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# *Introspective Training Apprehensively Defended*

*Reflections on Titchener's Lab Manual*

**Abstract:** *To study conscious experience we must, to some extent, trust introspective reports; yet introspective reports often do not merit our trust. A century ago, E.B. Titchener advocated extensive introspective training as a means of resolving this difficulty. He describes many of his training techniques in his four-volume laboratory manual of 1901–1905. This paper explores Titchener's laboratory manual with an eye to general questions about the prospects of introspective training for contemporary consciousness studies, with a focus on the following examples: introspective knowledge of the combination tones that arise when a musical interval is played; the 'flight of colours' in the afterimage of a field of bright, broad-spectrum light; and the possibility of non-obvious visual illusions. Introspective training appears to have some merit, but also to involve significant hazards.*

Introspection must play a central role in the study of the mind; yet introspective reports, even of current conscious experience, are highly unreliable. I have found that philosophers typically accept the first of these propositions and deny the second, while psychologists typically accept the second and deny the first.<sup>1</sup> Indeed, there is some tension between the two claims: If introspection is unreliable, what business does it have playing a central role in the study of the mind? Nonetheless, I expect many of the readers of this special issue find themselves drawn, as I do, toward both of these claims. The study of consciousness demands that we trust introspective reports — at least some of them, sometimes — yet introspective reports appear not to merit our trust. What is to be done?

As you will have guessed from the title, I recommend that we consider introspective training as a potential response to this difficulty. Even if introspective

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[1] I myself have argued for the second in Schwitzgebel & Gordon (2000) and Schwitzgebel (2002a,b).

reports collected from the general population are often undependable, perhaps subjects can be *trained* reliably to generate trustworthy reports, with sufficient discipline and practice. The prominent American psychologist Edward B. Titchener emphasized this approach a century ago, and his work will serve as the focus of this essay.

Although the principal aim of this essay is to suggest a resuscitation of the practice of introspective training, introspective training is beset with substantial difficulties and perils. Considerable space is devoted to the articulation of concerns that promise no straightforward resolution and which might thus be taken to count against the central thesis. On balance, I think, the promise of introspective training recommends its pursuit despite the concerns.

The terms *consciousness* and *introspection* are notoriously difficult to define; I will use them throughout this essay as though we all knew what they meant. Titchener was not at his best when he set about to characterize the nature of consciousness (e.g., 1910/1915, pp. 15–19; 1929, ch. 3), so I do not think it would be prudent to rely upon him here. Perhaps it helps to suggest that we read ‘consciousness’ here as at least roughly equivalent to Block’s (1995b) ‘phenomenal consciousness’. Introspection Titchener characterizes as the observation of conscious processes, or the attention to and noting of such processes (1912a; 1912b; 1910/1915, pp. 19–25). I myself am drawn to a similar view of introspection, according to which it is a species of *attention to conscious experience* (Schwitzgebel, in preparation), but I cannot present the details of such an account here.<sup>2</sup> I will also set aside the issue of the extent to which the introspective act itself affects the experience introspected. Titchener argues that for the well-trained introspector, introspection becomes almost effortless and automatic, distorting very little the experience observed (1910/1915, pp. 21–3; 1912a, pp. 442–44; cf. 1899b, pp. 27–9; 1908, pp. 176–80; 1912b, pp. 490–3; Wundt, 1895, vol. II, part 2, pp. 174–5). Titchener is not entirely convincing on this point, but this issue has not been sufficiently explored (though see Ericsson and Simon 1984/1993).

### I: Historical Background, and Titchener’s General Position on Introspective Training

A rough history of psychology will help put Titchener in context and display his relevance to contemporary consciousness studies (detailed histories include Bor-ing, 1950 and Danziger, 1990). As is generally known, experimental psychology as a distinct academic discipline arose in the second half of the nineteenth century. It did so partly through the labour of Wilhelm Wundt in founding a productive laboratory and training a generation of students and partly through the model of Gustav Fechner’s and Hermann von Helmholtz’s work in quantifying and

[2] This view conflicts sharply with that of ‘transparency theorists’ (e.g., Harman, 1990; Dretske, 1995; Tye, 2000) who argue that we *cannot* attend to our conscious experience (for counterarguments see Block, 1995a; Siewert, 2004). It is also a narrower sense of ‘introspection’ than is often used (e.g., by Wilson in the first volume of this collection).

experimentalizing sense experience. Early experimental psychologists were generally committed to employing introspection as a scientific tool.<sup>3</sup> By the early twentieth century, psychologists had achieved considerable sophistication in introspective methodology. Among the more permanent accomplishments of early introspection were the construction of the colour solid or spindle, with its characterization of colour experience in terms of hue, saturation, and lightness or brightness, and the measurement of relations between stimulus quality or intensity and sense experience for each of the various sensory modalities (including measurement of the stimulus changes required to produce a ‘just noticeable difference’). Much of what we know about the structure of sensory experience traces back to the careful reports of relatively few trained introspectors from this period.

By the 1910s, however, behaviourism had declared war on introspective psychology, portraying it as bogged down in irresolvable debates between differing introspective ‘experts’ (which was partly true) and rebuking the passive introspective taxonomizing of experience in favour of developing a socially usable paradigm for the modification of behaviour. In the 1920s and 1930s, introspective studies were increasingly marginalized. The consequent amnesia for early introspective methodology was compounded by the simultaneous rise, as the chief competitor to behaviourism, of Gestalt psychology. Gestalt psychology, though it gave an important role to introspection, regarded classical introspective training as harmful, leading to reports in which the whole sensory ‘Gestalt’, which is primary in ordinary experience, is disregarded in favour of particular sensory elements (a criticism which, like the behaviourists’, has some merit). With behaviourism and subsequently cognitivist functionalism dominating experimental psychology for the remainder of the century, little room existed for serious academic interchange on introspective methods. Although it has now become fashionable again to discuss consciousness, and a rise in the respectability of introspection seems bound to follow, we have not yet recovered the methodological insights of our pre-behaviourist predecessors.

Titchener trained with Wundt at the height of Wundt’s career and was the leading practitioner of classical introspective technique in the United States. He stands out as a potential source of insight into introspective method particularly due to his *Experimental Psychology* (1901–1905), a ‘manual of laboratory practice’ detailing a course of introspective training for students — a manual that runs approximately 1600 pages (with separate parts for student and instructor) and describes both the pitfalls of introspective laboratory work and the conditions of its success with an explicitness one rarely sees in textbooks or journal articles.

[3] William James, in the section on ‘The Methods of Investigation’ in his influential *Principles of Psychology* writes that ‘introspective observation is what we have to rely on first and foremost and always’ (1890/1981, p. 185, emphasis in original). This is too strongly put: Leading early psychologists like Francis Galton and Alfred Binet devoted considerable energy to (non-introspective) test performance, and Wundt himself thought that introspective ‘inner perception’ illuminated only a limited range of psychological phenomena. Nonetheless, most of the major overview texts of the period, like James’, treat introspection as the, or at least a, chief method of psychological investigation.

Psychologists of Titchener's era generally accepted, as a condition of sound scientific method, that introspective reports come from subjects — or as Titchener preferred to say, 'observers' — with some significant degree of introspective training. In published research, it was standard to depend exclusively on the introspective reports of observers with graduate training in psychology and thus presumably at least several months, often several or many years, of intensive experience with introspective methods. Wundt is reputed not to have admitted data from observers who had performed fewer than 10,000 laboratory introspections (Boring, 1953).

In his *Primer of Psychology*, Titchener compares the development of skill in introspection with the development of skill in physical measurement and chemical analysis (1899b, p. 25). Just as a chemist would never rely on an untrained assistant for any but the simplest measurements, so also the laboratory psychologist cannot rely on untrained introspectors for any but the crudest observations. In fact, precise, 'quantitative' introspection is considerably more difficult, in Titchener's view, than quantitative work in chemistry (1901–1905, vol. II, part 2, pp. cliii–clvii).<sup>4</sup> Consequently, 'the average student, on entering the laboratory, is simply not competent' to participate as an introspective observer in quantitative experiments (II.2.cliv; cf. I.2.389). Difficulties include maintaining consistent attention, avoiding bias, knowing what to look for, and parsing the complexity of experience as it flows rapidly past (1899b, pp. 24–5; cf. 1915, pp. 20–2). For example, without introspective training, Titchener asserts, it is difficult to compare the relative brightness of two different colours (I.1.13; I.2.31); to discern a very low tone sensation from a sensation of atonal noise (II.1.1; II.1.3); or to make the quantitative assessment that two sensations are each an equal distance, in different directions, from a third (e.g., that one tone sounds as high in pitch above a reference tone as another tone sounds below it) (II.2.201–204; II.1.xxxii–xxxiv). Experienced introspectors are also more likely than untrained introspectors to maintain a consistent standard of judgment and accurately to report lapses of attention and interfering influences.<sup>5</sup>

Titchener turns on its head the standard argument against introspective training, that it introduces bias. Especially regarding our own minds, Titchener believes, everyone is subject to bias and preconceptions. People do not generally approach psychology neutral between theses, even when those theses are dry psychophysical ones — and when people do start out relatively open-minded,

[4] Further references to the laboratory manual will list the volume in Roman numerals, followed by the part in Arabic and the page in either Arabic if it is from the body or Roman if it is from an introduction (e.g., II.2.clviii–clvii). The second part of each volume is intended for the instructor's use only. The 1971 reprint of *Experimental Psychology* omits the second part of the first volume, and each part of the first volume is itself misleadingly divided into two 'parts'.

[5] For more specific discussions and examples of the benefit of practice in focusing on stimuli, steadying one's sense organs, and controlling one's attention, see I.2.30–1; I.2.121; II.2.cliv–clvi; II.2.307; for the benefit of practice in attaining a consistent standard of judgment, see I.2.87; II.1.xxxiii; II.1.1–2; II.1.25–6; II.2.307; regarding knowing what to abstract, attend to, or look for in a complex sensation, see I.1.41–2; I.2.48; I.2.52; I.2.75; I.2.87; I.2.217; I.2.300; regarding the report of lapses of attention and interfering influences, see I.2.167; I.2.220–2; I.2.341–5; II.2.402; and, in conjunction with each other, II.1.104–6; II.2.2–3; II.2.260.

after a few introspections they are apt to speculate and form hypotheses. Titchener consequently rejects the ideal of an introspective account ‘furnished by a naive, commonsense, non-scientific observer, who has not yet adopted the special attitude of the psychologist’ and thus supposedly takes a ‘neutral standpoint’ (1912b, p. 489). Such a neutral standpoint is unattainable. ‘We can hardly, with the pressure of tradition and linguistic forms upon us, consider mental phenomena in a really naive way, with a truly blank prescientific impartiality’ (*ibid.*).<sup>6</sup> In Titchener’s view, the avoidance of bias requires not naiveté but expertise. Introspective practice and an ‘objective’ frame of mind aid the observer in setting aside expectations to report mental phenomena accurately (I.2.xxv–xxvii; I.2.151; II.2.133–4; II.2.202). ‘The trained observer, psychologist or physicist or what not, can take the suggestion [i.e., the hypothesis toward which he might be biased] for what it’s worth; he does not allow it to affect his observation. But the beginner is exceedingly liable to be led by interest into partiality’ (1899a, p. 45; cf. Müller, 1904).

Probably no part of classic introspective methodology was more thoroughly and permanently overthrown than the emphasis on extensive introspective training. (Some of the reasons for the overthrow were briefly mentioned above; it is probably also worth mentioning that introspective training is quite tedious.) Even among psychologists interested in introspection today, the idea that a subject would have to be trained in introspection for more than a few minutes — much less hundreds or thousands of hours over the course of months or years — remains alien (but see Varela, 1996; Nahmias, 2002; and remarks in several essays in the first volume of this collection).<sup>7</sup> If accurate introspection is difficult, however, it is plausible to suppose that training could bring substantial benefits. Titchener was surely too optimistic if he felt that the well-trained observer could completely insulate his introspective judgments from the influence of theory and preconception, but given that the naive subject may be similarly prone to bias, it is not clear that innocence is generally preferable to sophistication.

At one point, Titchener suggests that introspective controversies affected by bias may profit from the flourishing of a diversity of perspectives. With respect to the raging debate in his time over Weber’s Law, which holds that the intensity of a sensation is a logarithmic function of the intensity of the stimulus producing it, Titchener writes:

We want a large number of **O**’s [observers], we want **O**’s of all types and degrees of training, we want tests of the method by men who are prejudiced or prepossessed both for and against, we want a volume of introspective reports, we want the analysis and critical judgment of those who see the method from within, in the light of

[6] However, E.G. Boring claims that later in his career Titchener put ‘considerable faith’ in the method of naive phenomenological report that he here criticizes, though he never published on the subject (1950, p. 416; also 1927, p. 502; Evans, 1972). It is unclear how much Titchener actually shifted his position or what his motivations for doing so would have been.

[7] Psychophysicists do sometimes train subjects perceptually — e.g., in ‘analytic listening’, which involves distinguishing particular tones in a complex auditory stimulus — but such training is not generally regarded as introspective or approached with Titchenerian introspective standards in mind.

their own introspection, and of those who see it merely from without, as a piece of applied logic (II.2.230–1).

In general philosophy of science, Longino (1990) and others have defended similar approaches to dealing with bias. Such broad pluralism seems not to have been characteristic of Titchener — he was generally inclined to privilege the judgments of his own trained observers — but it would appear nonetheless to be sound advice. Consciousness studies is presently well supplied with naive introspective observers, but it is sorely lacking in trained observers who might bring a different perspective.

The remainder of this essay will examine three particular exercises from Titchener’s manual in order to display more clearly both the promise and challenges of introspective training.

## II: Examples of Introspective Training: Combination Tones

If two tones of frequency U (for the upper tone) and L (for the lower tone) are sounded together, it is sometimes possible simultaneously to hear a third, lower (and generally quieter) tone, called a *difference tone*. The pitch of this difference tone will resemble that of a tone of frequency  $U-L$ .<sup>8</sup> For example, when two flutes simultaneously play the notes  $F_6$  (fundamental frequency 1396.9 hertz) and  $C_6$  (1046.5 hertz), listeners may also report hearing a note at about the pitch of  $F_4$  (349.23 hertz) (Stickney & Englert, 1975). Similar effects may be produced by combining sine waves in a sound editor program and listening to them through headphones. The standard view, and Titchener’s, is that difference tones so generated do not exist in the environment but rather are a consequence of ‘non-linearities’ in the human ear — i.e., that they result from the ear’s failure to respond proportionately to all frequencies and energies of auditory input, distorting the signal it transmits somewhat as an overdriven amplifier does (e.g., Plomp, 1976; Hall, 2002; Rossing *et al.*, 2002).<sup>9</sup> In addition to the (first) difference tone at  $U-L$ , a *second difference tone* (also called a *cubic difference tone*) may sometimes be heard at  $2L-U$ , and more rarely other tones, including a *third difference tone* at  $3L-U$  and disputably a *summation tone* at  $L + U$ . As a class, these are known as *combination tones*.

Titchener introduces his introspectors-in-training to combination tones in the seventh experiment series in the first volume of his laboratory manual (I.1.39–46). He begins by directing their attention to a particularly salient difference tone produced by two Quincke’s tubes with fundamental frequencies of

[8] For readers unfamiliar with these terms: *Frequency* is a physical measurement of the rate of vibration, in this case of a sound wave, in hertz or cycles per second. *Pitch* is a subjective phenomenon pertaining to how high or low a tone sounds on the musical scale. Generally speaking, higher frequency tones sound higher in pitch (doubling the frequency increases the pitch by one octave), though as with most psychophysical phenomena the relationship between stimulus and experience is complex when examined in detail.

[9] I am not entirely convinced that there isn’t a sense in which difference tones exist in the environment (see also Hall, 1981), but the philosophical and acoustic issues are complex. Ultimately, I think no major points in the text hang on this issue, as should become evident later in this section.

approximately 1584 hertz and 1980 hertz. (Quincke's tubes consist of a glass whistle connected to a resonator, producing a relatively pure tone. Drawings appear on I.1.40 and I.1.44.) Titchener remarks that the difference tone's 'moderate loudness' combined with its depth (two octaves below the lower of the primary tones) should make it 'easily recognizable' to the student (I.1.41). He advises repeated production of this difference tone until the observer 'is entirely satisfied with his introspections' (*ibid.*). Titchener next recommends the student listen for the difference tone of two Quincke's tubes of 1584 and 2376 hertz, which he describes as particularly loud and one octave below the lower generator. After these two hopefully easy introspections are each rehearsed several times, the student is instructed to proceed up and down the musical intervals, then to practice hearing difference tones when one or both of the generating tones is quiet and when the duration of the tones is short. Finally, the student is instructed in similar procedures for the second and third difference tones and the summation tone. Titchener expects students to have only limited success in hearing the more difficult of these tones. Still, by the end of the experiment series — presumably conducted within one or a few sessions over the course of a week or less — the student should be able to discern combination tones that would previously have eluded her. She has, apparently, become something of an 'introspective expert' in this limited domain.

On my website, I have posted an adaptation of Titchener's training procedure, using sine wave tones generated by a sound editor (a link is on my homepage, [www.faculty.ucr.edu/~eschwitz](http://www.faculty.ucr.edu/~eschwitz)). I recommend that the reader pause now to attempt the procedure to obtain a more vivid sense of the nature of Titchenerian introspective training.

Several features of Titchener's training procedure bear comment. First, the training does not proceed by mere repetition of a stimulus or presentation of stimuli in random order. Rather, it begins with comparatively easy introspections and proceeds to more difficult ones only after the easier are mastered. Also, since there is good theoretical reason to expect each difference tone to be heard at a particular pitch — reasons having to do with acoustics and the ear and confirmed by accomplished introspectors — the students' introspective reports can be verified. Titchener suggests that several tones be produced and the students be required to say which tone is closest in pitch to the difference tone they purport to hear (I.2.70). Many (but not all) of Titchener's exercises share these features of *scaled difficulty* and *corrective feedback*. Indeed, so do many ordinary non-introspective training procedures.

Let's back up a bit, though, and ask: Are students in this experiment really *introspecting*? In my experience, attempting to discern a combination tone feels no different from attempting to discern a faint tone of the ordinary sort. It feels just like listening for sounds in the external environment. One could presumably develop substantial expertise in discerning combination tones without ever taking oneself to be introspectively reporting one's own mental states.

One might hope to defend the view that the training is nonetheless introspective on the grounds that combination tones, being (in general opinion) an artefact

of the ear, do not exist in the world in the same way that ordinary tones do, and thus that in attending to them one cannot be attending to the outside world. Since it sounds odd to say that one is attending to one's ear, it is easy to suppose that one must be attending to some part of one's experience, that is to say, introspecting. However, this argument would prove too much. If every sensory or perceptual feature that does not exist outside the observer is introspectively discovered, then many illusions are discoverable only by introspection. Perhaps, indeed, we should regard combination tones as similar to double images, colour adaptation effects, or the floating black spots experienced by people with a certain type of eye damage — that is, as a kind of illusion, a product of our sensory apparatus not straightforwardly reflecting how things stand in the world beyond. If you hold your finger six inches before your eyes and focus on something in the distance while continuing to attend to the finger, and you consequently notice a double image, are you necessarily introspecting? I'm not certain. (By the way, did the double image exist before you attended to it?) But surely you needn't be introspecting if, with yellow-adapted eyes, you mistakenly judge a white object to be blue. The blue is, in some sense, only in your own mind — but you do not introspect it. Introspective attention to one's own mind is no more necessary for the discovery of difference tones than it is for the discovery of other actual or illusory features of the world.

To see how Titchener's procedure qualifies as introspective training we must take a different tack. Consider the naive introspector asked to describe her auditory experience of an interval sounded by a musical instrument. If she has a minimum of musical knowledge, she might be able to describe the interval as, for example, a major third, considerably above the middle of the scale, and indicate the instrument upon which it was played if it is a familiar one. But her experience is vastly richer than those words suggest, influenced by harmonics, resonances, echoes, deficiencies in her ear, and sundry other acoustic and aural phenomena, including combination tones. Some of these facts are indicated indirectly by her statement that it was a major third played upon, say, a piano; others are not. Auditory experience is far too complex for ordinary people to parse. Thus, a new student entering Titchener's laboratory, asked to describe her auditory experience with care and in detail, would be baffled. To provide introspective reports of any value, she needs concepts and a vocabulary, a sense of what to look for, and practice in discerning these aspects of her experience as it occurs. Training in the recognition of combination tones is thus introspective training not because reporting such tones is necessarily an introspective act but because for the person antecedently interested in introspectively attending to her own auditory experience, the training provides a way of identifying and labelling one aspect of it.

Trained musicians and psychophysicists, therefore, although they don't generally conceive of themselves as 'trained introspectors' in the Titchenerian sense, and although they have ordinarily not undergone any general course of training and reflection on the methodology of introspection, possess some tools for apprehending their conscious experience that others lack and that it's part of the Titchenerian introspective training procedure to provide. Indeed, to the



extent that their aim *is* to apprehend their own experience — as opposed to, say, just improving (or mapping) their capacity to discriminate and label aspects of the publicly shared audible world — their project does resemble Titchener's, and might profit from broader reflection on introspective methodology.

When an untrained observer at first cannot discern a combination tone, and later in an acoustically identical situation can do so, a range of possible interpretations suggest themselves. At one extreme, we might suppose that, while on the second occasion she genuinely experiences the difference tone, on the first occasion the difference tone was in all respects so thoroughly absent from her experience that we couldn't even say that it contributed in some inarticulable way to its richness. At the other extreme, we might hold that the auditory experience remains in all respects completely identical from one occasion to the other, the only difference consisting in a separable introspective process and judgment. Neither of these extremes is especially inviting. Most philosophers and psychologists now take for granted that general knowledge can influence sensory experience, so that two people with the same peripheral sensory stimulation may nonetheless have different sensory experiences. If so, it seems likely that knowledge of combination tones and practice in discerning them will affect one's auditory experience, at least when one is deliberately listening for them. On the other hand, if we grant that sensory experience is rich, beyond the capacity of most observers fully to parse and articulate, and if we grant that combination tone sensations are not wholly created by the training procedure but can in some sense be *discovered* in experience by the person adopting the introspective attitude, then despite the 'top down' effect of general knowledge on sensory experience, a gap of ignorance still divides the auditory experience from the introspective judgment about it; and if Titchener is right, introspective training can help reduce this gap.

One might adopt the position that all mathematically simple combination tones contribute to any auditory experience of a musical interval, despite in many cases their never being reported even by the most sophisticated observers. (Besides the combination tones described, combination tones of 2U–L, 3L–2U, 4L–3U, 2U–2L, and others are sometimes reported for various stimulus intensities and frequency ranges, as well as combination tones arising from the interaction of harmonics of the fundamental tones.) However, supposing we reject that view, in many cases particular combination tones will be genuinely and in all respects unheard, and the introspective report of their absence will be accurate. When, consequently, should we regard an introspective observer as sufficiently attentive and well-trained that we may take at face value her claim not to hear a difference tone? I see no simple resolution. Furthermore, difficulties of this sort will necessarily emerge in any domain in which one admits the possibility of erroneously reporting the absence of particular experiences — potentially creating a major stumbling block for introspective methods. Tellingly, Titchener himself slides, either deliberately or in confusion, between speaking of unreported difference tones as absent and speaking of them as merely introspectively undetected — most often choosing to say, ambiguously, that the observer does not 'hear' them (I.1.39–46; I.2.66–72, *passim*).

### III: Examples of Introspective Training: The ‘Flight of Colours’

At the end of the fourth experiment series, after his students have already conducted fourteen other introspective experiments on afterimages, some rather complex, and so have significant introspective training in this regard, Titchener describes an experiment that begins with an observer sitting for five minutes in a dark room with a curtained window. When his partner gives a signal, the observer looks toward the window, the curtain is removed, and he stares fixedly for twenty seconds at the vertical bar separating the window panes. He then closes his eyes and reports his visual experience over the next few minutes. This experiment is to be repeated until the observer reports similar visual experiences on every trial (I.1.29–30).

What the observer sees is a sequence of shifting afterimages, known as the ‘flight of colours’. The reader can induce a flight of colours in herself by staring for a few moments at a light bulb or by glancing quickly at the sun, then closing her eyes, or she may wish to attempt a closer replication of the experiment Titchener describes.

I quote at length from Titchener’s discussion of this experience in the instructor’s part of the first volume:

This experiment shows, in a striking way, the effects of practice. The report of a wholly unpractised observer is a mere chaos. With attention, the uniformity of the phenomenon soon becomes apparent; and presently the observers who at first gave radically different accounts of the after-image will reach agreement upon all essential points.

With an unclouded sky, or a sky thinly covered with clouds and presenting an even white surface, the flight of colours is as follows:

- (a) A momentary positive and same-coloured image.
- (b) Interval of 5 or 6 sec.
- (c) Positive image, fluctuating in colour; sometimes with patches of red and green. After 1 or 2 sec., the image settles down to a sky *blue*, the vertical bar remaining dark.
- (d) The blue passes, with or without interruption, into a *green*. The green is at first very vivid; it disappears and reappears five or six times, growing gradually paler; at last it is almost whitish. — These initial changes show a good deal of individual variation. Some O’s [observers] now see
- (e) A *yellow* image. This (or the whitish green preceding) is regularly followed by
- (f) A deep *red* image. The black bar becomes luminous and slightly greenish, the light appearing first as a crack in its length. This is the stage of transition from the positive to the negative image. The red undergoes several fluctuations. Then follows
- (g) A deep *blue* image, with yellowish bright bar, more lasting than any of the preceding phases. The blue darkens, and the image gradually disappears, with or without passing into

(h) A dark *green* image. . . . Note the periodicity of stages *c* to *h*:

$$\begin{array}{c} | \text{---} | \text{---} | \\ \text{B-G-Y-R-B-G}^{10} \quad (\text{I.2.48}). \\ | \text{---} | \text{---} | \end{array}$$

It is by no means clear whether Titchener is right that practised observers eventually settle on similar descriptions of the flight of colours. Titchener cites Helmholtz (1860/1962) and Washburn (1899), who report roughly similar sequences of colours. However, Helmholtz's description is a rather bare statement that the afterimage colours produced by intense white light proceed white–blue–green–red–blue, while Washburn is Titchener's student and so not really an independent source. One might wonder whether Titchener's explicit statement that observers are to settle on a single sequence influenced his findings. It is also unclear what influences, including theories discussed in the laboratory, might incline observers to report one sequence rather than another.

By far the most detailed treatment of the flight of colours, complete with colour plates depicting the afterimages, is Homuth (1913). Homuth emphasizes the importance of training to even a greater degree than does Titchener, indicating the necessity of several months of intensive practice in observing afterimages. Homuth divides his images (which do not include a vertical bar) into four parts, the centre, border, outer frame, and extreme periphery, which undergo different colour shifts. In his primary condition with bright white light, Homuth reports the centre of the afterimage to be mainly blue alternating with reddish-violet, magenta, or pinkish-violet, although the sequence concludes with a brownish-yellow. The resemblance to Titchener's description is minimal at best.

William Berry (1922) offers a broad review of the literature on the flight of colours, dating back to Aristotle, and finds great variability of this sort among researchers. His conclusion is that there is no consistent sequence in the flight of colours, a point he supports with a study using his own observers (1927). (All Berry's (1927) observers were graduate students in psychology at Rochester, but he doesn't otherwise indicate their level of training.) On the other hand, Robertson and Fry (1937) point out that earlier observations were conducted under a wide variety of conditions and thus might be expected to produce variable results even if there is consistency in the flight of colours under any one condition. They report consistency among their observers, with results fairly similar to Titchener's (as do Weve, 1925 and Barry and Bousfield, 1934). The very sparse more recent research that I have been able to find does nothing to resolve the issue. The matter was less settled than dropped.<sup>11</sup>

[10] Blue and yellow are generally treated as opposing colors in visual perception, as are red and green.

[11] Wallace (1979) takes individual variability in the flight of colours for granted, while Young (1948) and Feldman *et al.* (1974) assume the contrary. In his influential general review of the literature on afterimages, Brown (1965) seems at one point to agree roughly with Titchener's description of the flight of colours (p. 480) but at another point, apparently inconsistently, to endorse Berry's claim that the flight of colours varies greatly from person to person (p. 490). A related issue is whether people experience a similar or variable evolution of coloured afterimages following exposure to coloured

When introspective training was banished from experimental psychology, so also was the possibility of verifying or disproving Titchener's claim. If introspective training is re-instituted, we can put Titchener to the test. Titchener seemed satisfied in this instance that observers with little general practice in introspective reporting but some practice in reporting afterimages — the undergraduates who had proceeded to the thirtieth page of his laboratory course (I.1.29–30) — would eventually settle on a common description of the flight of colours (presumably without feedback other than the explicit expectation that a consistent flight of colours will be found). We can duplicate these conditions.

Suppose it turns out that unpractised observers report very different colour sequences, while observers with both general experience reporting afterimages and specific experience reporting the flight of colours converge on Titchener's B–G–Y–R–B–G sequence; and suppose further that the observers have no special expectations about the sequence to be found. It would be possible that the trained and untrained observers had both accurately described their experiences — that somehow the training procedure had tamed the flight of colours. However, it is hard to see why this should be so. I would rather suspect, if the suppositions hold, that the pandemonium of colours in the naive introspectors' reports reflected some sort of introspective incompetence on their part and that the flight of colours is really as Titchener claims. We would then have learned something interesting about the evolution of afterimages, something that might have a general impact on our understanding of the visual system. And introspective training would appear to be vindicated, at least in this one particular research domain.

Of course, there is no guarantee that things would turn out that way. Even the best-trained introspective 'experts' on the flight of colours might continue to give divergent reports. That would reflect rather badly on Titchener. Here, then, is an opportunity to assess the merits of introspective training.

#### IV: Examples of Introspective Training: Non-obvious Visual Illusions

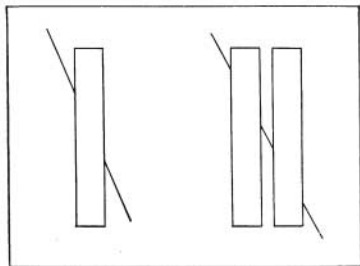


Figure 1.

The more powerful illusions that one generally sees in textbooks and at colloquia mask the introspective difficulties that arise for weak or non-obvious illusions. Confronted with Poggendorf's illusion (fig. 1, from I.1.165), most people feel unambivalently comfortable in reporting that, in some sense, the partly occluded line which we may know to be straight nonetheless 'looks' crooked.

If we accustom ourselves only to such easy cases — the 'best' illusions — we are not apt to reflect that one might have to look hard to find an illusion, that one

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light. The evidence on this question is also divided (see, e.g., Homuth 1913; Weve 1925; Judd 1927; Brown 1965; Stamper *et al.* 2000; Taya & Ohinata 2002). Other papers of interest include Fröhlich (1921) and Shuey (1924).

might be talented or inept in the introspection of illusions, and that the criteria of illusori-ness and visual appearance are evasive.

Examine the figure below, from page I.1.154:

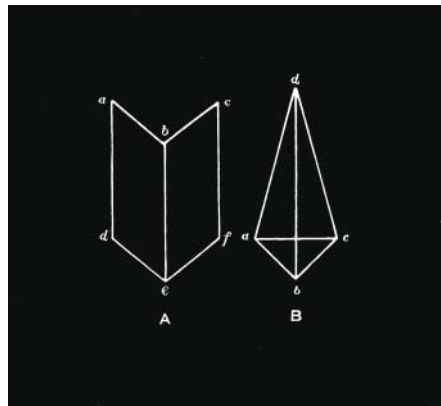


Figure 2.

Titchener invites his students to consider the following questions, which I ask the reader also to consider:

How does the figure A strike you at first sight? Fixate on some point on  $be$ . What is the appearance of the figure? Move the eye slowly from  $b$  to  $e$ , and back again. Does the figure change its perspective? Move the eye from  $b$  to  $c$ , and back again. Is there any change? Is there any uniformity of perspective, according as you move in the directions  $bc$ ,  $ba$ ,  $ef$ ,  $ed$ , or in the opposite directions?

How does the figure B strike you at first sight? Fixate, first, a point upon  $bd$ , and then a point upon  $ac$ ,  $ad$  or  $cd$ . Is there any difference of perspective? Move the eye slowly in the direction  $ba$  or  $bc$ ; and then in the direction  $ab$  or  $cb$ . What happens in the two cases? What secondary modifications of the appearance of the figure are conditioned upon the shift of perspective? (I.1.154)

If you're like me, following these directions is rather difficult — perhaps surprisingly so. The difficulty lies partly in controlling one's attention and the movement of one's eyes, resisting the temptation, for example, to glance at point  $c$  as one is supposed to be moving one's fixation slowly along  $ab$ . Since control of attention is crucial to many introspective tasks, this point is worth noting. It seems likely that attentional control varies considerably between people and that it may be improved by both general training in introspection and specific training with particular stimuli.

In the instructor's manual, Titchener comments that in both figures, the central line is generally seen as convex (i.e., closer to the observer) but that fixation on any point on a line tends to bring that line forward (I.2.310–11).<sup>12</sup> Although my introspections of the experiences produced by fig. 2 were initially quite disorganized, I find them now mostly to conform to the pattern described. But I am unsure whether I am now judging my experience of the figures more accurately or whether acceptance of Titchener's generalization has altered my experience. Perhaps a bit of both.

[12] Many people have discussed ambiguous figures that appear to reverse perspective, the most famous example being the Necker cube. The view that attention to a particular vertex tends to bring it forward traces back to Necker himself (Necker, 1832). More recent research suggests that this tendency is not perfect and a number of factors may be involved (Köhler & Wallach, 1944; Hochberg, 1950; Pritchard, 1958; Gregory, 1970; Girgus *et al.*, 1977; Peterson & Hochberg, 1983; Long & Olszewski, 1999).

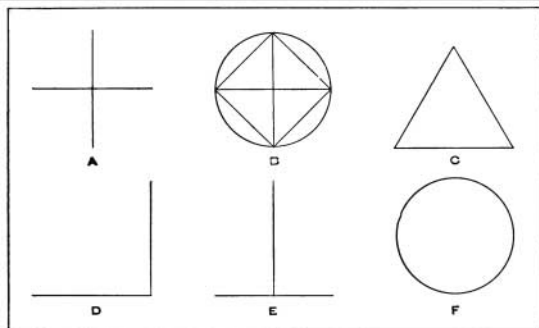


Figure 3.

The introspective difficulties in fig. 2 do not stop there. To gain a more acute sense of them, it is helpful to consider another figure (from I.1.160; apologies for the imperfect reproduction, especially of B): Titchener has his students view the objects in fig. 3 serially, first with both eyes, then with one eye at a time. He asks: 'Is there any illusion of extent [i.e., in the apparent length of the

lines]? Is there any other illusion? Look very carefully, in both cases, and do not be satisfied with your first discovery' (*ibid.*).

I find, in looking at these figures, as well as at those in fig. 2, that I feel considerable uncertainty about how they presently look to me. Perhaps the reader will feel the same way. In fig. 3A, does the vertical line look taller, shorter, or the same length as the horizontal? With one eye closed, does the inner horizontal limb (on the side of the nose) look longer, shorter, or the same length as the outer? Of course, you can carelessly toss out a response, confident that no one will prove you wrong (if such proof is even possible); but approaching these questions conscientiously, I at least feel unsure of myself, hesitant, or perplexed.

If you share this feeling, I hope you'll also share the sense that to find oneself in such a difficulty is, in a way, peculiar. How could it be hard to reach a judgment about how things appear to you? Although judgments about how things *are* understandably carry some risk, judgments about how things *look to you right now* are insulated in a particular way. Could you really go wrong in such a judgment? And if you couldn't go wrong, where does the difficulty lie?

Some readers will not feel any difficulty or have any sense that they could be mistaken. Those readers for whom such a feeling arises out of general temperament or philosophical conviction will probably be out of sympathy with the themes of this essay. Others, however, may have approached the task too casually, since, after all, no Titchener is standing over your shoulder forcing you to write a detailed lab report. Consider, then, in more detail, fig. 3A. Look at it both monocularly and binocularly. On first glance, in my experience, most viewers report no illusion: The two lines look to be equal length and to bisect each other perfectly at right angles. Nevertheless, figures of this sort are standardly presented as examples of the 'horizontal-vertical' illusion (e.g., Robinson, 1972, p. 97; Coren & Girgus, 1978, p. 29).<sup>13</sup> Experts in visual illusion appear to agree that, in some sense, the vertical line in 3A *does* look longer to normal perceivers. Perhaps something about the arrangement of this particular figure, with other

[13] Classical sources for the horizontal-vertical illusion include Opper (1854-1855) and Künnapas (1955). Titchener claims that every object in fig. 3 shows this illusion, except the last, which he says shows no illusion.

figures and a frame nearby, compromises this illusion, but Titchener appears not to think so (I.2.309, I.2.315). Bearing this in mind, return to the figure. Are you still confident that the lines look the same length? With one eye closed, the horizontal-vertical illusion purportedly is reduced or vanishes (I.2.315; also Prinzmetal & Gettleman 1993). Titchener also claims that in monocular vision the outer horizontal limb looks longer than the inner, and that in binocular vision the upper vertical limb looks longer than the lower (*ibid.*).<sup>14</sup> Some people, myself included, do not find it obvious, on reflection, which of these illusions is present or absent in their own experience.

Part of the difficulty here may be that it is not clear what it is for two lines to ‘look’ the same length. Clearly, it cannot be a matter of one’s *overall* judgment about the length of the lines, since one can judge that two lines look different lengths even when one knows them actually to be the same length. Is it a judgment about what one’s assessment of the lines would be, if one were to depend only on visual cues? I doubt visual cues operate separately from general knowledge in the way that would seem to be presupposed by such an approach. And in any case, the necessary judgment would be a difficult hypothetical one, requiring us to ascertain the bases of and influences on our assessments — which we seem to be rather poor at, generally speaking, for reasons famously reviewed in Nisbett and Ross (1980). Do two lines look the same length if they extend equal lengths across the ‘television screen of visual experience’? Many psychologists and philosophers now think that there is no one locus of visual experience, where everything comes together as on a screen, but rather a sequence of processes, some in parallel, that may yield differing results.<sup>15</sup> Even if there is something like a television screen of visual experience, it is unclear whether how things look should be judged by their projection upon it. Does a penny viewed at an angle ‘look’ elliptical or round? Does an oar half in water ‘look’ straight or bent (see Ayer, 1940; Austin, 1962)? Presumably, there is an illusion in fig. 3A just in case the lines look different lengths. But now I am puzzled as to what this means or how we are to come to a dependable judgment about it.

[14] I have been unable to find contemporary verification of these last two illusions (the first of which is supposed also to be present in fig. 3E, the second in 3B). Titchener attributes to Kundt (1863) the view that in monocular vision the outer limb appears longer than the inner. I’m not sure this is unambiguously implied by Kundt; but Kundt does clearly claim that in bisecting a horizontal line, subjects will show bias toward one side. I informally tested this claim by having subjects monocularly bisect, with a pen stroke, lines of varying length, but I found no consistent trends. Titchener attributes the view that the upper limb looks longer than the lower to Delboeuf (1865; see also Nicolas, 1995). I also informally tested Delboeuf’s claim, parallel to Kundt’s, that subjects bisecting a vertical line will tend to cut it too high. My subjects actually showed a weak tendency in the opposite direction.

[15] Such a perspective is engagingly explored in Dennett (1991). There is empirical evidence that different visual subsystems are differently subject to illusion. One influential series of experiments studied the Ebbinghaus (or Titchener Circles) Illusion, in which a circle surrounded by large circles is judged verbally to be smaller than a circle of the same size surrounded by small circles. The experimenters found that the part of the visual system that guides reaching, as measured by aperture size during grasp, is largely unaffected by the illusion (Aglioti *et al.*, 1995; Haffenden & Goodale, 1998; for reviews and discussion of these and similar experiments, see, e.g., Clark, 2001; Glover, 2002). (I owe this point to Tori McGeer.)

To add a different sort of difficulty: Suppose that when you focus on the horizontal line your sense is that the vertical line, as peripherally attended at that moment, is the same length as the horizontal, but you recall the vertical line to have looked longer when it was in focus. Or suppose that you don't feel sure whether the vertical line looks longer while you are attending to the horizontal but feel a kind of compulsion to focus upon it to make the judgment. If visual experience is a complicated flux, there may be no stable experience of the lengths of the lines to underwrite a stable judgment about which looks longer.

One way to approach the question of whether there are illusions in fig. 3, even for people who claim to see none, would be to construct a variety of figures like fig. 3 but in which the relevant lines differ in length. The subject might then be required to choose which lines are longer, and the researcher could check for a tendency toward error in one direction or the other (as Künnapas, 1955 did for figures like those in 3D and 3E). Alternatively, the subject might be given the opportunity to adjust the lines until they are judged to be equal length (as Gardner and Long, 1960a; 1960b did for the same types of figures). Such experiments either replace judgments about how long the lines look with judgments about how long the lines are, or blur the two judgments together. Perhaps this is acceptable if the subjects are sufficiently naive, but a subject aware of the possibility of illusion might treat the two questions rather differently. Furthermore, the presentation of multiple figures in sequence, or the ability to control the length of the lines, significantly alters the cognitive situation. Gardner and Long find that as small a variation as whether the horizontal line is fixed and the vertical adjustable or vice versa can have a pronounced effect on the magnitude of error. It is therefore conceivable that someone may consistently err on such tests and yet experience no corresponding illusions in fig. 3.

So, if someone reports no horizontal-vertical illusion in fig. 3A, should we conclude that she genuinely does not experience such an illusion? Or might one line look longer than the other despite the observer's being an insufficiently capable introspector to discover that fact about her visual experience? I can't see how we might easily go about deciding which is the case. To insist on the former seems unrealistically to deny the possibility of inaccuracy in assessing the complex stream of visual experience. To insist on the latter risks opening the door to a world of illusions that no one reports and that never deceive us.

Perhaps we can imagine an observer who, when presented with a variety of figures such as those in fig. 3, reports experiencing several small illusions in one direction or other for each of the figures, though most observers report no such illusions; and, further, that it turns out that both this observer and those who report no illusions err, on tests like those described in the last paragraph but one, in the directions predicted from the illusions reported by the first observer. Perhaps it would be plausible to suggest in such a case that all the observers experienced illusions in the original figures, that the lines actually looked to them, in *some* relevant sense of 'looked', to be different lengths despite their contrary report — and thus that we had on hand one introspector talented at reporting



illusions and a mass of others misreporting their own visual experiences. But I doubt things will turn out so neatly.

### V: Conclusion

It is reasonable to suppose, with Titchener, that introspection is a *skill*, one that not all people possess in equal degree. If so, then it is also natural to suppose that it is a skill that may profit from cultivation beyond what can easily be provided to a subject in fifteen minutes. Since the scientific study of conscious experience depends on introspective report, trained observers ought in some cases to be desirable. Close examination of cases from Titchener, however, reveals that the process of training may raise a tangle of epistemic and methodological issues that promise no easy resolution. Until we grapple with those issues and discover adequate means of distinguishing trustworthy introspective reports from undependable ones, the basic data of consciousness studies will remain muddy and inconsistent, and we will have no firm scientific footing.<sup>16</sup>

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