1892), from which unconscious inference had been entirely expunged. Titchener's was criticized for its emphasis on the empiricist elements of Wundt's book. Charles H. Judd (1873–1946) translated Wundt's *Outlines of Psychology* in 1867, and the text went through 3 editions. Judd's are the only translations revised and approved by Wundt himself (Rieber, 2001, p. 157).
- <sup>10</sup> “It was more than 40 years ago than the writer (i.e., C. S. Peirce) was among the first to be impressed by the awakening physiological and directly experimental psychology; and nobody could have been more deeply or intensely enthusiastic about this new movement in science than he, to whom all the great steps that had been taken before his eyes, the mechanical theory of heat, the conservation of force, the spectrum analysis, anesthetics, seemed to be quite outdone and faded by this new method.” (Peirce, MS 606, 1903 p.q., p. 22–23).
- <sup>11</sup> Peirce also added that “the science itself (i.e., the science of psychology) took its rise in England” (Peirce, MS 606, 1903 p.q., p. 26). I aim to discuss elsewhere the precise terms in which the English school of psychology would have influenced Peirce.
- <sup>12</sup> Wundt 1863, p. 55: “Die einzige Verknüpfungsweise der Urtheile, die uns bekannt ist, besteht in dem Schluß. Wenn also eine Denkhätigkeit existiert, die aus den Merkmalen den Begriff bildet, so kann dies Thätigkeit nichts als ein Schluß sein.”
- <sup>13</sup> Wundt 1862, p. 437: “Es ist demnach die Voraussetzung der logischen Begründung der Wahrnehmungsvorgänge eine Hypothese, die für jede einzelne Wahrnehmung vollständig passend ist, und die zugleich auf alle Wahrnehmungsvorgänge passt, [...] sie hat das wesentliche Erforderniss jeder fest begründeten Theorie, dass sie der einfachste und zugleich passendste Ausdruck ist, unter welchen die Thatsachen der Beobachtung sich subsumieren lassen.”
- <sup>14</sup> Wundt 1862, p. 438: “Für unser bewusstes Denken ist die logische Form nicht eine Hypothese, sondern, wie schon bemerkt, eine Thatsache der Beobachtung. Wir sehen aber, dass sich zwischen Bewusstsein und Unbewusstsein eine scharfe Grenze niemals ziehen lässt. Mag auch vom wissenschaftlichen Standpunkte das Bewusstsein scharf definierbar sein, in der Wirklichkeit gehen stets beide Zustände ohne Grenze in einander über. Ein solcher kontinuierlicher Übergang ist nur denkbar, wenn die beiden Zustände in ihrem Wesen mit einander übereinstimmen, wenn das Bewusstsein nur als die weiter Entwicklung eines und desselben Grundzustandes auftritt. Diese Betrachtungsweise passt nun vollständig zu der Annahme einer logischen Entwicklung des unbewussten Lebens.”
- <sup>15</sup> “Erstens bemerken wir bei genauer Untersuchung der Resultate der Wahrnehmungsvorgänge, dass dieselben sehr häufig in gegenseitiger Verbindung mit einander stehen, dass insbesondere innerhalb eines und desselben Sinnesgebietes die verwickeltern Wahrnehmungen aus einfacheren sich zusammensetzen. Diese Zusammensetzung, so verschieden sie in den einzelnen Fällen sein mag, hat doch immer das Übereinstimmende, dass sie als das Resultat einer Reihe von Schlüssen, also eines logischen Processes sich betrachten lässt, während bis jetzt keine andere Hypothese aufgefunden wurde, welche in ähnlicher Weise den Erscheinungen zu genügen im Stande ist.”
- <sup>16</sup> “Sogar die sinnliche Anschauung gründet sich schon auf Reihen von Schlüssen. Wenn wir Farben oder Töne wahrnehmen, so machen wir Schlüsse.”
- <sup>17</sup> “Wenn wir nicht darnach fragen, wie die Begriffe logisch verwandt sind, sondern untersuchen, wie sie sich erfahrungsgemäß bilden, so ergibt es sich, daß sie selber sich nur auf dem Weg der Erfahrung entwickeln. Dies lehrt uns ebensowohl die alltägliche Beobachtung wie die Entwicklungsgeschichte der Wissenschaft.”
- <sup>18</sup> On the respective influences of Mill and Whewell on Wundt, see Araujo, 2016; p. 40, n. 49; pp. 65–66.
- <sup>19</sup> On the role of Uncle Friedrich Arnold and of the chemist Robert Wilhelm Bunsen (inventor of the burner bearing his name) in fostering Wundt's commitment to the experimental method, see Araujo, 2016, p. 66. Other better-known influences are Johannes Müller, Emil du Bois-Reymond, and Helmholtz.
- <sup>20</sup> “Die Induktion beginnt damit, daß sie Thatsachen, welche ihr in der Erfahrung in einer großen Zahl von Fällen entweder gleichzeitig oder in regelmäßiger Folge gegeben werden, steht mit einander verknüpft. *Die Kolligation, die Verknüpfung der Thatsachen, ist daher die erste Stufe der Induktion.*” Emphasis added.
- <sup>21</sup> “...es hat sich ja gezeigt, daß wir in der Empfindung zuweilen Fehlschlüsse machen, die dann unser besseres Wissen mit aller Absicht nicht zu korrigieren im Stande ist, eben weil jene Empfindungsschlüsse mit Bewußtsein und Absicht gar nichts zu thun haben.”

- <sup>22</sup> The same point (almost same wording) is also made in Peirce's previous essay, "Questions Concerning Certain Faculties Claimed for Man," W2, p. 198.
- <sup>23</sup> Wundt 1863, p. 288: "Dem Kinde ist der eigene Leib zunächst nur ein von allen andern Gegenständen seiner Erfahrung geschiedenes Ding, das durch ganz bestimmte Merkmale von allen sonstigen Erfahrungen geschieden werden muß."
- <sup>24</sup> Helmholtz, 1867, p. 452: "In der That sehen wir auch die Kinder in dieser Weise an den Gegenständen experimentiren. Sie drehen sie immer wiederholt nach allen Seiten, betasten sie mit den Händen und dem Munde, wiederholen dies Tag für Tag mit denselben Gegenständen, und prägen sich so ihre Form ein, d. h. die verschiedenen Gesichts- und Tasteindrücke, welche derselbe Gegenstand, von verschiedenen Seiten betrachtet und befühlt, gewährt."
- <sup>25</sup> It is interesting to note that, although Wundt dismissed his inferential theory of perception as too philosophical for empirical psychology in 1874 (see Ch. 1), he developed some of its consequences at the level of *Völkerpsychologie*, i.e. at a social level.
- <sup>26</sup> Fechner, 1860, 568: "...ob die Hebung der Eindrücke durch den Contrast bloß auf einem Acte des Urtheiles oder auch auf einer Abänderung der Empfindlichkeit beruhe." Emphasis added.
- <sup>27</sup> Boring rightly saw this aspect in Helmholtz; perhaps his mistake was to take Helmholtz's version of the theory of unconscious inferences for the correct description of that theory in general: "The doctrine of unconscious inference (unbewusster Schluss) is historically a very important part of Helmholtz's theory of perception and thus of his systematic psychology. The doctrine is really a corollary of the empiristic [sic.] position." (Boring [1950/1957], p. 308).
- <sup>28</sup> Helmholtz, 1867, p. 430: "Die bezeichneten unbewussten Schlüsse von der Sinnesempfindung auf deren Ursache sind nun in ihren Resultaten den sogenannten Analogieschlüssen congruent. Weil in einer millionenfachen Ueberzahl von Fällen die Erregung der Netzhautstellen am äusseren Augenwinkel von äusserem Lichte herrührte, welches von der Gegend des Nasenrückens her in das Auge fiel, urtheilen wir, dass es auch in jedem neu eintretenden Falle so sei, wo die genannte Netzhautstelle erregt wird, ebenso, wie wir behaupten, dass jeder einzelne jetzt lebende Mensch sterben werde, weil bisher die Erfahrung ergeben hat, dass alle früher lebenden Menschen gestorben sind."
- <sup>29</sup> The paper in question is "How to Make our Ideas Clear" (1878), and the first version of the pragmatic maxim goes: "Consider what effects, which might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object." Peirce, 1878; W3, p. 266.

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**How to cite this article:** Cristalli, C. (2022). Unconscious inferences in perception in early experimental psychology: From Wundt to Peirce. *Journal of the History of the Behavioral Sciences*, 58, 432–448. <https://doi.org/10.1002/jhbs.22211>