Handbook of Experimental Phenomenology
Visual Perception of Shape, Space and Appearance

Edited by Liliana Albertazzi

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Handbook of
Experimental Phenomenology
“Systematic concern with visual appearances is as old as modern science but it has not been pursued with the consistency accorded to visual processing. Galileo interrogated appearances in contrast to the optical approach heralded in his day by Kepler and Scheiner. Now the study of appearances is enjoying a renaissance due in no small part to the novel techniques of experimental phenomenology so clearly expounded in this book.”

Nicholas Wade, Emeritus Professor, University of Dundee

“Liliana Albertazzi’s *Handbook of Experimental Phenomenology* is the first of its kind, and brings together an internationally distinguished group of researchers. ‘Experimental phenomenology’ was primarily a development within European psychology, and includes the pioneering research of David Katz on color vision and touch, of Albert Michotte on perceived causality, permanence, and ‘reality,’ and of Edgar Rubin on reversible figures. As a distinctive ‘school,’ it has continued to flourish in Italy, thanks to the leadership of Gaetano Kanizsa and Paolo Bozzi.

Although several of the contributors to this handbook would not identify themselves with experimental phenomenology, they do share, as Albertazzi rightly points out, a fundamental concern: ‘a focus on the subjective, valence, and meaningful aspects of experience and their endeavor to provide a scientific explanation of them which is as rigorous as those of the kindred disciplines of psychophysics and neuroscience.’ This handbook will be a significant resource both for phenomenological psychology and for the psychology of perception.”

Alan Costall, Professor of Theoretical Psychology, University of Portsmouth

“This handbook brings together a distinguished collection of thinkers and researchers who address the subjective nature of visual perception as a science in its own right and who have developed a variety of new methods and concepts to investigate it. This could become an important book that redresses the balance of discussion and debate about what ‘seeing’ is, and its role in our mental lives.”

Mark Georgeson, Professor of Vision Sciences, Aston University, Birmingham
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Preface

Among the several variants of phenomenology, the experimental one is the most promising. While maintaining a strongly theoretical character, experimental phenomenology is a full-fledged science whose specific object of inquiry is appearances or mental phenomena.

What experimental phenomenology incontestably entails is the need to devise a psychological science per se which goes beyond current proposals, and the development of new methods of investigation, measurement, and modeling of phenomena of subjective experience.

The positions of individual researchers on the role and function of experimental phenomenology may vary between those who tend to think that analysis of phenomena can be conducted by remaining exclusively within the field of the qualitative, and those who choose to explore all the possibilities offered by psychophysics or the neurosciences to find correlations which shed light on the world of subjective experience. What distinguishes and links the reflections conducted in this handbook on experimental phenomenology is the explicit effort to provide a scientific explanation of the subjective aspects of experience as rigorous as those of the kindred disciplines of psychophysics and neuroscience.

Devising and developing a science of appearances or a psychological science per se is obviously a bold undertaking. Collaboration with the colleagues who have wanted to share this enterprise with me shows that rigorous philosophy and exact science are inseparable, and it demonstrates the extraordinary results that can be achieved when the effort is shared. Not all those who share an experimental phenomenological approach to vision science are present here, but the space of a handbook is physically and necessarily limited.

I would also like to thank the publishers, Wiley-Blackwell, for the trust and support they gave to the handbook project, and to the editorial staff for the kindness and professional attitude they demonstrated during the preparation of the manuscript.

Finally, I thank the contributors to the handbook because their professional and human excellence is one of the best gifts that life can offer. Working on the project for a science of appearances from the phenomenological point of view, when it yields its most interesting insights, which are also of an applicative nature and which may indeed induce the revision of a scientific paradigm, is an experience and a privilege that rarely occurs in the life of a researcher.

Liliana Albertazzi
Experimental Phenomenology: An Introduction
Liliana Albertazzi

Save the phenomena. (Plato)

The Concept

The expression “experimental phenomenology” seems to be an oxymoron. Phenomenology, in fact, understood as the science of phenomena, appearances, or subjective experiences, was born in the classical age as a philosophical theory. It is a complex neo-Aristotelian theory which originated in the empirical and descriptive psychology of Brentano (Brentano, 1874/1995, 1988) but is best known in the version developed by Husserl (1913/1977, 1929/1963).

There are two main “classical” versions of phenomenology: the Husserlian one and the experimental version of Stumpf and Michotte. Husserl stated as follows the specificity of phenomenological analysis with respect to the Galilean science of nature and modern psychological science:

The modern science of nature arose from a one-sided orientation of interest and method, which under the heading “nature,” did not simply single out of original experience a sphere of directly exhibitable experiential givens [i.e., appearances], but rather had in view what was already an artificial product of method. Thus, it was a nature which it did not have beforehand as experienced, but was an idea which it undertook to realize by theory.

A consistent elimination of all “merely subjective” properties belonging to the things of immediate experience, of all features stemming from subjectivity, belonged essentially to its method. This extraction of the subjective, and therefore mental, was however not at all interested in the mental itself, but precisely in that which remained over as a residuum in such a method, as purely physical or material. The purely physical was the theme and not the mental, which here was merely to be disposed of as a contamination.
And thus the subjective itself was not scientifically grasped and delimited (Husserl, 1925/1977, pp. 39–40 [Eng. tr.]; words added in square brackets)

Husserlian phenomenology therefore set out to analyze and describe the purely mental (i.e., “presentational”) nature of objects as they appear to subjective awareness: be they concepts of numbers, connected with the existence of Gestalt moments in the process of constructing the numerosness of objects (Husserl, 1891/1970); visual appearances and their modes of appearing; the perspective “shading-off” of an object due to kinesthesis and colour; the forms of grouping and multistability; relationships of similarity, and so forth (Husserl, 1939a/1973). In principle, the Husserlian method rejects the complete formalization (Husserl, 1939b) of phenomena and/or their explanation in terms of experimental science (Husserl, 1925) (on the specificity of the phenomenological philosophical method see Attneave, 1950, 1972; Depraz, Varela, & Vermersch, 2003; Gurwitsch, 1966b; Mohanty, 1989; Spiegelberg, 1982, Part 5; and, in other contexts, Giorgi, 2009).

Moreover, drawing on its Aristotelian origins (Benussi, 1913; Ehrenfels, 1890; Meinong, 1899, 1904; Stumpf, 1873, 1883), phenomenology engendered the outstanding tradition of experimental inquiry which culminated in Gestalt psychology (Koffka, 1935, 1969; Wertheimer, 1923; see Ihde, 1986; Masin, 1993; Vicario, 1993), whose principles have never been disputed, and which today arouses renewed interest in the neurosciences (e.g., Hess, Beaudot, & Mullen, 2001; Kovács, 1996; Kovács, Fehér, & Julesz, 1998; Kovács & Julesz, 1993; Todorović, 2011).

A classic definition of experimental phenomenology, its area of inquiry, and its interests is provided by Albert Michotte, who wrote as follows about the experiments conducted at his laboratory in Louvain:

"Our research at Louvain, particularly on vision, seems to demonstrate that some specific phenomena (or, more precisely, certain phenomena that possess specific characteristics) occurring at the level of perception correspond to concepts fundamental to our spontaneous, non-critical, understanding of the physical world. These include the reality of things; the persistence of their substantial identity during change (displacement or transformation); the continuity of their existence despite the discontinuity of their presence in our experience; and the actions they perform upon another (causality) on in relation to one another (fleeting, pursuit, etc.), etc. (Michotte, 1950a/1991, p. 224)"

What, therefore, is the difference between the two classic versions of phenomenology? Are they incompatible with each other, in that one pertains to philosophical analysis and the other to science, or are they in some way concordant?

The aspect mentioned by Michotte—that experiential reality is constructed on the basis of the subjective space-time continuity of the presentation—is an essential part of phenomenological research. In principle, there is no mutual exclusion (Gurwitsch, 1966a) between the mental operations (acts) described by Husserl as “simple” (schlichte) observations of the phenomena that appear in the visual field at presentational level, on the one hand, and the observation and description to which those phenomena are subjected on the other (Hering, 1920/1964, chaps. 1 and 2; Michotte, 1954). Michotte was a great admirer of Husserl; and the Husserlian principle of eidetic variation (which is not an empirical generalization) has interesting
analogies with his procedure of analysis (Thinès, 1991, pp. 17–18). Both are procedures with which to uncover the nature of phenomena and their “essence,” or the universal nature of perceptual contents. As Buytendiik writes:

In the detailed and exact investigation of Michotte on the perception of causal relations . . . the external stimulus-factors for the attribution of meaning to perceived objects were exactly determined. But one can also study the genesis of the attribution of meaning, that is, the modalities of signifying, interpreting, valuing; and this leads to a knowledge of what, to the essence, the idea, the *eidos* of a causal relations. (Buytendiik, 1987, pp. 39–40)

Galileo himself was aware of the problem of defining *what* phenomena are and *why* they appear as they do (see below), and he prudently declared that he was not to seek to prove the essence (Galilei, 1612/1970).

The importance of the phenomenological method also resides in its simplification of different theories concerning the interpretation of phenomena. As Koffka writes:

A good description of a phenomenon may by itself rule out a number of theories and indicate the definite characteristics which a true theory must possess. We call this type of observation “phenomenology,” a word which has various other meanings which must not be confused with ours. For us phenomenology means as naïve and full a description of direct experience as possible. (Koffka, 1935, “On the phenomenological method,” chap. 3)

This, moreover, is one of the most crucial aspects of phenomenological research.

It is worth quoting a long extract from Kanizsa (1991) because even today what an experimental phenomenology should/can do is often misunderstood:

The goal pursued by experimental phenomenology does not differ from that of other sectors of psychology: discovery and analysis of necessary functional connections among visual phenomena, identification of the conditions that help or hinder their appearance or the degree of their evidence, in other words: determination of the laws which the phenomenological field obeys. And this *without leaving the phenomenal domain*; without, that is, referring to the underlying neurophysical processes (to a large extent unknown) or to the concomitant non-visual psychological activities (logical, mnestic, affective activities which are just as enigmatic as vision itself). The influence of such processes and activities certainly cannot be denied, but they must not be identified with seeing . . . The experimental phenomenology of vision is not concerned with the brain but with that result of the brain’s activity that is seeing. This is not a second-best choice justified by the slowness of progress in neurophysiological research and its uncertain prospects; it is a methodological option taken for specific epistemological reasons. And mainly the conviction that the phenomenal reality cannot be addressed and even much less explained with a neuro-reductive approach because it is a *level of reality* which has its own specificity, which requires and legitimates a type of analysis suited to its specificity. The knowledge obtained in this way is to be considered just as scientific as the knowledge obtained in any other domain of reality with methods commensurate to that domain. (Kanizsa, 1991, pp. 43–44; emphasis added)
The phenomenological procedure consists, for example, in lining up particular phenomena in a continuous series based on the order of their similarities: for instance, ordering a series of grays from white to black where the order follows their “given” and “natural” affinity of gradation; or, by looking at several reds and recognizing the universal that they have in common on the basis of their likenesses; or recognizing that every variant of red is in conflict with every variant of green, and their common shared universality of color (the eidos) (Da Pos & Albertazzi, 2010).

The gestaltists adopted several features of the phenomenological method, such as the eidetic description of phenomena (Koffka, 1935, Part III), but they did not always declaredly subscribe to the investigation of essences, except for Koffka in relation to the analysis of demand characteristics (Albertazzi, this volume; Koffka, 1935, chap. 1) or Krueger (1928/1953) in relation to feelings, but doing so within Ganzheitpsychologie. Katz, in his analysis of color, furnished an exemplary description of eidetic variation by showing that a particular appearance of red is nothing but an instance of a certain shade of red in general (as pure color) and that there is a phenomenal difference between surface colors and film or volumetric colors (Katz, 1935, Part I).

Hering provided a psychological grounding for this method of analysis in the two first chapters of his Outline of a Theory of a Light Science (Hering, 1920/1964), which led to recovery of the laws of opponence among the unique colors which were subsequently confirmed at neurophysiological level (De Valois, 1969; De Valois, Abramov, & Jacobs, 1966; De Valois & De Valois, 1993; Hurvich & Jameson, 1955, 1961). Although further research has cast doubt on some of the results obtained by neuroscientific investigation (Burns, Elsner, Pokorny, & Smith, 1984; MacLeod, 2010; Valberg, 1971, 2001), it has not changed in the slightest the validity of Hering’s analysis at the phenomenological level. As Metzger observed when describing the task and method of an experimental phenomenology used to study the laws of seeing:

we have proceeded exclusively and without any glance into physics, chemistry, anatomy, and physiology, from within, from the immediate percept, and without even thinking of rejecting any aspect of our findings or even changing its place, just because it does not fit with our contemporary knowledge of nature so far. With our perceptual theory we do not bow to physiology, but rather we present challenges to it. Whether physiology will be able to address these challenges, whether on its course, by external observation of the body and its organs, it will be able to penetrate into the laws of perception, is pointless to argue about in advance. (Metzger, 1936/2006, p. 197)

It is also true that, as Köhler pointed out, “phenomenology has sometimes offered a commodious refuge for a very vague way of philosophizing. Of course, we wish to have nothing to do with such aberrations” (Köhler, 1938/1976, chap. 3). Obviously, nor do any of the contributors to this handbook.

How do matters stand at present?

The State of the Art

The relationship between philosophical phenomenology and the experimental sciences has fluctuated over time, producing uneven, sometimes contradictory, results
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(Albertazzi, 1998, 2001a, 2001b. On Husserl’s influence on the Gestalt psychology movement see Lyons, 1968; MacLeod, 1968). To cite only some examples, reference has been made to Husserl (and Heidegger) in regard to topics concerning both artificial intelligence and the cognitive sciences (Dreyfus, 1982, 2002), interpreting Husserlian phenomenology in representationalist terms and, more recently, in relation to discovery of the mirror neurons (Rizzolatti & Sinigaglia, 2006): in this case, the interest has centered on the concepts of space and kinesthesia in Husserl (1907/1997) read in terms of perception and action. Other studies on perception and action using the so-called sensory-motor approach (Hurley, 1998; Hurley & Noë, 2003; Noë, 2004, 2009; O’Regan & Noë, 2001) have embraced the more “literary” phenomenologies of Heidegger (1927/1966) and Merleau-Ponty (1962, 1968), while rejecting Husserl’s. Instead linked with Husserl is the “neurophenomenology” developed by Varela (Petitot, 2008; Varela, 1999), in relation to embedded cognition. These different readings testify to the complexity of Husserl’s theory, which is probably not included with all its manifold aspects in any single approach. Recently, moreover, some authors would have phenomenology confined to the domain of the purely philosophical (Merleau-Ponty, 1962; Thompson & Zahavi, 2007; Zahavi, 2004) on the grounds that phenomenology is not and cannot be a line of scientific inquiry, nor can it underpin an experimental science of qualitative phenomena (Dennett, 1992). This stance, as Koffka noted (1935, chap. 1), is not new in the history of psychological science. It is argued that the mind can never be investigated using the methods of the natural sciences; it is only possible to describe subjective experiences of phenomena and compare them linguistically. Yet this position overlooks the fact that comparison among experiences can also be conducted in quantitative terms, and that quantification helps researchers find significant interactions among phenomena (Canal & Micciolo, this volume).

Moreover, it is a fact that the phenomenological analysis of appearances has furnished inputs to the neurosciences, as shown by the efforts made by the latter to explain the phenomenon of illusory contours at neural level (Baumgartner, von der Heydt, & Peterhans, 1984; Tse, 1998, 1999, 2002), and its modeling (Grossberg, 1994, 1997). Other evidence concerns the neural mechanisms in the primary visual cortex (V1), which have been hypothesized as underlying phenomena like contour orientation (Lamme, 1995), or grouping by coherent motion (Albright & Stoner, 1992; Spillman & Ehrenstein, 1994; Unno et al., 2003). Not only the phenomena but also the principles of Gestalt have been subject to neurophysiological investigation: for instance, the already-mentioned principles of figure/ground segregation (Zhang & von der Heydt, 2010) or of good continuity (Hess & Field, 1999; see Spillmann, 2009). Very rarely, however, have the results of neurophysiological analyses furnished insights for phenomenological analysis. Moreover, our current knowledge about neuronal mechanisms does not enable us to establish with precision the relations between the two levels: the qualitative level and that of the underlying neuronal activity.

It is certainly a historical fact that phenomenology has primarily concerned itself with phenomena of vision (Milner & Goodale, 1995, p. 13). Nevertheless, excellent results have been obtained in the acoustic (Benussi, 1907, 1913; Ehrenfels, 1890; Stumpf, 1883) and tactile fields (Michotte, 1905); and, as said, Husserl’s theory has been taken up again by the sensory-motor approach to perception. In principle,
experimental phenomenology does not exclude consideration and comparison with other levels of information production, such as the neuronal level. The isomorphist hypothesis, according to which the order of subjective experiences coincides with the order of the underlying physiological processes, as sustained by Gestalt psychology (Koffka, 1935), for example, is still today the phenomenological point of view most widespread in the sciences. Experimental phenomenology excludes the reduction of phenomena to physical or neuronal correlates.

Independently of the different interpretations and uses made of phenomenology by researchers in the exact sciences, the apparent contradiction in the concept of experimental phenomenology derives essentially from the belief, or otherwise, that it is possible to develop an exact and experimental science of phenomena, which are substantially mental entities. On this point, the various branches of phenomenology have not yet obtained precise statuses and identities. The boundaries among them are blurred for reasons that are both intrinsic to phenomenology’s domain itself (analytical description of subjective experiences, explanation of the conditions for their verification, and use of experimental methods to investigate phenomena), and related to its position within the dominant contemporary research paradigm, which is primarily inferentialist—whether of classic associationist type (Helmholtz, 1867/1962), non-associationist (Gregory, 1970, 1980, 1998; Rock, 1983), or subjective probabilistic (Bennett, Hoffman, & Prakash, 1989) (on this see Hatfield, 2002, 2003).

A second critical issue in phenomenology concerns the fact that visual appearances are naturally endowed with meaning, given both by the qualitative characteristics of visual appearances and by their relation with the subject in the presentation: even numbers, in fact, like the color, size, shape, and reciprocal position of visual objects, are perceived as magnitudes with meanings (Lu, Mo, & Hodges, 2011). Some characteristics of appearances are general: for example, the meaning and the expressiveness conveyed by sharp or rounded forms, as in the takete/maluma case analyzed by Köhler (1929b), which holds for phonemes (http://www.pcho.net/takeluma/). Others are characteristics that the subject experiences as being of a certain type, for example, positive or negative, attractive or repellent, useful or dangerous, or simply irrelevant. Yet others may be due to the particular stance of the subject in a given situation, which may partially modify their semantic content. Framing a scientific theory of the perceptual meanings of appearances is clearly a major undertaking that concerns all the dimensions of analyses already mentioned.

At present, the exact sciences show a lively interest in appearances, and several conferences have been held on the theme. The reason is often a practical one: the endeavor to construct devices that produce an output consonant with the psychological needs of the user and which, as such, is subjectively satisfactory. An example is provided by the camera, which produces an image fully appreciable by the subject because it is precise in its details, even though the input has very large differences of stimulation, so that the human eye is unable to obtain a complete and perceptually well-organized image. Those who concern themselves with this type of measurement of appearances do not generally have detailed knowledge about how human vision is qualitatively organized, and the theories expounded are very often excessively simple and partial (in the field of images, for example, the retinex is used). It
is therefore believed that appearances can be measured, but the measurement is often indirect (by external models), so that what is measured are the physical correlates. There are exceptions, of course, like measurement of ambient brightness, but they are in the minority (Fotios, 2011).

Today, therefore, demand for an experimental phenomenology springs mainly from those (disciplinary different) areas of research seeking to implement qualitative aspects in artificial agents, such embedded robotics, virtual reality, human/computer interfaces, and especially computer graphics. All of these, in fact, have to understand, define, manipulate, measure, represent in simulations, and implement subjective experiences (Albus & Meystel, 2000; Maes, 1990, 1994; Meystel, 1991). The same applies to the design of exteriors and interiors in architecture, as in the case of research on the luminous environment of 3D spaces, which increasingly focuses on the user’s experience. To develop a science of appearances requires adoption of a phenomenological-experimental point of view, development of a specific operational method, and definition of a categorial apparatus: for example, identifying and distinguishing what and how many types of diffuseness of luminous environment are perceptually observable; what the conditions are for their different appearances; what tertiary properties from time to time connote their quality; and finally how to devise a terminology with which to distinguish among different appearances (see Pont, this volume), exactly as Katz did for the modes of appearing of colors. Whence derives the importance of an approach that clearly distinguishes between physical and subjective components in perception and is scientifically able to treat and also to measure the latter, which are usually considered to be secondary or tertiary properties.

This handbook addresses the questions of what experimental phenomenology is, its origins, and its future, and it does so in particular from the standpoint of the contemporary science of vision. Consequently, the handbook presents the current state of the discipline, and its potential developments in the near future, against the background of the conceptions, studies, and experiments that characterized classic experimental phenomenology.

In order to shed light on the manifold aspects of this question, the sections of this handbook—some more theoretical, others more experimental (Linking Psychophysics and Qualities, Qualities in Space, Time, and Motion, Appearances, and Measurement and Qualities)—analyze problems concerning the nature of qualitative phenomena or appearances: for example, their causes and the laws that they obey; their primitives; the space-time in which they are located; their scientific explanation and measurement; and the relation between this type of analysis and the correlated psychophysical and neuronal inquiries.

It is important, in fact, to clarify what distinguishes an experimental phenomenologist from a researcher in classical psychophysics or neuroscience. Are their disciplines mutually exclusive, or is an experimental phenomenologist a psychophysicist and/or a neuroscientist with a particular attitude toward qualitative phenomena? How can the phenomenological attitude contribute to the development of psychological science and its applications? Is a psychological science of phenomena as such possible, one which is in principle independent from physics, psychophysics, and neurophysiology? What are the tools best suited to the modeling of phenomena? Despite the development of research and the abundance of results in both psychophysics and
neuroscience, the question of isomorphism—in the various forms that it assumed from Wertheimer (1912) to Koffka (1935)—seems still distant from receiving a generally acceptable solution. By presenting the analyses of some of the best researchers in vision studies, the handbook shows the complexity of the problems, offers some answers to the above questions, and raises further questions for future research.

**Phenomenology and Science**

One of the basic assumptions of experimental phenomenology is that qualitative phenomena are irreducible to stimuli: not only the great variety of perceptual illusions (see Pinna, this volume) but the widespread phenomenon of occlusion and the appearances of color, as well as the value and demand characteristics of visual appearances, are incontrovertible evidence of the all-pervasive presence of objects and characteristics visible in the absence of stimuli.

Though starting from this assumption, however, as the contributions to the handbook show, the positions of researchers may vary by area, disciplinary purpose, method, or personal conviction, or by all of these factors.

In the exact sciences, phenomenology has been predominantly conceived and treated as the mere description of qualitative aspects and/or as the point of departure for rigorous and quantitative analysis, whether psychophysical or neurophysiological. It has almost never been considered to be a causal explanatory science according to the classical canons of Galilean science or psychophysics. The reason for this is simple, and it recalls the above-mentioned considerations of Husserl. As Köhler wrote:

> The physics of the late baroque period destroyed naïve realism. The objects which exist independently of the observer and are to be the subject of scientific study could not possibly possess all the variegated characteristics which the phenomenal environment certainly shows. Thus the physicist subtracts many so called sensory qualities if he wants to extract what he considers the objective realities from the phenomenal manifold. I do not venture to judge whether the greatest minds of that time [i.e. Galileo and Newton] were immediately aware that much more is needed, namely a radical departure from the identity of the phenomenal object and physical object. Sometimes it seems that for them the phenomenal object was simply the physical object itself, somewhat changed by all kinds of subjective trimmings, thus basically still one and the same existence. (Köhler, 1929a/1971, pp. 125–141; emphasis and words in square brackets added)

Still today it cannot be said that the radical departure to which Köhler referred has been accomplished. Quality and meaning remain largely external to scientific consideration. While the discrepancy between physical and perceptual objects has been broadly demonstrated since the first Gestalt studies (Köhler, 1929b), it is widely believed that the importance of Gestalt descriptions consists in their functioning as heuristic cues for the presence of physical objects (Todorovic, 2011). A conception broadly endorsed today by scientists of perception, also phenomenologists, is therefore that phenomenology describes (in terms of first-person accounts), while psychophysical or neurophysiological research explains (in terms of third-person accounts) (Spillmann, 2009; Spillmann & Ehrenstein, 2004). On first-person accounts
see Varela and Shear (1999). In other words, molar behaviors raise problems for scientific research; molecular behaviors explain them. And science is predominantly molecular today.

As Spillmann, for example, writes concerning the current state of affairs:

Fechner (1860/1966) would have called the complementary relationship between neural correlates and phenomena “inner psychophysics” as opposed to the relation between retinal stimuli and perceptions, i.e., “outer psychophysics.” An account of visual perception requires a conceptual framework that describes as well as explains, in neural terms, what we see, including illusions. (Spillmann, 2009, p. 1518; emphasis added)

The current opinion is that qualitative-descriptive analysis, psychophysical analysis, and neuronal analysis are not necessarily mutually contradictory/exclusive; rather, they are complementary (Lee, Martin, Valberg, & Kremers, 1993; Shepard, 1981; Spillmann, 2009, p. 1510;). Usually, however, it is assumed that descriptive analysis is reducible to neurophysiological and psychophysical explanation, because per se it does not have explanatory capacity, with the consequence that the science and measurement of the qualitative as such is impossible in principle. Obviously, at the basis of these conceptions is the idea that the structure of our perceptual experiences reflects the structure of the “objective world,” whatever that expression means, and that it can be measured in terms of physical characteristics (for a criticism see Hoffman, this volume). That “measurement of the impossible” is an awkward issue in research is demonstrated by the fact that precisely this topic has been at the center of recent research projects on appearances (for example, some European projects funded under FP6: see Bialek et al., 2009; Canal & Micciolo, this volume).

Simultaneously, as already mentioned, the requirements of certain disciplinary areas stress the urgent need that scientific analysis and measurement of the qualitative aspects of experience be conducted for their implementation in artificial agents, the construction of usable, ergonomic, and aesthetic interfaces, or the modeling of material qualities in photorealistic images of 3D models in computer graphics (Magnenat-Thalman, 2010; Violino & Magnenat-Thalman, 2000; Wann Jensen, 2001). Hence developing a science of phenomena, or a psychological science in the strict sense, is currently crucial for the progress of various areas of research, and the endeavor attracts the increasing interest of researchers.

**Subjective Experiences**

One of the obstacles to be addressed is the belief that the content of subjective experiences is neither communicable nor universalizable, so that a science of psychic phenomena based substantially on individually experienced occurrences is impossible.

Perceptual organization—a key question in regard to perception—is in fact commonly understood in the sense that accomplishing the leap from information detected by our sensory receptors to our perception of the world requires not just the detection of information but the organization of that information into veridical percepts (Pomerantz & Kubovy, 1986).
In other words, a science of perception should consider only percepts that are veridical about the information contained in stimuli. The concepts of information and truthfulness, moreover, are problematic because almost nothing of what is perceived subjectively is contained in stimuli or reducible to them (Albertazzi, van Tonder, & Vishwanath, 2010; Koenderink, 2010). What is becoming apparent, and what some researchers are beginning to realize, is that it is possible to identify the formal properties of a psychological science in third-person accounts, on the basis of the observation, description, and measurement of individual subjective operations and judgments: that is, rendered in a first-person account, for example, by measuring the extent to which a seen object is more or less qualitatively “remote” in the perceiver’s visual space, and how much with respect to other perceivers, and therefore also what the psycho-geometric characteristics of this highly virtual space are with respect to physics (Albertazzi, 2011b; Hildebrand, 1893/1969; Koenderink, 2006; Koenderink et al., 2010). Thus are identified purely qualitative phenomena (the “remoteness” or the “flatness/voluminousness” of a visual appearance) which are then measured according to formal criteria. This method, starting from observations that furnish a purely subjective judgment in the first person (for example, what is the perceived slant of a shape), also makes it possible to furnish third-person quantitative predictions about potential observations. A formal psychological science would therefore be constructed on the basis of an operation analogous to that of physics, which does not say what an atom is, but formally defines it and shows its behavior (the “how”) and its interactions (Koenderink, this volume).

Despite the frequently alleged impossibility of a science of subjective experiences (as individual mental contents), still to be explained is why and how different observers in the same conditions see very similar situations. Consider the experience of color, whereby, given a series of nuances of red, observers spontaneously identify the prototypical red among them, regardless of their mother tongue (Rosch, 1973; Rosch et al., 1976); or the fact that, when given the task of ordering a series of achromatic squares of different brightness arranged at random, all subjects with normal eyesight perform it “without errors” and therefore show that they mentally share the same natural ordering (Da Pos & Albertazzi, 2010). Even more generally, consider the immediate comprehension of the meanings conveyed by everyday perceptual appearances, so that people take similar decisions or make concordant judgments of similarity, certain slight individual differences notwithstanding (Hoffman, this volume). Such differences can be analyzed in the laboratory: For example, identification of unique hues reveals a subjective variability, albeit within generally very narrow margins (Würger, Atkinson, & Cropper, 2005). The role of evidence, the intersubjectivity of descriptions, habit, the emotions, the geographical and cultural environment common to the observers of the same scene (all of which are factors that convey broadly shared meanings of appearances), has not yet been thoroughly explored—apart from analyses based on linguistic descriptions provided by the subjects. In the majority of cases a scientific way to do so has not yet been found, nor perhaps a categorial apparatus suitable for the purpose, or because what was previously to hand has been lost. For example, lost is the fundamental concept of presentation (which is not a “representation” of the stimulus) (Albertazzi, 2001b; Brentano, 1874/1995; Koenderink, 2010, and this volume), or the concept of
anticipation (which is not an unconscious inference) constitutive of the subjective space-time of the presentation (Benussi, 1913; Husserl, 1966/1991) and which explains the structure of phenomena like stroboscopic movement or stereokinetic movements. In the case of the latter, for example, in a unitary visual presentation, a two-dimensional vision of surfaces is followed by vision of the depth and transparency of one object over another, and then by vision of a single volumetric object endowed with height and orientation, like an apparent cone. Or consider the role of the so-called “range of action” (Yela, 1952) in experiments on the perception of causality, which show the existence of a salient zone in the development of the kinetic presentation responsible for the perceived meaning of the phenomenon.

The commitment of phenomenology in the sciences can be summarized by referring to the following factors made explicit by Spiegelberg in regard to the work of Stumpf, who was one of the first experimental phenomenologists, a student of Brentano, and director of the Berlin Institute of Psychology in the first decades of the 1900s:

1. identification and painstaking exploration of a field of phenomena not covered by physical or psychological science in Brentano’s sense [i.e., descriptive psychology], as the proper object for a new science taking the name of “phenomenology”;
2. realization of the importance of systematic study of this area of neutral phenomena as the matrix for all the sciences;
3. demonstration that this area could be studied with all the rigour of scientific, and even experimental, techniques;
4. discovery of structural laws within the concrete phenomena of a character fundamentally different from, and more valid than, merely probable inductive generalization. (Spiegelberg, 1982, p. 60)

Even if factor 2 may appear overstated and debatable, the other three factors constitute what is meant by “experimental phenomenology.” From the experimental point of view, manipulation of the variables evidential in the perceptual field and the use of experimental methods have the purpose of allowing “for the precise selection and presentation of the phenomena” (Spiegelberg, 1982, p. 58). Some years later, Stumpf’s approach produced the excellent results obtained by Katz (1935), Hering (1920/1964), Michotte (1950a/1991, 1950b), Gibson (1979), and Kanizsa (1979, 1980, 1991), who contributed to the development of experimental phenomenology. The same applies, among others, to the research conducted by Da Pos (Da Pos & Bressan, 2003; Da Pos & Green-Armytage, 2007; Fischer, Da Pos, & Stürzel, 2003), Kubovy (1994), Hoffman (2008, 2009), Lappin, Norman, and Phillips (2011), Palmer (1999), Sivik (1985, 1997; Hård & Sivik, 1981), Spillmann and Ehrenstein (2004), and Tse (1998, 1999, 2002). To be noted is that these analyses have achieved excellence precisely because they have identified how to analyze, also experimentally, and measure the qualitative and valence characteristics of subjective experience: for example, the volumetricity and solidity of shapes (for a solid object to be perceived, it must be delimited by surfaces which are not all directly visible, but partially amodally perceived, as experimentally shown by Tampieri [1956]); or the illumination of
surfaces (Da Pos & Pietto, 2010; Gilchrist, 2006; Pont, this volume); the “visibility” of weight, like that of spatial layout, size, and luminance (Lu, Mo, & Hodges, 2011); the warmth and coldness of colors (Da Pos & Valenti, 2007; Sivik, 1974a, 1974b; Wright, 1962); and the expressive and intentional nature of kinetic structures (Kanizsa & Vicario, 1968), which reveals the what and how of causality in perceptual phenomena (Leslie, 1988; Michotte, 1950b; Schlottmann, 1999, 2000).

Unfortunately, philosophers and scientists almost always refer to qualitative phenomena with the generic term “qualia” borrowed from British empiricism. But in empiricism the term “qualia” denoted sense data, that is, entities greatly simplified with respect to the complexity of perceptual patterns qualitatively understood because they are assigned to a specific sense organ in the biological organism (Locke 1690/2008) and which today are often identified with intrinsic properties of certain brain states (Hudak, Jakab, & Kovács, this volume).

The questions, analyses, and principles that concern the appearance of qualia from the point of view of subjective experience must not be explained solely with the laws that regulate the firing of neurons during the same experience; rather, they should be posed, analyzed, and explained according to qualitative principles (Albertazzi, this volume). Moreover, the use of the term “qualia,” with all the semantic ambiguities that it causes, is paradigmatic of a long list of polysemous words present in studies on perception (consider, for instance, terms like “object,” “shape,” “representation,” “event,” “perception,” “structure,” “symbol,” “function”) that contribute to the indeterminateness of the boundaries among the various conceptions and among the different methodological approaches used by studies on vision.

The Science of Appearances

Whatever the initial conception of departure, as soon as one seeks to give better definition just to what is meant by a science of phenomena, appearances, or subjective experiences, one encounters a series of theoretical, epistemological, and definitional problems. Dealing with these problems serves to set order on numerous taken-for-granted assumptions, and often to call them into question.

First, to be able to talk about appearances, one must have a description and a classification of their properties. In other words, one must know what the specific qualities of subjective experiences are, how to identify them, how to analyze them, and at what level to stop—for instance, at the primary perceptual level or continuing to higher-order entities such as abstract concepts, whether these are considered to be genetically innate information or as derived from past experiences or probabilistic inferences. A phenomenological conception reduces the role played by past experience in perceiving, and it distinguishes the grammar of seeing from the rules of thinking (Kanizsa, 1991), unlike a Helmholtzian or inferentialist conception which instead considers as essential the role of both abstract and unconscious components. As Gregory writes in regard to the inferentialist position:

A central notion here is that perceptions are hypotheses. This is suggested by the fact that retinal images are open to an infinity of interpretations, and from the observed
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phenomena of ambiguity. The notion is that perceptions are like the predictive hypotheses of science. Hypotheses of perception and of science are risky, as they are predictive and they go beyond sensed evidence to hidden properties and to the future. For perception, as for science, both kinds of prediction are vitally important because the eye’s images are almost useless for behavior until they are read in terms of significant properties of objects, and because survival depends on behavior being appropriate to the immediate future, with no delay, although eye and brain take time to respond to the present. We behave to the present by anticipation of what is likely to happen, rather than from immediate stimuli.

Seeing a table, what the eye actually receives is a grainy pattern which is read as wood—though it may be a plastic imitation, or perhaps a picture. Once the wood hypothesis is selected, behavior is set up appropriately. (Gregory, 1998, pp. 10–11)

The nature of appearances, and the classification of their properties necessary to construct a psychological science of vision, is not at all a banal question. Consider, for example, that appearances as the material constitution and the surface corrugations of seen objects are in their turn the product of an eminently qualitative phenomenon: that of light (not luminance but subjective, perceived, environmental brightness) (Fotios, 2011; Kurki et al., 2009; Zavagno & Daneyko, 2008). This therefore concerns qualitative phenomena on which others depend by interaction (Vicario, 1978), according to a mereological relationship of whole/parts and of inner relationships, from which it is difficult to extract qualities as features (or atomic sense data/qualia) that are such independently of their context of appearance (for a survey on part/whole questions in the history of psychology see Pastore, 1971. On the primitive part/whole relation in object representation see Biederman, this volume). Unless, obviously, appearances are not reduced to, or treated as, stimuli or neuronal correlates, which epistemologically are acknowledged to have “objective” properties. Two initial attempts to set order on the classification of qualities were made by Metzger (1941/1963) and Rausch (1966), but their classifications require refinement and further development, from both a theoretical and an experimental point of view (Albertazzi, 2011a, and this volume). Recent discoveries in the field of synesthesia (Harrison, 2001; Harrison & Baron-Cohen, 1997; Hubbard et al., 2005; Savage-Rumbaugh, 1996; Tyler, 2005; Ward, Huckstep, & Tsakanikos, 2006), studies on the so-called weak or diffused synesthesia (Marks, 1978; Martino & Marks, 2001; Simner et al., 2005), and above all the naturally biased associations found in the normal population (Spector & Maurer, 2008, 2011), have furnished further information on the intrinsic cross-modality of subjective experiences and therefore on their shared aspects as patterns of relationships present in different sensory modalities. As said, one of the main problems that arise when compiling a list of qualities, like a list of features, is that perception has less to do with atomic qualities or sense data than with dynamic, contextual, relational, and cross-modal patterns. The same pattern—crepe, for example—characterizes both crimped hair and the surface of the sea ruffled by the breeze; a dark patch is a classificatory characteristic of natural objects as well as artifacts; the same red appears differently according to the background and the context; the same object assumes different qualities according to the brightness of the environment in which it appears; a certain taste is sweet in some situations, bitter in others. The still classic example of the relational characteristics of appearances
is provided by color and its modes of appearance as surface, film, or volumetric color (Katz, 1935), or by the assimilation phenomena which change in appearance according to the context (Albers, 1975; Chevreul, 1839/1855; Fuchs, 1923; Gilchrist, 2002; von Bezold, 1874/1876). Other complex examples of the nature of internal relations in the visual field (made classic by analysis of the Gestalt qualities in the acoustic field: see Ehrenfels, 1890; Mach, 1886, 1905/1976; Meinong, 1899; Wittasek, 1897) are, for example, the reciprocal relations among the different qualities of light, the luminosity framework, the lighting atmosphere (Pont, this volume), and the already-cited development of the phases in the presentation of stereokinetic phenomena. Put briefly, in the duration of the presentation in which appearances appear, what regularly happens is that some of their properties are simultaneously the conditions and effects of others. Just as at the end of the 1800s, so today, the nature of the internal relations among the different components of a perceptual whole (Benussi, 1914; Cornelius, 1892–93; Ehrenfels, 1890; Meinong, 1877, 1882; Stern, 1897), the extent to which these relations are intrinsically dependent on the process of seeing, and how they can be analyzed and measured, are still unsolved problems. Moreover, Gestalt psychology (in its successful Berlin version: see Albertazzi, 1993) is also mostly focused on products rather than processes, despite the explicit definition of Gestalten as processes and/or parts of processes by Wertheimer (1923) (Albertazzi, 2006b; Koenderink, this volume).

Thereafter, from the 1930s onwards, one is struck by how rapidly and successfully the logical-formal paradigm affirmed itself: “qualities” were supplanted by “predicates” even in the philosophy of mind; the complexity of the “relations” that had characterized debate among the various branches of Brentanism and Gestalt was restricted to inclusion, negation, and conjunction; “dynamic and functional invariants” became “logical constants”; and so on. As a consequence, science privileged a certain formalistic way to represent its objects, excluding or neglecting other aspects of them, so that it is still difficult today to speak of appearances in phenomenological terms, that is, as intrinsically relational properties not detachable from seeing.

**A Perceptual Physics**

Recognizing that the physical perceptual object is not the physical object is dramatic (and sometimes even outrageous) for some current approaches to the study of perception. Recognizing the fact raises a series of difficulties and requires the revision of methods. For example, because current science is a science of the primary properties, or of the quantities classically understood as stimuli, it does not consider the secondary (bitter), tertiary (appealing), and expressive (friendly) qualities. These last are generally explained with reference to other aspects such as adaptive behavior, evolution through natural selection (Knill & Richards, 1996; O’Regan & Noë, 2001), and linguistic, cultural, or social influence. These references, however, do not explain their intrinsic nature, nor do they allow the development of a corresponding science. Interwoven with this difficulty is the definition itself of the physics on which scientific research is grounded.