OPTICAL-GEOMETRICAL ILLUSIONS: THE NOMENCLATURE

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1. Introduction[1]

«Nomenclature is the action or the art of assigning a name to any thing, or thought or principle *etc*. in a given set of cognitions.» It should be «… the systematic combination of terms that refer to a certain science or discipline, well arranged and prepared according to accepted rules, to avoid any possible confusion among objects of one discipline…» (Bosco 1970). I will expound some problems of nomenclature in the field of optical-geometrical illusions, because I think that the field lacks a good and useful tool of this kind. A possible nomenclature is offered for discussion.

2. The Objects of Nomenclature

In the literature on optical-geometrical illusions we have *descriptions* and *images*. Oppel (1855) and Kundt (1863) diffusely describe the perceptual effects of partitions of lines and surfaces, but they do not exhibit any figure. Since figures can be viewed, whereas descriptions cannot, it seems convenient to remove descriptions of effects from the population of optical-geometrical illusions.

Not all figures bring out illusions. Some authors present outlined schemes to indicate the way to obtain the desired effect (*e.g.*, Kundt 1863, fig. 11 for partition; Loeb 1895, fig. 1-3 for misalignment), or present figures where the illusory effect is depicted (*e.g.*, Delboeuf 1865, fig. 4; Titchener 1899, fig. 8bc), or the illusory display is dismembered in order to facilitate the observation of the effect (*e.g.*, Farnè *et al.* 1978, page 81; Gillam 1979, fig. 1-2). Even if these figures are not strictly illusions, I am inclined to number them in a hypothetical atlas, because they are finalized to the acknowledgement of effects. After all, they are very small in number.

I believe that it is better to keep out of the optical-geometrical effects the major group of visual illusions concerning brightness and colour. It is a matter of convenience, not a theoretical one: since there is no geometry for brightness or colours, let other students attend to those phenomena. I said "the major group" on purpose, because some illusions show a strong interference between the linear elements of the display and their chromatic or achromatic characteristics. The fact was discovered very early, for instance in the studies of Einthoven (1898), Benussi (1902) and Botti (1910). We find the best instance of this fact in the variant of Zöllner illusion offered by Brunswik (1935, fig. 63). See also the first research on "irradiation" (Plateau 1842; Helmholtz 1867), that is unanimously considered a cause of size illusion.

[1] Obviously enough, this report cannot include all the figures I presented to the Macerata *Arbeitstagung*. Some of them can be seen in my papers listed in the references.

There are a lot of optical-geometrical illusions vaguely joined with disparate perceptual phenomena, like simultaneous masking (*e.g.*, Galli & Zama 1931, fig. 17), anomalous surfaces (*e.g.*, Farnè 1968, fig. 2; Coren 1972, fig. 5), "impossible objects" (*e.g.*, Penrose & Penrose 1958 fig. 1; Fisher 1968, fig. 7b), reversible figures (Necker 1833, fig. 18; Schröder 1858, fig. 12-13), amodal completion (*e.g.*, Burmester 1896, fig. 15; Kanizsa 1972, fig. 5), perspective (*e.g.*, Thiéry 1895, fig. 2; Ebbinghaus 1908, fig. 83), and so on. Some reviews, under the title of "visual illusions" (Robinson 1972, Da Pos & Zambianchi 1996, Ninio 1998, Goto & Tanaka 2005) mix together optical-geometrical illusions and phenomena even farther than the above mentioned ones, for instance pictorial perception, *trompe l'oeil*, Mach bands or apparent movement. In principle we cannot deny that there is something in common in all visual illusions – at least, our feeling of being deceived - but if we have to create a manageable data base for the students of pure optical-geometrical illusions, we should avoid instances of those far more complex phenomena.

A historical consideration of optical-geometrical illusions points out two contrasting tendencies: on one side the search for conditions that attenuate the phenomena (to begin with Filehne 1898), on the other side the search for even more astonishing variants of well-known perceptual faults (see, for instance, Kitaoka *et al*. 2001). I think that while the first tendency is useful to have a look inside the mechanisms of illusions, the second tendency is misleading, since it results only in a useless sensationalism. To give a historical example of the two tendencies from the same author, let us consider the famous paper by Fraser (1908): his celebrated "spirals" (figures 3-9) undoubtedly fit to *épater le bourgeois*, but the key to those astounding illusions are in his figures 1b-1e. It seems to me that a lot of figures, created to maximize the effects, can be disregarded in the nomenclature of optical-geometrical illusions because (a) they are possibly endless in number, and (b) they look like rhetorical expedients.

It is surely difficult to separate figures that are worthy of nomenclature - in a hypothetical atlas of optical-geometrical illusions - from illusory figures in which the already mentioned circumstances have the major weight. I offered some criteria, but a more sharp-witted examination of the matter can lead to add new criteria or to better specify the here presented ones. The goal is to have a *corpus* of figures whose names are largely shared, and we can attain this by successive adjustments.

I think that psychology is a natural science, and that perceptual facts are something like stones for the petrologist, leaves for the botanist and birds for the zoologist. According to this position, the first thing to do is to carefully describe facts, which in our domain means to exhibit figures. Next, to give each figure a name that can identify it, in so allowing the reader to visualize a specific object. We cannot continue to utter "Zöllner illusion" without specifying if we refer to the original pattern (1860, fig. 4) or to one of the hundreds of variants – or supposed such to be – of it.

3. The Current State of Affairs

Now, a short list of complaints.

[1] We are accustomed to speak of the "Oppel-Kundt illusion", mainly referring to a display like the one reported by Goto & Tanaka (2005, fig. 11). In Oppel's main papers (1855, 1857, 1860) there are 30 figures, but none is like that of Goto & Tanaka. The same thing can be said for Kundt (1863, 21 figures). We discover that the inventor of Goto & Tanaka's display is Ebbinghaus (1908, fig. 61, but Bourdon 1902, fig. 97 already presented a similar display). Neither Ebbinghaus or Bourdon – not to mention Helmholtz (1867) or Wundt (1898) – refer to Oppel or Kundt. Titchener (1901, 1, 1, fig. 34) presents various kinds of partitions as "Oppel's lines".

[2] As anyone should know, Poggendorff did not exhibit a figure or write a line on the illusion that bears his name. He simply noticed that in the famous Zöllner display (1860, fig. 4) not only do the long lines appear displaced, but that also the short lines lose their alignment (Zöllner 1860, pages 501-502). The display that we are used to seeing (Goto & Tanaka 2005, fig. 3) is by Burmester (1896, fig. 3), that merely ameliorated a figure by Hering (1861, fig. 22 and 28). Kundt (1863, fig. 20 and 21) studied the effect, so that Delboeuf (1865, page 195) refers to Poggendorff display as "Kundt's illusion". Helmholtz (1867, fig. 176) reported the figure 22 of Hering, without mentioning Hering or Poggendorff. See figure 1 here.

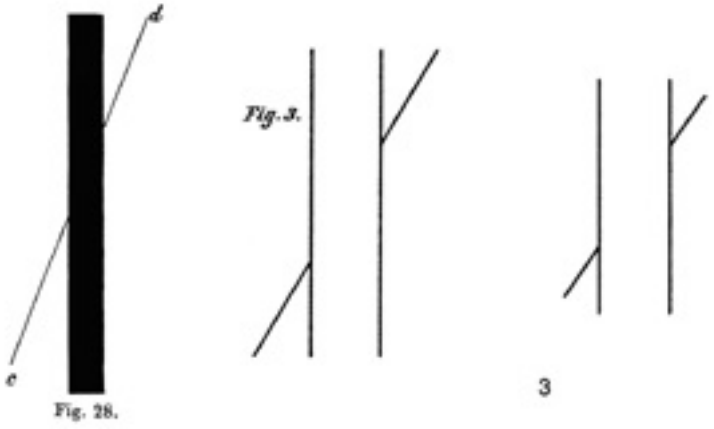

Fig.1. Left: the first representation of the Poggendorff illusion (Hering 1861*28). Centre: the best instance of it (Burmester 1896*3). Right: the current sample (Goto & Tanaka 2005*3).

[3] The current display of Müller-Lyer's display cannot be found in his original papers (1889, 1896a, 1896b): see figure 8 here. The current instance is by Heymans (1896, fig. 2), who simply put horizontally a diagonal figure by Brentano (1892, fig. 9). See figure 2 here.

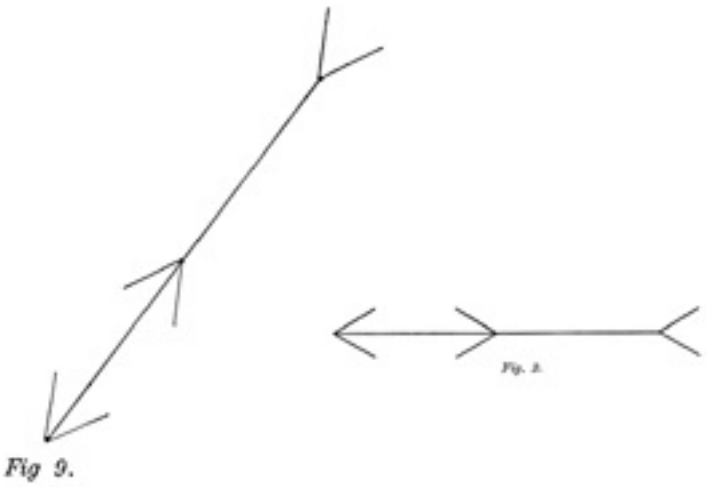

Fig. 2 Current representations of Müller-Lyer illusion are due to Brentano (1892*9) and to Heymans (1896*2). See also figure 6 here.

[4] The display well known as "Baldwin's illusion" in the usually quoted paper (1895) does not exist. Baldwin simply published the sketch of an apparatus he employed to measure the size contrast in pairs of squares. Somebody noticed, at the centre of the drawing, something strange, and so came to light the "Baldwin's illusion". I cannot understand why Robinson (1972, pages 41 and 43, fig. 2.41) – to whom we are presumably indebted for the current paradigm of the illusion – tells us that in Baldwin's paper there are two figures, where there is one sketch and two graphics. Old illustrations of the illusion (*e.g.,* Bourdon 1902, fig. 111; Berrettoni 1907, fig. 17) have discs in place of squares. See figure 3 here.

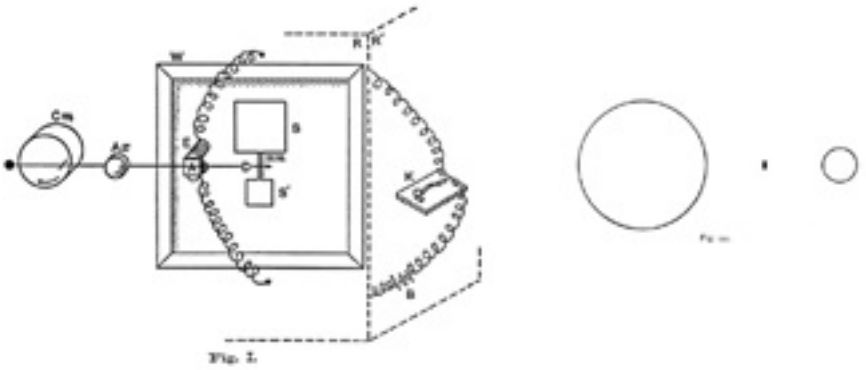

Fig. 3 Left: the only figure present in Baldwin's 1895 paper. Right: the first instance I found of "Baldwin's illusion" (Bourdon 1902*111)

[5] The size illusion affecting two equal circles, the one surrounded by small circles, and the other by large circles, is usually ascribed to Ebbinghaus (Luckiesh 1922, page 56; Ehrenstein 1954[3], page 132; Coren & Girgus 1978, page 37; Ninio 1998, page 137), but Robinson (1972, page 47) ascribes it to Titchener, and Goto & Tanaka (2005, page 59) to both Titchener and Ebbinghaus. As a matter of fact, there is no illusion of circles in Ebbinghaus (1908), while there is in Titchener (1901, 1, 1, page 169, fig. 3). The point is that the illusion was first published by Thiéry (1896, fig. 51a and 51b), and that it appeared also in the treatise by Wundt (1898, fig. 49), with no mention of the author. See figure 4 here.

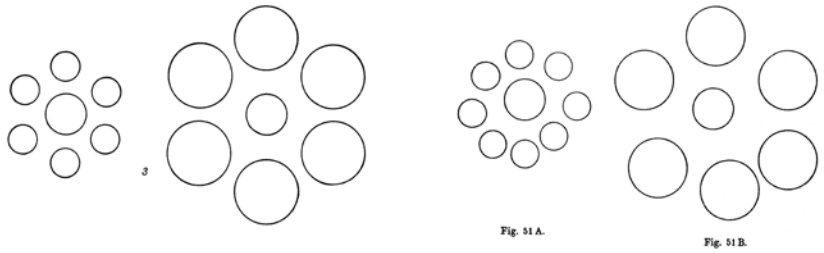

Fig. 4 The so-called "Titchener's illusion" (1901, 1, 1, 169 *3) is in fact by Thiéry (1896*51a-51b).

6] Münsterberg's *Schachbrettfigur* (1897, page 185) was first published by Heymans (1897, fig. 15), who moreover tells that he saw it in a book edited in the USA, perhaps in 1895, by a certain Milton Bradley. In the oldest literature (*e.g.,* Filehne 1898, page 42) the Münsterberg illusion is known as "*die Milton-Bradley'sche Figur*".

[7] Ponzo never presented an illusion in the form set forth, *e.g.*, by Goto & Tanaka (2005, fig. 4). He simply made use (1912, page 127) of a similar figure, borrowed from Sanford (1900, fig. 45a), in order to explain the moon illusion (the moon at horizon appears larger because it is in the corner between the horizon and the vault of heaven). The only link to illusions actually presented by Ponzo is a figure (1928 or 1929, fig. 6) where the points of a column, placed in the narrow part of an angle, appear more numerous than in an equal column placed in the open side of the angle. By the way, the "Ponzo effect" was already described by Lipps (1897, fig. 82).

4. About the Name of the Authors

In the botany and zoology domains, the nomenclature of species refers to the name of the one who first described the new object. There is an absolute rule (see Minelli 1994, 9, but also the website of the International Code of Zoological Nomenclature: www.iczn.org) according to which the name is assigned on the mere *priority* of the discovery.

Concerning optical-geometrical illusions, a nomenclature based on the names of the authors according to priority is difficult to accept, and for two reasons. First, there are authors that published figures devised by others, sometimes properly mentioned.

The most impressive case is that of Oppel, who notified in 1855 two illusions by a certain Poppe (fig. 2 and 5, figure 5 here) and in 1857 two other illusions by a certain Schultze (fig. 3 and 9, figure 6 here).

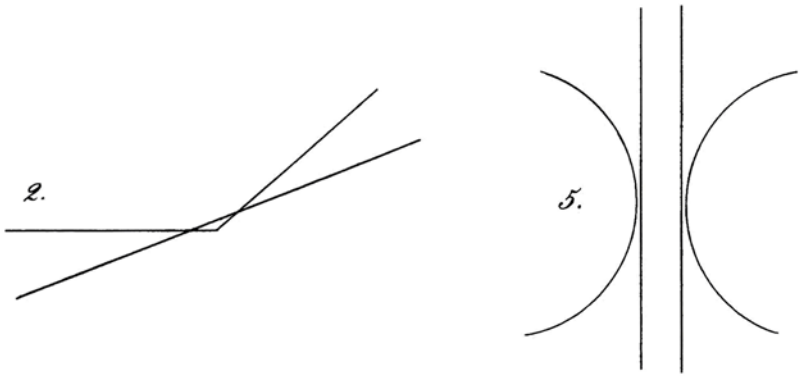

Fig. 5 Left: the first Poppe's illusion (Oppel 1855*2): the diagonal line looks bent when crossing the angle. Right: the second Poppe's illusion (Oppel 1855*5): vertical lines look distorted when passing near to the semi-circumferences.

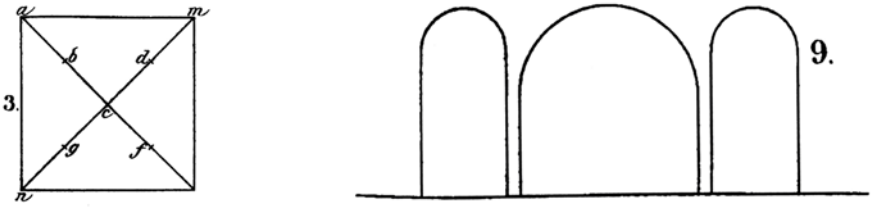

Fig. 6 Left: the first Schultze's illusion (Oppel 1857*3): *a*-*b* looks shorter than *b*-*c*. Right: the second Schultze's illusion (Oppel 1857*9): the junctions between semicircumferences and vertical lines present a *Knickung* – a breaking, an unevenness.

This fact cannot pass unnoticed, because the first display by Poppe would be at the root of all distortions of curves crossing right lines (from Kundt 1863 fig. 1, and Delboeuf 1865 fig. 4, till Gatti 1927 and Orbison 1939) and the second display is the paradigm of all distortions of right lines running in the nearness of a curve (from Lipps 1897, fig. 102, to Mayer-Hillebrand 1942, fig 20b). As to Schultze, the first display reported by Oppel (1857, fig. 4) has innumerable issues from Judd (1899, fig. 2) to Fisher (1970, fig. 5a), and the second display (Oppel's figure 9) generated a small number of presentations on the perceptually imperfect junction of a straight line with an arc of circle (from Höfler 1896, fig. 1 and 2, till Robinson 1972, fig. 2.50).

Second, and apart from the fatherhoods incertitudes set forth in the previous paragraph, there is another circumstance to bear in mind. Oppel published 30 figures (1855, 1857, 1860), Delboeuf 108 (1865a, 1892, 1893), Müller-Lyer 83 (1889, 1896a, 1896b), Lipps 183 (1897). For the most, the figures of these authors are not quotations

of other's preceding observations, or variants of the same effect, but original discoveries. These being the premises, what does "Delboeuf's illusion" mean? *Which* one? Does it make any sense to speak about "Lipps' illusion"? *What is* Lipps' illusion? See, for instance, figures 7 (Delboeuf) and 8 (Müller-Lyer) here.

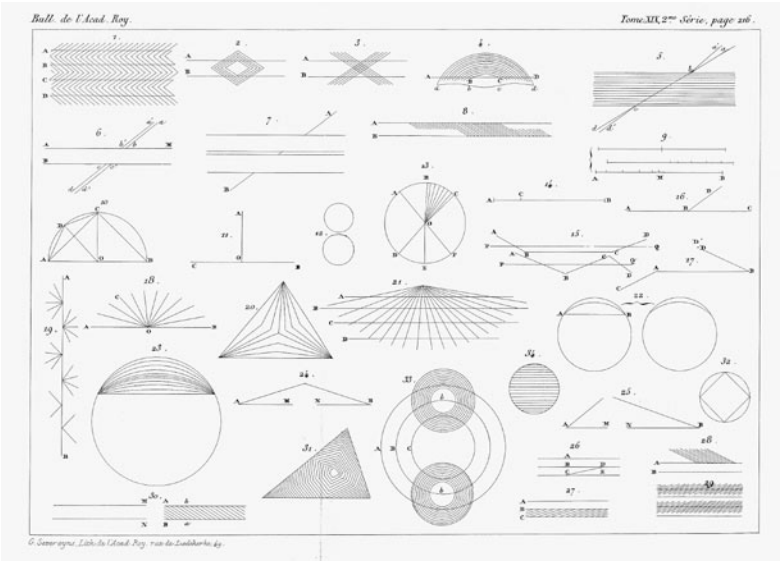

Fig. 7 The many optical-geometrical illusions published by Delboeuf in 1865. The illusion that bears his name was published in 1892, figure 25.

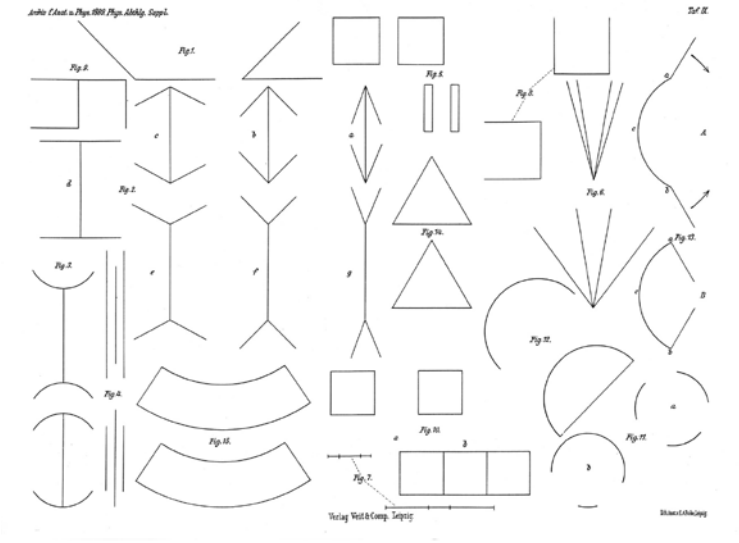

Fig. 8 The many optical-geometrical illusions published by Müller-Lyer in 1889. For his famous one, see figure 2 here.

5. A Proposal

Let us accept the principle that we can speak only of figures that we can see in books and journals: at least, we shall have a sure and manageable source of perceptual effects. Since the nomenclature based on the names of the authors does not work – as I tried to demonstrate - my proposal is to refer only to figures, and not to other elements (see later). In order to *identify* each figure, I suggest that the name of each illusion should bear these data: [name of the author] [year of publication] [number of the figure in the paper]. This way, the famous "inverted T" becomes **Schumann 1900b*29** (where the asterisk stands for "figure"), and the wooden version of Penroses' triangle becomes **Gregory 1968,73** (where the comma means that in the paper figures are not numbered, and that the number refers to a page).

6. Conclusion

The problems of nomenclature do not end here. If we write "Schumann 1900b*29", the reader gets no idea of what sort of visual illusion it is. Some extension is necessary, that informs whether the figure is of concern or not. At this point things become most difficult. In the literature, optical-geometrical illusions are distinguished not only by the names of their inventors, but also [a] on the visible effects (distortions, misalignments, numerousness, ambiguity *etc.*), [b] on the resemblance with actual objects (arrows, cubes, spirals, Kindergarten pattern *etc.*) and [c] on the supposed explanations (assimilation, contrast, anisotropy of the visual field, first or second order *etc*). This fact leads directly to the main problem of the field: classification. Now, I listed 24 classifications of optical-geometrical illusions: Oppel (1855), Lipps (1897), Wundt (1898), Bourdon (1902), Benussi (1904), Pegrassi (1904), Berrettoni (1907), Botti (1910), Ebbinghaus (1908), Luckiesh (1922), Boring *et al.* (1935), Mayer-Hillebrand (1942), Rausch (1952), Kleining (1953), Ehrenstein (1954[3]), Tausch (1954), Oyama (1960), Piaget (1961), Tolansky (1964), Robinson (1972), Coren & Girgus (1978), Imai (1984), Ninio (1998), Goto & Tanaka (2005), and there are surely other ones. In these classifications the above mentioned criteria (perceptual aspect, resemblance, explanations) are mixed, so that it is hard to choose the proper word for the extension in the string of characters that is the name of the illusion.

This problem is partly solved by everyday practice: in the titles of papers there is often a reference to a *prototype*. There are prototypical illusions, like Zöllner, Poggendorff, Hering, Müller-Lyer, Ponzo and so on, so that the reader promptly understands the matter at issue. Unfortunately enough, these names do not deplete all the figures, because for some of them the name of the author is unknown, and for other ones the aspect of the illusion is more important than the name of the discoverer. There is a lot of work to do, if we want to have a useful and shared nomenclature of optical-geometrical illusions; yet I hope to have made the first step, that is by defining a way to at least *identify* each figure of our interest.

Summary

The numerous inaccuracies of the current nomenclature of optical-geometrical illusions are set forth. The Oppel-Kundt display cannot be found either in Oppel (1855) or in Kundt (1863): it is by Ebbinghaus (1908); Poggendorff illusion was first depicted by Hering (1861); Loeb's illusion (1895) is ignored in the cases of misalignment; the current display of Müller-Lyer was outlined by Brentano (1892) and ameliorated by Heymans (1896); Baldwin (1895) never presented the optical-geometrical illusion that bears his own name; Ebbinghaus's (or Titchener's) illusion is by Thiéry (1896); Münsterberg simply reported a figure found in Heymans (1897); Ponzo' illusion, in its current form, cannot be found in his works (1912, 1928). Besides, current nomenclature, based on author's name, neglects the fact that some authors presented many and different illusive figures (for instance: Delboeuf: 108; Müller-Lyer: 65; Lipps: 183), so that any reference to the authors is useless. A *nomenclature centred on figures*, and not on authors is suggested: each figure would be identified by a string of characters bearing the name of the author, the year of publication and the number of the figure in the text (or the number of the page that contains the figure). Some considerations follow, on the necessity of adding some specification to the bare name of the author and the number of the figure.

Keywords: Optical-geometrical illusions, vision, visual illusions.

Zusammenfassung

Die zahlreichen Ungenauigkeiten der gängigen Nomenklatur der geometrisch-optischen Täuschungen werden dargestellt. Die Oppel-Kundt-Täuschung ist weder in Oppel (1855) noch in Kundt (1863) zu finden, sondern geht auf Ebbinghaus (1913) zurück. Die Poggendorff-Täuschung ist erstmalig von Hering (1861) dargestellt worden. Die Loeb-Täuschung (1895) wird in ähnlichen Darstellungen des *misalignment*-Phänomens nicht erwähnt. Die übliche Form der Müller-Lyer-Täuschung wurde von Brentano (1892) vorgestellt und von Heymans (1896) verbessert. Baldwin (1895) hat die Täuschung, die seinen Namen trägt, nie dargestellt. Die Ebbinghaus- oder Titchener-Figur ist auf Thiéry (1896) zurückzuführen. Die von Münsterberger aufgezeigte Täuschung ist bei Heymans zu finden (1897). Die Ponzo-Täuschung kann in ihrer gängigen Version in seinen Werken (1912, 1928) nicht gefunden werden. Darüber hinaus ist die übliche, auf dem Autorennamen basierende Nomenklatur nicht wirklich hilfreich da sie die Tatsache vernachlässigt, dass einige Autoren mehrere und unterschiedliche Täuschungen vorgestellt haben (z.B. Delboeuf: 108; Müller-Lyer: 65; Lipps: 183). Es wird eine *auf die Figur* und nicht auf den Autor bezogene Nomenklatur vorgeschlagen: jede Täuschung soll durch eine Zeichenfolge identifiziert werden, die den Namen des Autors, das Jahr der Veröffentlichung sowie die Abbildungsnummer der Figur enthält (bzw. die Nummer der betreffenden Seite im Text, falls die Abbildungen nicht nummeriert sind). Anschließend werden ergänzende Überlegungen zur Notwendigkeit, weitere Informationen zu Autorennamen und Abbildungsnummer hinzuzufügen, dargelegt.

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