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Objectifying the Phenomenal in Experimental Psychology: Titchener and Beyond

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Résumé : Tout en situant la méthode introspective de Titchener dans l'environnement intellectuel de la psychologie expérimentale naissante, nous examinons la notion d'erreur du stimulus proposée par ce savant dans l'étude de l'expérience mentale. Nous suivons l'évolution ultérieure de l'expérimentation dans le domaine de la perception, principalement dans la littérature américaine avec, au besoin, quelques références à la littérature britannique et allemande. Des chercheurs ont par la suite transformé la notion spécifique d'erreur du stimulus en questions d'ordre expérimental dans lesquelles les attitudes des sujets par rapport aux tâches perceptives devinrent les variables indépendantes à manipuler expérimentalement. Ces manipulations plaidèrent en faveur de la distinction entre l'accès phénoménal et les aspects cognitifs des réponses des sujets aux objets de stimulation.

Abstract: This paper examines Titchener's notion of stimulus error in the experimental study of mental experience. It places Titchener's introspective methods into the intellectual world of early experimental psychology. It follows the subsequent development of perceptual experimentation primarily in the American literature, with notice to British and German studies as needed. Subsequent investigators transformed the notion of a specifically stimulus error into experimental questions in which subjects' attitudes toward their perceptual tasks became independent variables to be manipulated experimentally. Ultimately, these manipulations supported a distinction between accessing phenomenal as opposed to cognitive aspects of subjects' responses to stimulus objects.

1 Introduction

Experimental psychology arose in the nineteenth century when experimental techniques were applied to the investigation of mental phenomena, especially sensory states. The early applications, at mid-century, included Ernst Heinrich Weber's and Gustav Fechner's psychophysical studies of various sensory phenomena and experiments on color perception by Hermann von Helmholtz and others. In the 1880s and 1890s experimental studies multiplied, not only on sensory phenomena but also on reaction times and memory and attention.

Together with this expanded application of experimental techniques came methodological literatures on the new approaches. These included focused critiques of psychophysics and wider discussions of the notion of introspection or self-observation [*Selbstbeobachtung*] (e.g., [Wundt 1888], [Scripture 1899, chap. 1], [Titchener 1912a,b]).

At first taking its place in German universities—where Wilhelm Wundt and colleagues at Leipzig and Georg Elias Müller and colleagues at Göttingen trained early generations of experimenters—from 1890 this avowedly “new” psychology grew most rapidly in North America and specifically the United States.

In the United States, the experimental psychology of introspection was most closely allied with Edward Bradford Titchener. A classics and philosophy undergraduate at Oxford, he took his doctorate with Wundt at Leipzig and then accepted a position at Cornell University, teaching there from 1892 until his death in 1927. Until at least 1915, he retained a notion of *experimental* or *scientific introspection* as the fundamental method of psychology.¹ In standard historical surveys (e.g., [Palmer 1999, 48–50]), his approach is characterized as bankrupt. In connection with the imageless thought controversy, his methods provided fodder for J. B. Watson [Watson 1913, 163–164] and other detractors who sought to undermine introspectionist and mentalist psychology.

This standard story has been challenged in various ways [Beenfeldt 2013, ix], [Hatfield 2002]. My aim here is to follow the development of an approach to perceptual experimentation that arose, at least partly, out of Titchener's methodological reflections and took on a life of its own. In Titchener's hands, the methodological topic concerns the “stimulus error”, which (pending closer description) arises when experimental subjects in studies of sensory perception focus on what they think, know, or judge the stimulus object to be, rather than describing or indicating the characteristics of their own perceptual experience.

1. From 1915, Titchener's publication rate diminishes and there is talk of a new system, only part of which was written and then published posthumously [Titchener 1929]. In the 1920s, he no longer uses the term “experimental introspection” but he still invokes the importance of experiment and of self-observation, for example, of after-images [Titchener 1929, 41–45]. There is appreciation for a phenomenological turn in psychology [Titchener 1925, 323], but these remarks are sketchy.

Titchener's brand of introspection went hand-in-hand with a theoretical conception that sensory experience is constituted out of elements, which include "sensations". The stimulus error occurs when, in an experiment in psychophysics, subjects describe a stimulus aspect (say, the length of a line) using knowledge or measurement of the objective physical length instead of focusing on their own sensations (phenomenal experience of the line's length [Titchener 1910, 7, 202]). Titchener's concerns arose within a theoretical outlook that sought to isolate, as much as is possible, meaningless sensations as the ultimate constituents of integrated perceptions—the line as a black extent, not treated as a mark on a surface.

Interpreters disagree on the specific characteristics of Titchener's theoretical framework and its intellectual origins. Some characterize Titchener as hewing theoretically to traditional English associationism [Beenfeldt 2013], [Brock 2013, 30–31], while others have him turning to embrace a German tradition stemming from Wundt and Oswald Külpe (Wundt's assistant when Titchener was at Leipzig) [Boring 1929, 402–413].² The sensory atomism of both traditions, along with the introspective search for elemental dimensions of phenomenal experience, came under challenge on several fronts, especially in the Gestalt psychologists' notion of direct experience, e.g., [Köhler 1929, 8, 35], which was well known in the American context.³ Nonetheless, the role of Titchener's discussion as an impetus to methodological reflection in experimental sensory psychology should not be undervalued. By tracing the subsequent fate of discussions initiated over stimulus error, we can follow a notion of *introspection* or *experimental introspection* that continues to the present day.

2. Titchener was at Leipzig from 1890 to 1892. Külpe was first there in 1881–1882, returning as Wundt's student in 1886, taking his doctorate in 1887 (on a topic begun with Müller in Göttingen) and becoming Wundt's assistant. He published his *Outlines* in 1893 [Külpe 1893], was promoted to extraordinary professor, and left in 1894 for Würzburg. Külpe dedicated the book to Wundt. He agreed with Wundt that sensations are simple elements but differed in ascribing spatial attributes to visual and tactual sensations [Külpe 1893, 335, 373]. (They also disagreed in interpreting reaction-time experiments.) Titchener translated Külpe's book, as he did some of Wundt's. Külpe's (and the Würzburger's) radical divergences from Wundt and Titchener on imageless thought started after 1905. When in 1909 Titchener accused the Würzburgers of the "stimulus-error" [Titchener 1909, 145], he was applying a concept he had already developed.

3. The Gestaltists active in America (primarily, Wolfgang Köhler, Kurt Koffka, and Max Wertheimer; later joined by Kurt Lewin) were opposed to the introspective search for simple elements, which Köhler criticized early [Köhler 1913]. Still, they advocated starting from what Köhler called "direct experience" [Köhler 1929, chap. 1–2], which may itself be seen as a form of introspection [Hatfield 2002, 2005]. According to Köhler, "direct experience" is of a world of meaningful objects (a lake, some trees, a boulder) in three dimensions. An honest description of such experience would be a naive description of this world (as containing a lake before one, a boulder to sit on, and so on), which does not privilege descriptions based in the science of physics.

This paper examines Titchener's notion of stimulus error in relation to the experimental investigation of phenomenal experience, or what he variously termed (conscious) "mental experience" [Titchener 1897, 12], or "human experience considered as dependent on the experiencing person" [Titchener 1910, 16]. It follows the subsequent development of perceptual experimentation primarily in the American literature, with notice to British and German studies that entered this stream. It discusses how Titchener's outlook was eventually supplanted by more sophisticated approaches to perceptual experimentation and by less theory-driven descriptions of phenomenal experience. These new approaches to perceptual experimentation did not seek specifically to neutralize subjects' presumed favoring of physical descriptions, but rendered subjects' attitudes toward both stimulus objects and their own experiences as independent variables to be manipulated and evaluated experimentally. They sought to reveal what the manipulation of attitude could uncover about both phenomenal and cognitive aspects of subjects' perceptual responses.

2 Titchener, introspection, and the stimulus error

Although Boring reviews several applications of the term "stimulus-error" [Boring 1921], its primary meaning derives from Titchener, who finds that even though subjects in experiments have been directed to report on sensations, they instead make responses using their beliefs about the physical stimulus:

We are constantly confusing sensations with their stimuli, with their objects, with their meanings. Or rather—since the sensation of psychology has no object or meaning—we are constantly confusing logical abstraction with psychological analysis; we abstract a certain aspect of an object or meaning, and then treat this aspect as if it were a simple mental process, an element in the mental representation of the object or meaning. [Titchener 1905a, xxvi]⁴

The "error" results when, instead of holding object-perception and meaning in abeyance, the subject gathers an object-content from perception and reports it. Titchener gives examples from auditory, gustatory, and haptic perception and describes the tendency in visual spatial perception to overlook sensations

4. Titchener introduces the term itself in the instructor's part of his lab manual, using the formulation "R-error", where "R" stands for German *Reiz*, meaning "stimulus" [Titchener 1905b, lxiii, 198]. The English "stimulus-error" is found at [Titchener 1909, 145]. Titchener's claim that sensations have no intrinsic meaning is based in theory; he ultimately does not claim that we must be able to experience sensations in complete isolation [Titchener 1915].

(which correspond to “peripheral cues”) in favor of objects arrayed in space [Titchener 1910, 314]. According to him, the elemental sensations of vision are bidimensional (planar), and we acquire perception of the third dimension (or depth) [Titchener 1910, 303–306].

Titchener’s notion of stimulus error must be understood in the wider context of his psychological theory. He believes it should be possible to focus on sensations, or at least phenomenal dimensions of sensations (e.g., hues, pitches), by ignoring “meaning”, including any conception of an object as possessing its own attributes. Let us consider his theoretical commitments as they condition his notion of stimulus error.

2.1 The background to Titchener’s theoretical conceptions

Boring described Titchener as “an Englishman who represented the German psychological tradition in America” [Boring 1929, 402]. This oft-repeated characterization has been challenged. Beenfeldt forcefully argues that Titchener was rather a representative of British associationism [Beenfeldt 2013].

Beenfeldt attributes four characteristics to British associationism, which he also finds in Titchener’s thought:

- (1) a reductive decomposition of human mental life into (2) elements that ultimately are (3) sensationistic in nature and (4) follow certain law-like regularities (e.g., the classical laws of association). [Beenfeldt 2013, 41]

Accordingly, David Hume, David Hartley, and James and John Stuart Mill provide the fundamental background for Titchener’s psychology, including a notion of “mental chemistry”, according to which associations can yield novel qualities, taken from John Stuart Mill [Beenfeldt 2013, 42].

In fact, Titchener rejected or modified all of these points and was highly critical of the “English” associationism.⁵ Rather than asserting outright that

5. His criticisms gained strength and explicitness between the early *Outline of Psychology* [Titchener 1897, 190–191] and later works [Titchener 1909, 22–37], [Titchener 1910, 374–395]. Those emphasizing Titchener’s English background often quote this sentence from the *Outline*: “The general standpoint of the book is that of the traditional English psychology” [Titchener 1897, vi], while omitting the ensuing sentence: “The system which is outlined in it, however, stands also in the closest relation to that presented in the more advanced treatises of the German experimental school, Külpe’s *Outlines of Psychology* and Wundt’s *Grundzüge der physiologischen Psychologie*” [Titchener 1897, vi]. We may ask what general aspect of the “English” psychology Titchener meant to endorse and what aspects of “system” he gleaned from Wundt and Külpe. Perhaps he adopted the general framework of introspection and elements from British psychology; but he rejected much of the rest of their framework, as he understood it (including sensations as “static” elements [Titchener 1915, 265]).

mental life can be reduced to sensational elements and their laws of combination, he adopted decomposition into elements as a “heuristic” attitude, which reflected his estimation that science begins with analysis into constituents. His elements were provisional. He distinguished his “sensationalism” from traditional “associationism”, contending that the latter (a) did not properly distinguish epistemology from psychology; (b) treated ideas as static entities, like the blocks out of which a mosaic is constructed, rather than as transitory processes, as, he says, Wundt has taught us to think; and (c) invoked the superseded notion of mental chemistry.⁶ He rejected the traditional “laws of association” for trying to connect “ideas” as static epistemological blocks [Titchener 1909, 24–28] and as overemphasizing connections based on succession as opposed to simultaneity [Titchener 1910, 390].

A more promising conceptual background for Titchener’s description of the stimulus error is the general distinction between sensations, or sensational elements, and perception of objects through complex ideas or representations. Such a distinction can be found in traditional associative accounts, but Titchener was more in tune with Wundt’s elementism.⁷ Wundt defined sensations [*Empfindungen*] as “those states of our consciousness that cannot be analyzed into simpler constituents” [Wundt 1880, 1: 271]. They differ among themselves only in quality and intensity. Sensations from the sense organs divide into those of touch, sound, temperature, smell, taste, and sight (light) [Wundt 1880, 1: 272, 278–279]. Perceptions [*Wahrnehmungen*], which Wundt also called intuitions [*Anschaungen*], are by contrast a type of idea [*Vorstellung*], namely, one that “refers to an actual object” present to the senses [Wundt 1880, 2: 1].

The distinction between elemental sensations and perceptions of objects was deeply embedded in German sensory psychology. Helmholtz prominently and notoriously wrote that we ignore our sensations except insofar as they

Although he did not accept Wundt’s voluntarism [Titchener 1909, 36–37] with its active subject [Titchener 1897, 119–120], he did accept Wundt’s search for elements conceived as “processes” and his conception that sensory processes include “passive experiences”, that is, laws of connection yielding syntheses that are in some ways associative [Wundt 1901, 24, 276].

6. He held that experimental psychology has “transcended” the chemical analogy [Titchener 1909, 32]; Wundt, too, had recently found aspects of disanalogy between chemical and psychical synthesis [Wundt 1893, 2: 46], [Wundt 1908, 269–271], after earlier using the analogy without apology [Wundt 1880, 2: 28].

7. Wundt scholarship since the 1980s has curiously denied that Wundt sought the elements of sensory processes; see [Beenfeldt 2013, 29]. It is almost as if, having discovered that certain aspects of Wundt had been de-emphasized in America, such as his voluntarism and his ethnographic psychology, scholars felt the need to define Wundt exclusively in terms of what had been omitted. But despite his emphasis on active synthesis, apperception, attention, and the will, Wundt regarded sensory processes as involving the synthesis of elemental sensations and set as a task for psychology the discovery of elemental processes [Wundt 1880, 1: 271], [Wundt 1901, 29–31].

are informative of external objects, which are, accordingly, the usual objects of our perceptions proper. The elemental sensations that initially arise from sensory stimulation become so embedded in external perception that we are unaware of the sensations themselves and their relations: “the connection between sensations and external objects may interfere very much with the perception of their simplest relations” [Helmholtz 1866, 3: 9].⁸ Helmholtz in fact adopted, as did Wundt, the view that sensations are non-spatial and that all spatial organization takes place by learning. Wundt more generally held that the psychologist always begins from “composite psychical experience” and seeks “psychical elements” by a process of “analysis and abstraction” [Wundt 1901, 32].

Titchener was well aware of Helmholtz’s and Wundt’s postulation of non-spatial sensations [Titchener 1910, 304–305], but nonetheless maintained that primitive visual sensations are two-dimensional.⁹ At the same time, he accepted that naive subjects naturally attend to objects and their properties as opposed to sensations. Ernst Mach also endorsed a distinction between sensation or sensory elements and complexes of such elements [Mach 1886]. And in America, George T. Ladd, an early expositor of the “new” psychology, followed the German tradition closely. He distinguished between “sensations” (as “modes of our being”) and presentations of “objects” or “things” with their inherent properties. The latter perceptions are a product of development, so that an adult psychologist “does not remember by what stages he first learned to see or feel the extended and external objects of sense” [Ladd 1889, 382]. Nonetheless, he held that presentations are elaborated “from the material of simple sensations” through various processes, including a Wundtian “synthetic” process [Wundt 1880, 2: 29, 164, 177], which he glossed as a “constructive” process [Ladd 1889, 387–388].

8. Helmholtz expressed this outlook in an early lecture on music (Bonn, 1857): “It is a universal law of the perceptions obtained through the senses that we pay only so much attention to our sensations as is sufficient for us to recognize external objects. [...] All sensations which have no direct reference to external objects we are accustomed, as a matter of course, entirely to ignore” [Helmholtz 1896, 98]. He was speaking of the upper partial tones that can be isolated through practice or using laboratory instruments, which, as he saw it, allows the listener to discover in a musical note—originally heard simply as the sounding of an instrument—a complex set of partial tones. Terminologically, Helmholtz distinguished the “sensations of vision” [*Gesichtsempfindungen*], comprising light and color, from the “perceptions of vision” [*Gesichtswahrnehmungen*], extending to the “existence, form and position of external objects”; perceptions are formed from sensations [Helmholtz 1866, 2: v; 3: 1; also, 3: 533]. His more intricate terminological distinctions [Helmholtz 1866, 3: 10] need not detain us.

9. The idea that sensations originally are aspatial and possess only quality and intensity became prominent in the nineteenth century together with the notion that each sensory nerve fiber produces a single sensation [Hatfield 1990, 157–158, 184]. In denying this tenet of Wundt and Helmholtz, Titchener sided with older theory but also with a recent trend among his contemporaries.

2.2 Titchener, introspective analysis, and synthesis

Titchener echoed the general sort of distinction made by Helmholtz, Wundt, Mach, and Ladd, in distinguishing (a) sensations as elements having the attributes of quality, intensity, temporal duration, and (sometimes) spatial extent—aspects of which one may hope to partially isolate in consciousness—from (b) perceptions compounded from sensations and imbued with meaning by their relation to other sensations. His psychology aimed to find the basic elements of mental life by analysis (provisionally, the basic elements are sensations, images, and affections or emotions) [Titchener 1910, 36–41, 47–48]. This analysis was then supplemented by a synthesis of the elements to constitute complex perception.¹⁰ Such syntheses yield psychological “meanings”, which are contexts of sensations and, in a manner not fully explained, yield reference to objects via organism-environment interaction [Titchener 1909, 175–179]. “Pure perceptions”, which are rare, would be complexes only of sensations; “mixed perceptions” include both sensations and images (often, memory images) [Titchener 1910, 364–365].

Titchener held that although the sensations of vision are two-dimensional and come from two eyes, we nonetheless experience unitary objects at a distance through meaning. Accordingly, perceivers normally overlook the pervasive double images found in a stationary field of objects at various distances under steady fixation. While acknowledging other factors, such as roving fixations or suppression of one image, he attributed binocular unity “perhaps mainly, to cortical set or adjustment; we mean, expect, are disposed to see singly things that are objectively single” [Titchener 1910, 309, note 1]. Still, in a psychological experiment, if experiencing a double image, one should report it on pain of committing the stimulus error. In such experiments, one is not aiming to elicit a physical description of an objectively single object. Titchenerian sensory experimentation aims for a description of experience, and not a report based on knowledge of objects from past experience or on an interpretation (that a single object is present) gleaned from their double vision.

It was part of Titchener’s view that sensations and images are adequate to account for all the content of perception. In his *Text-Book*, at the end of the long section on perception, he discussed an objection to his outlook that perception involves only sensations as supplemented by images and meanings [Titchener 1910, 367–368]. According to the objection, the contents of perceptions are more than the combination of their parts. Complexes such as melodies or shapes include as a distinct element a “form of combination”. Accordingly, a square is

10. In addition, Titchener’s psychology includes explanation through the physiological conditions of mental life, which leads to his psychophysical parallelism and denial that neural processes cause mental processes while still claiming that physiology is explanatory in psychology [Titchener 1910, 39–41], views that cannot be examined here.

more than four linear extensions, sensibly of the same length, and occupying certain relative positions in the visual field; [...] squareness is a new character, common to all squares, but not to be explained by attention, or by the laws of sensory connection, or by those of imaginal supplementing. [Titchener 1910, 372]¹¹

His reply to this objection is revealing of his conception of the (at least provisional) task of experimental and introspective psychology. To the proposal that a “form of synthesis” is distinct from the elements as synthesized, he answered:

this attitude betrays a confusion of the analytic and the genetic points of view. We cannot generate the square from lines, or the melody from rhythm and scale; but neither is that what we try to do. The square and the melody are given, as perceptions. Our psychological task is to analyse these given perceptions, to discover their elements, and to formulate the laws under which the elementary processes combine. That done, we can write, for “square” and “melody”, “these and these elements connected in these and these uniform ways”, and we can go on to search for physiological conditions (§9). We have solved our problem in analytical terms; we have not first defined the terms, and then put them together to produce something that was not contained in the definition.—The author cannot, in his own introspection, identify the form of combination as a distinct mental element. [Titchener 1910, 372–373]

There is a lot that might be discussed in this quotation.¹² But the main point is clear: Titchener is committed to a psychology of elements and firmly believes that organized wholes, such as melodies or shapes, can be derived by

11. Titchener [Titchener 1910, 372] cited the English philosopher-psychologist G. F. Stout as holding this position [Stout 1909, 2: 48] and recommended a related article by I. M. Bentley. The article [Bentley 1902] discussed Mach, Ehrenfels, Meinong, Cornelius, Witasek, and Stout, all of whom save Cornelius are cited in [Titchener 1909]. Later [Titchener 1929], he cited Mach, Meinong, Witasek, and Stout, the last three as adherents of a Brentanian “psychology of act”. He did not address the Gestalt psychologists who became prominent in the United States (Wertheimer, Koffka, and Köhler), citing [Titchener 1929, 229, note 207] only an early paper by Koffka on *Vorstellungen*. However, Chapter 3, in which act psychology is discussed, was completed by 1919 [Titchener 1929, xvii–xix], before the systematic writings of the Gestalt trio had appeared.

12. In the quotation, “genetic” means developmental. He here allows that we do not introspectively consider isolated sensations separately and then conjoin them in thought. Rather, the psychologist starts from experience of the square and seeks the elements (sensations or images) that could be conjoined to form the square. He is not committed to the elements being present before the square; rather, through analysis, they are found to be adequate constituents for it.

the summation of parts—while granting that it is the wholes that are given in experience.

Titchener, then, was trained into a world in which a sensation-perception distinction was widely accepted. There was disagreement on whether visual sensations are non-spatial or two dimensional. But it was widely agreed that uninitiated subjects focus on perceived objects rather than sensations. That is, in ordinary life, observers focus on objects, not the sensations caused by those objects.

2.3 Titchener and introspection as observation

Although Titchener believed that sensations are primitive (not further analyzable) elements of mental life, for him even the seasoned introspector does not experience unvarnished sensations. Rather, we discover the properties of sensations by establishing conditions for focusing on them and then reporting introspectively on their attributes, such as quality, intensity, or duration. Typically, all of these attributes cannot be attended to at once or made the subject of a single report. Moreover, sensations may become so connected with other sensations that their attributes (quality, intensity, extent) cannot be introspectively isolated [Titchener 1910, 51].

Titchener regarded introspection as a form of observation [Titchener 1912b, 486–487]. Observation involves “attention to the phenomena, and record of the phenomena” [Titchener 1910, 20]. In an introspective experiment, the job of the subject is to describe experience as it is, as opposed to guessing about the stimulus:

The question, however, so far as the validity of introspection is concerned, is not whether the reports tally with the stimuli, but whether they give accurate descriptions of the observer’s experimental consciousness; they might be fantastically wrong in the first regard, and yet absolutely accurate in regard to conscious contents. [Titchener 1912b, 489]

In saying that introspection is observation applied to mental experience, Titchener did not mean to assert that it involves the observation of a special mental object that is distinct from what he considered to be the objects of everyday perception (physical objects with various properties). In particular, he did not suppose that in introspecting a sensory experience one turns away from the world and looks within. There is a deep and persistent misunderstanding of classical introspection on this point. Titchener himself tried to allay this misunderstanding. Because the misinterpretation is so pervasive, he is worth quoting in full. He finds:

that certain psychologists, in writing of self-observation, think of the “mind” as in some way “turning in upon itself”, very much

as one might fancifully conceive of the eyes as turning about to view the brain; that this mental gymnastic appeals to them as something far more difficult of performance than the direction of the mind to the outer world; and that they are thus led to regard self-observation as the mind's crowning achievement, the signal difference between man and the lower animals [...] the psychological observer is supposed to be aware of himself as introspecting himself, aware of himself as observer and aware of himself as observed, while at the same time he is aware of the relation of the two selves [...] as a matter of fact, introspection knows nothing of this sort of mind or self and its performances. Introspection is an interrogation of experience; as such, it issues either from a present conscious purpose or from a habit of observation which is the resultant of previous conscious purpose; and, in so far, it is the expression of "reflection" or of "reflective thought". In so far, but no farther: it implies self-consciousness only in the sense and to the degree in which all scientific observation, that of physics and chemistry included, implies self-consciousness. [Titchener 1912a, 440]

He goes on explicitly to reject the view that in introspection there are "two objects,—on the one hand, the mental operation itself which is to be observed, and on the other, the object to which this mental operation is directed" [Titchener 1912a, 441]. Titchener here stays close to Wundt [Wundt 1888, 293, 296, 306–307], who was careful to observe that in saying psychology takes "immediate experience" which is "inner" as its object, "the expressions outer and inner experience do not indicate different objects, but *different points of view* from which we take up the consideration and scientific treatment of a unitary experience" [Wundt 1901, 2–3]. In introspection, one focuses on how external objects appear [Hatfield 2005, 272–275].

This form of observation can be undertaken by psychologists possessing divergent theoretical outlooks. These outlooks may yield disagreements about what is a simple or basic element of sensory experience and what is the artificial product of a special point of view. According to Titchener, if one succeeds in focusing on the pitch of an upper partial tone in a musical note, one has noticed an attribute of a primitive, constituent element that was present in the tone all along [Titchener 1910, 100–101]. Because Titchener held that visual sensations are primitively bidimensional, he held that when spatial perception tends toward the two-dimensional under reduced-cue conditions, the experimenter is inducing "primitive" spatial sensations. Others disagreed, holding that the act of attention changes the experience of the tone, so as to highlight the overtone [Köhler 1913, 14–22], or that when an experience as of a two-dimensional field occurs under a special attitude or reduced stimulus conditions, the experience as reported is genuine but artificial [Koffka 1935, 235–236], [Gibson 1950, 42].

In these cases, there need be no disagreement on the description of the experiences themselves. The Gestaltist might well hear the partial tones. But they give them a different theoretical interpretation: they are not elements uncovered, but a product of perceptual reorganization. Titchener's claim that the partial tone is getting closer to elemental sensations is a product of theory [Titchener 1915]. Introspection doesn't settle the matter, for different schools might agree in their introspective reports. In fact, the Gestalt assault on Titchenerian elements [Köhler 1913] was aimed more at the theoretical positing of unnoticed sensations than at empirical claims. The Gestaltists proposed a new theory of what is basic in experience: a three-dimensional world of meaningful objects [Köhler 1929, chap. 1–2], [Koffka 1935, chap. 1–3]. Others delayed grand theory in order to study more closely the relation between different aspects of phenomenal experience. In this, they were following up Titchener's warning about the stimulus error but widening the context of experimental investigation.

3 Ongoing discussions of stimulus error and phenomenal report

Titchener's notion of introspective observation and his distinction between a report of sensory experience and a focus on object properties remained valuable. His idea that introspection involves attention to dimensions or attributes of perceptual experience was widely applicable, even to conceptions of the content of that experience foreign to his own. As Titchener observed, even James, the arch anti-atomist, nonetheless found describable characters or attributes in the unitary stream of consciousness, taking note of "flights and perchings"¹³ or of various sensation-attributes that we can abstract from the stream. "Voluminousness" or spatiality is, according to James, a distinguishable feature of experience [James 1890, 2: 134–136]. We can attend to this aspect of experience and report its characteristics. In this sense it is an element of experience, but not an atomic constituent out of which experience is compounded [James 1890, chap. 6].

James and Titchener agreed on the need to distinguish reports on sensory experiences from reports of stimulus properties as physical properties. James contended that a primary error in psychology arises from the ill effects of speech: we name our mental states by the objects that cause them and then "assume that as the objects are, so the thought must be" [James 1890, 1: 195]. This is effectively a description of the stimulus error. James feared that such an error would yield an overly fragmented description of experience, mirroring

13. Titchener refers to James's phenomenological point [James 1890, 1: 243], that the stream of consciousness does not flow uniformly, but consists of "flights" ("transitive parts") and "perchings" ("substantive parts", experienced for the moment).

the known physical constituents of the situation. Titchener rued the error because it could lead to the description of a stable, unified, constant physical object in place of varying and discrete sensory attributes or sensations. The two authors differed over what is fundamental in perceptual consciousness, with James being skeptical of atomic elements. I am interested in both their commonalities and differences, and their relations to subsequent descriptions of phenomenally immediate sensory experience.

3.1 Changing attitudes toward “direct experience”

James, like Titchener, accepted that spatiality is part of sensory experience [James 1890, 2: 135–136]. He did not hold that we visually perceive depth and distance innately. Nor did he hold that our sensory experience tracks the real sizes of things. Coming close to Titchener’s subsequent analysis of stimulus error, he held that when we perceive things such as dinner plates at different distances, we attribute to them the same sizes as when they are close. We do this not because of our sensory state, which he held varies with the retinal image, but because we impose a standard size, as a “meaning”. Plates farther away “feel” smaller, but we “overlook” that fact because we “know” them to be equal in size [James 1890, 2: 179–180].

Titchener was aware that some theorists held the third dimension to be directly sensed. Earlier, Ewald Hering held that in binocular vision we immediately perceive height, width, and depth [Hering 1864, 324]. Titchener objected that this position is “psychologically impossible”. He elaborated:

Sensations of height and breadth might pass muster, if we mean by them qualitative local signs, but a sensation of depth is an impossibility: depth has no specific quality that can be seen, and, if it had, we have no sense-organ wherewith to see it. [Titchener 1910, 338]

Presumably, Titchener means to affirm a Berkeleyan point that the visual stimulus is unable to produce experiences of distance directly, perhaps because it has only two dimensions itself. But he also makes a phenomenal point: there is no “experience” of depth or distance.¹⁴

Soon, others besides Hering were rejecting both points. In the teens and twenties, researchers related to the Gestaltists found phenomenal size constancy [Köhler 1929, 105]: that phenomenal experience does not vary directly with proximal stimulation, but includes depth and distance. Accordingly, when

14. Hering held that binocular stimulation, through corresponding and disparate points, is a stimulus for depth [Hering 1864]. Koffka held that three-dimensional spatial forms arise in visual experience through Gestalt laws of organization [Koffka 1935, 161]. Here, Titchener might be accused of the stimulus error regarding the proximal (two-dimensional) retinal image, using knowledge of the image to describe what is fundamental in visual experience.

dinner plates are seen at different distances around the table, even though those farther away subtend a smaller visual angle, they are experienced phenomenally with roughly the same size. In 1929, Köhler published, in English, in the United States, a systematic introduction to the Gestalt point of view, entitled *Gestalt Psychology*. He argued for taking phenomenally direct experience at face value. Instead of seeing the constancy of size as a constructed meaning for the “real” (two-dimensional) sensations, he argued that the direct experience of the world as in depth should, at least initially, be treated as a description of actual sensory experience.

Once it was accepted that visual experience might be treated as phenomenally three-dimensional, it became possible to conceive of doing experiments to test the characteristics of subjects’ perceptions under various conditions, in order to distinguish different kinds of experiences and different aspects of subjects’ responses. Perhaps sometimes subjects do guess or cognitively evaluate physical properties of things from prior knowledge as applied to phenomenal experience. Perhaps in other cases they can be induced to describe phenomenal experience as they have it. This became the new goal. Instead of assuming that subjects naturally tend toward a cognitively based “stimulus error”, the question of how subjects approach the perceptual task was to be brought under experimental control.

3.2 Stimulus error and instructional set in size-perception experiments

The first decades of the twentieth century witnessed a lively discussion on the effect of attitude or “set” on psychophysical experiments, including close discussion of using instructions to affect perceptual set. Much of this discussion focused on the relation between judgments of “equality” between two stimuli (or experiences) and judgments of uncertainty over whether they differ. Samuel Fernberger and others attributed some equivocal results to the fact that subjects were not given clear “tasks” [*Aufgabe*] with respect to the judgments, allowing the “set” or attitude [*Einstellung*] behind their judgments to vary without experimental control [Fernberger 1914]. More generally, some psychologists regarded it as a mistake to ask for anything except a report on the physical stimulus itself (a position associated with James McKeen Cattell).

Boring entered this discussion with his paper on stimulus error [Boring 1921]. His goal was to show that even “behaviorists” and other “psychologists of capacity” (including Cattell) need to distinguish between physical stimulus and sensation if they are to avoid equivocal data arising from the stimulus error. He characterized the stimulus error as follows:

We commit the stimulus-error if we base our psychological reports upon objects rather than upon the mental material itself, or if, in the psycho-physical experiment, we make judgments of the stimulus and not judgments of sensation. [Boring 1921, 451]

The remedy is to control through instructions the attention of subjects and the criteria they employ in making a judgment. In the article, Boring made incidental reference to these issues as they arise for size perception. In the ensuing decades from the 1930s through the 1960s, there was ongoing discussion and refinement of the use of instructions in experiments on size and shape perception.

These discussions challenged a fundamental aspect of the notion of “stimulus error”: the claim that subjects tend to judge according to physical estimation or reasoning rather than appearances. The assumption that subjects naturally make physical estimates is evident in an early size-perception experiment by Martius, who wanted to prevent subjects from employing this attitude so that they could focus on appearances [Martius 1889, 605]. Going forward, experimenters at first made conflicting claims about the natural tendencies of uninstructed subjects. Ultimately, they instead employed instructions to control task and attitude for all observations, and then theorized about the responses they elicited under these varying conditions.

Writing in the early thirties, R. H. Thouless held that an undirected and unstudied response of the “average subject” would seek to report the *apparent* properties of shape (and also size), since assessment of *objective* physical size requires a “more complex process of judgement” [Thouless 1931b, 23]. In discussing such tendencies, Thouless distinguished among “real”, “projective”, and “apparent or ‘phenomenal’” shape:

Let us suppose that a subject is asked to report on the shape of an inclined plane figure whose shape is not previously known to him. He might be answering any one of three questions: (1) as to the “real” shape of the object observed, (2) as to the shape of its plane projection, (3) as to its apparent or “phenomenal” shape. It is only in answering number 3 that he is performing the simple operation of reporting immediate experience. [Thouless 1931b, 22]

Thouless usefully distinguishes among different tasks. But his experiments did not make task, attitude, or set into a variable; he instead controlled for the subject’s attitude by relating that he, as experimenter, wants “to know [from the subject] neither what the shape of the object really is nor how he thinks it ought to look but simply the shape it does look to him” [Thouless 1931b, 23]. He did not relate his experimental approach to discussions of stimulus error in Titchener and Boring; he framed his approach as an application of Hering’s discussions of lightness constancy to textbook descriptions of shape constancy as the norm [Thouless 1931a, 339, 343].

Other experimentalists did connect the study size perception and shape perception with the ongoing discussion of instructions. This group also did not believe that subjects naturally tend toward the “stimulus error” but assumed that subjects normally respond to appearances. But they did not fix

ahead of time what the “correct” character of experience should be (e.g., two-dimensional sensations for sight). By varying instructional set, they turned the question of how subjects make judgments about size and shape into an object of investigation. They retained the distinction, found in Titchener, Boring, and Thouless, between “immediate” judgments of experience versus complex cognitive judgments that apply to appearances reasoning about how size varies with distance.

In seminal experiments, Beverley Holaday¹⁵ studied size perception under varying experimental conditions, including variations in “intentional set”, which he characterized as psychological variations (as opposed to physical variations in the stimulus situation or physiological variations). He distinguished four different attitudes for comparing the sizes of two stimulus objects: (1) the “normal attitude”, in which we judge the “visual size” of the “visual object” as in everyday perception (this correlates with Thouless’s phenomenal or apparent judgment); (2) the “analytic” attitude, in which one seeks through instructions to direct subjects toward a projective estimate based on perceptual attitude alone, without using techniques such as squinting and without theoretical reasoning; (3) “objective procedure”, in which subjects are instructed to estimate the suspected size of the object using the appearance but supplementing it by moving their heads from side to side and using reflection to give their best bet about the correct sizes; and (4) the “analytic bet-procedure”, of seeking to judge what the projective value must be using techniques such as squinting or reflecting on what the photographic size would be [Holaday 1933, 422]. These instructional sets equate the “normal” attitude with apparent instructions but also bring that condition under the experimental control of instructions.

As research proceeded, investigators gave up claims to know beforehand the “basic” attitude of subjects and became interested in the dynamics of the various instruction sets [Carlson 1962]. Investigators noted some apparently paradoxical results. An empirical trend developed in which objective instructions yielded overconstancy for size perception, apparent instructions yielded slight underconstancy, and projective instructions produced a result toward projective values, but not reaching them [Holway & Boring 1941], [Gilinsky 1955].¹⁶ The question now concerned not the “stimulus error”, but James,

15. Holaday was an American investigator who did doctoral work at the University of Vienna with Karl Bühler among his teachers.

16. There is another dimension of discussions about Titchenerian introspection and subsequent perceptual experimentation, which concerns the subject. Titchener, like Wundt and indeed [Holway & Boring 1941], employed as subjects students or colleagues trained in perception science. This might lead to a charge that theoretical bias infects the outcome, or it might mean that observers are more accurate because they are trained scientists (see [Schwitzgebel 2011]). In any event, in [Gilinsky 1955] we see the modern practice of using a large group of naive subjects in perceptual experimentation, rather than a few trained observers.

Titchener, Boring, and Thouless's explanation of it: that "non-apparent" judgments arise from cognitive factors.

4 Sequel

How one continues the story from here depends on an assessment of which positions have panned out, which in turn is conditioned by theory-dependent assessments of the fundamental characteristics of perceptual experience. For instance, a naive realist would have a different account of the role of instructions, translating them into the language of taking different conceptual attitudes toward objective stimulus values as directly present in normal perception. I have no sympathy with this approach since I believe that naive realism is a non-starter.¹⁷

The story directly continues in recent findings of the developmental psychologist Carl Granrud, which vindicate the distinction between phenomenal reports and cognitively complex reports [Granrud 2012]. In studying size constancy in child development, Granrud found that some children, when instructed to report objective size, engage in a strategy of reasoning that things look smaller in the distance. Other children do not use such strategies or do so later. When he compared the two groups under conditions of apparent and objective instructions for near and far stimuli, all subjects showed slight underconstancy under both instructions for near stimuli. For far stimuli, instructional set made no difference for non-strategy users. Strategy users exhibited underconstancy under apparent instructions and overconstancy under objective instructions. Granrud ruled out (on phenomenal grounds) the conclusion that strategy users actually see more distant things as larger than they are. Consequently, he attributed that response to cognitive factors (reasoning according to a strategy). He classified the judgments under apparent instructions as reports of phenomenal experience.

In my terms, the apparent reports are cases of introspection. They are instances in which subjects are directed toward their experience of size, as a phenomenally available aspect of their experience.¹⁸ They are not everyday

17. Another objection comes from "transparency" theorists who might suppose that there can be no stimulus error and no truly "apparent" instructions because the content of perception is exhausted through representations of the physical object. This position is often paired, e.g., [Harman 1990] with the misreading of Wundt and Titchener on introspection (discussed above). More generally, transparency theorists try to settle questions about the metaphysics of qualities through phenomenology, but their phenomenology relies on their metaphysics [Hatfield 2005, 270–274].

18. I discuss introspection as "deliberate and immediate attention to certain aspects of phenomenal experience" in [Hatfield 2005, 279]. Chirimuuta [Chirimuuta 2014, 915–918] finds problems in distinguishing introspection from simply perceiving on this definition, but I believe that the notion of attending to phenomenal experience does the trick. Schwitzgebel adopts a similar conception of introspection in visual

judgments of how large the object over there is—that would be an objective report. They differ from such reports in that subjects are directed to attend to certain aspects of their phenomenal experience. Objective reports are not introspective, though they may rely on an introspective assessment of appearances. Once subjects have become strategy users, objective instructions induce them to use reasoning to report what can be known of objective stimulus properties. Such reports are not a matter of simply attending to phenomenally available dimensions of experience.

In the ongoing history of experiments that seek to study size and shape perception, there is an echo of Titchener’s distinction between accurate descriptions of experience and judgments focused on physical values of a stimulus object. But this distinction has been decoupled from assumptions about the elemental structure of phenomenal experience. There are few takers these days for the view that visual experience is “really” two dimensional. Rather, the characteristics of visual experience are to be determined by varying stimulus conditions and instructional set. Further, descriptions of phenomenal experience are to be distinguished from judgments of physical values. In this way, the earlier distinctions drawn by Titchener and James have received a new use, or a reformulated application. Investigators no longer speak of the “stimulus error”, but they do seek to tease apart phenomenal and cognitive (judgmental) factors in the complex of human perceptual experience. Indeed, recent findings by Granrud support the notion that introspective reports of apparent size describe phenomenal experience while reports that apply reasoning strategies to experience in order to judge objective size are manifestations of a cognitive response that goes beyond a description of phenomenal experience. In this context, a distinction between how things appear and how we judge them to be retains its validity, giving a partial vindication to Titchener’s earlier notion of stimulus error.

Bibliography

- BEENFELDT, Christian [2013], *The Philosophical Background and Scientific Legacy of E. B. Titchener’s Psychology: Understanding Introspectionism*, New York: Springer.
- BENTLEY, I. Madison [1902], The psychology of mental arrangement, *The American Journal of Psychology*, 13(2), 269–293, doi:10.2307/1412740.
- BORING, Edwin G. [1921], The stimulus-error, *The American Journal of Psychology*, 32(4), 449–471, doi:10.2307/1413768.
- [1929], *A History of Experimental Psychology*, New York: Century.

perception, while also surveying a variety of different activities that might be called “introspection” [Schwitzgebel 2012, 32–35].

- BROCK, Adrian C. [2013], The history of introspection revisited, in: *Self-Observation in the Social Sciences*, edited by J. W. Clegg, New Brunswick: Transaction Publishers, 25–43.
- CARLSON, V. R. [1962], Size-constancy judgments and perceptual compromise, *Journal of Experimental Psychology*, 63(1), 68–73, doi:10.1037/h0045909.
- CHIRIMUUTA, Mazviita [2014], Psychophysical methods and the evasion of introspection, *Philosophy of Science*, 81(5), 914–926, doi:10.1086/677890.
- FERNBERGER, Samuel W. [1914], The effect of the attitude of the subject upon the measure of sensitivity, *The American Journal of Psychology*, 25(4), 538–543, doi:10.2307/1413290.
- GIBSON, James J. [1950], *The Perception of the Visual World*, Boston: Houghton Mifflin.
- GILINSKY, Alberta S. [1955], The effect of attitude upon the perception of size, *The American Journal of Psychology*, 68(2), 173–192, doi:10.2307/1418890.
- GRANRUD, Carl [2012], Judging the size of a distant object: Strategy use by children and adults, in: *Visual Experience: Sensation, Cognition, and Constancy*, edited by G. Hatfield & S. Allred, Oxford: Oxford University Press, 13–34.
- HARMAN, Gilbert [1990], The intrinsic quality of experience, in: *Philosophical Perspectives*, edited by J. E. Tomberlin, Atascadero: Ridgeview, Action Theory and Philosophy of Mind, vol. 4, 31–52.
- HATFIELD, Gary [1990], *The Natural and the Normative: Theories of Spatial Perception from Kant to Helmholtz*, Cambridge, MA: MIT Press.
- [2002], Psychology, philosophy, and cognitive science: Reflections on the history and philosophy of experimental psychology, *Mind & Language*, 17(3), 207–232, doi:10.1111/1468-0017.00196.
- [2005], Introspective evidence in psychology, in: *Scientific Evidence: Philosophical Theories and Applications*, edited by P. Achinstein, Baltimore: Johns Hopkins University Press, 259–286.
- HELMHOLTZ, Hermann von [1866], *Handbuch der physiologischen Optik*, Leipzig: Voss, cited according to the English translation by J. P. C. Southall, from the reprint of this first edition in the third German edition: *Treatise on Physiological Optics*, 3 vols., Milwaukee: Optical Society of America, 1924–1925.
- [1896], Über die physiologischen Ursachen der musikalischen Harmonie, in: *Vorträge und Reden*, Braunschweig: Vieweg, vol. 1, 4th edn., 121–155, cited according to the English translation by A. J. Ellis and R. Kahl (with emendations): [Helmholtz 1971].

- [1971], The physiological causes of harmony in music, in: *Selected Writings of Hermann von Helmholtz*, edited by R. Kahl, Middletown: Wesleyan University Press, 75–108, translation by A. J. Ellis and R. Kahl.
- HERING, Ewald [1864], *Beiträge zur Physiologie, fünftes Heft: vom binocularen Tiefsehen*, Leipzig: Engelmann.
- HOLADAY, Beverley E. [1933], Die Grossenkonstanz der Sehdinge bei Variation der inneren und äusseren Wahrnehmungsbedingungen, *Archiv für die gesamte Psychologie*, 88, 419–486.
- HOLWAY, Alfred H. & BORING, Edwin G. [1941], Determinants of apparent visual size with distance variant, *The American Journal of Psychology*, 54(1), 21–37, doi:10.2307/1417790.
- JAMES, William [1890], *Principles of Psychology*, New York: Henry Holt, 2 vols.
- KOFFKA, Kurt [1935], *Principles of Gestalt Psychology*, New York: Harcourt, Brace, and World.
- KÖHLER, Wolfgang [1913], Über unbemerkte Empfindungen und Urteilstäuchungen, *Zeitschrift für Psychologie*, 66, 51–80, cited according to the English translation by H. E. Adler: [Köhler 1971].
- [1929], *Gestalt Psychology*, New York: Liveright.
- [1971], On unnoticed sensations and errors of judgment, in: *The Selected Papers of Wolfgang Köhler*, edited by M. Henle, New York: Liveright, 13–39, translation by H. E. Adler.
- KÜLPE, Oswald [1893], *Grundriss der Psychologie, auf experimenteller Grundlage*, Leipzig: Engelmann, cited according to the English translation by E. B. Titchener: [Külpe 1895].
- [1895], *Outlines of Psychology: Based upon the results of experimental investigation*, London: Sonnenschein.
- LADD, George T. [1889], *Elements of Physiological Psychology: A treatise of the activities and nature of the mind from the physical and experimental point of view*, New York: Scribner's.
- MACH, Ernst [1886], *Beiträge zur Analyse der Empfindungen*, Jena: Fischer, cited according to the English translation by C. M. Williams: [Mach 1897].
- [1897], *Contributions to the Analysis of Sensations*, La Salle: Open Court, translated by C. M. Williams.

- MARTIUS, Götz [1889], Über die scheinbare Grösse der Gegenstände und ihre Beziehung zur Grösse der Netzhautbilder, *Philosophische Studien*, 5, 601–617.
- PALMER, Stephen E. [1999], *Vision Science: Photons to Phenomenology*, Cambridge, Ma: MIT Press.
- SCHWITZGEBEL, Eric [2011], Titchener's introspective training manual, in: *Perplexities of Consciousness*, edited by E. Schwitzgebel, Cambridge, MA: MIT Press, 71–90.
- [2012], Introspection: What?, in: *Introspection and Consciousness*, edited by D. Smithies & D. Stoljar, Oxford: Oxford University Press, 29–47.
- SCRIPTURE, Edward W. [1899], *The New Psychology*, London: Scott.
- STOUT, George F. [1909], *Analytic Psychology*, London: Sonnenschein, 3rd edn.
- THOULESS, Robert H. [1931a], Phenomenal regression to the real object, I, *British Journal of Psychology. General Section*, 21(4), 339–359, doi:10.1111/j.2044-8295.1931.tb00597.x.
- [1931b], Phenomenal regression to the 'real' object. II, *British Journal of Psychology. General Section*, 22(1), 1–30, doi:10.1111/j.2044-8295.1931.tb00609.x.
- TITCHENER, Edward B. [1897], *An Outline of Psychology*, New York: Macmillan, 2nd edn.
- [1905a], *Experimental Psychology, Volume II, Quantitative experiments: Part I, Student's manual*, New York: Macmillan.
- [1905b], *Experimental Psychology, Volume II, Quantitative experiments: Part II, Instructor's manual*, New York: Macmillan.
- [1909], *Lectures on the Experimental Psychology of the Thought-Processes*, New York: Arno Press, 1973.
- [1910], *A Text-Book of Psychology*, New York: Macmillan, 1919.
- [1912a], Prolegomena to a study of introspection, *The American Journal of Psychology*, 23(3), 427–448, doi:10.2307/1413427.
- [1912b], The schema of introspection, *The American Journal of Psychology*, 23(4), 485–508, doi:10.2307/1413058.
- [1915], Sensation and system, *The American Journal of Psychology*, 26(2), 258–267, doi:10.2307/1413256.

- [1925], Experimental psychology: A retrospect, *The American Journal of Psychology*, 36(3), 313–323, doi:10.2307/1414159.
- [1929], *Systematic Psychology: Prolegomena*, Ithaca: Cornell University Press, 1972.
- WATSON, John B. [1913], Psychology as the behaviorist views it, *Psychological Review*, 20(2), 158–177, doi:10.1037.
- WUNDT, Wilhelm [1880], *Grundzüge der physiologischen Psychologie*, Leipzig: Engelmann, 2nd edn.
- [1888], Selbstbeobachtung und innere Wahrnehmung, *Philosophische Studien*, 4, 292–309.
- [1893], *Grundzüge der physiologischen Psychologie*, Leipzig: Engelmann, 4th edn.
- [1901], *Grundriss der Psychologie*, Leipzig: Engelmann, 4th edn., cited according to the English translation by C. H. Judd: [Wundt 1902].
- [1902], *Outlines of Psychology*, Leipzig: Engelmann, 2nd edn., translation by C. H. Judd.
- [1908], *Logik*, vol. 3, Stuttgart: Enke.