PAOLO BOZZI'S EXPERIMENTAL PHENOMENOLOGY

This anthology translates eighteen papers by Italian philosopher and experimental psychologist Paolo Bozzi (1930–2003), bringing his distinctive and influential ideas to an English-speaking audience for the first time. The papers cover a range of methodological and experimental questions concerning the phenomenology of perception and their theoretical implications, with each one followed by commentary from leading international experts.

In his laboratory work, Bozzi investigated visual and auditory perception, such as our responses to pendular motion and bodies in freefall, afterimages, transparency effects, and grouping effects in dot lattices and among sounds (musical notes). Reflecting on the results of his enquiries against the background of traditional approaches to experimentation in these fields, Bozzi took a unique realist stance that challenges accepted approaches to perception, arguing that Experimental Phenomenology is neither a science of the perceptual process nor a science of the appearances; it is a science of how things are.

The writings collected here offer an important resource for psychologists of perception and philosophers, as well as for researchers in cognitive science.

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PAOLO BOZZI'S EXPERIMENTAL PHENOMENOLOGY

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Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2019
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
Names: Bianchi, Ivana, editor. | Davies, Richard (Professor of theoretical philosophy) editor.
Title: Paolo Bozzi's experimental phenomenology / edited by Ivana Bianchi and Richard Davies.
Description: 1 Edition. | New York : Routledge, 2019. | Includes bibliographical references and index.
Identifiers: LCCN 2018015394| ISBN 9780815378457 (hardback : alk. paper) | ISBN 9780815378464 (pbk. : alk. paper) | ISBN 9781351232319 (ebook)
Subjects: LCSH: Bozzi, Paolo. | Phenomenology. | Psychology, Experimental.
Classification: LCC B829.5 .P345 2019 | DDC 142/.7--dc23
LC record available at https://lccn.loc.gov/2018015394

ISBN: 978-0-8153-7845-7 (hbk)
ISBN: 978-0-8153-7846-4 (pbk)
ISBN: 978-1-351-23231-9 (ebk)

Typeset in Bembo and Stone Sans
by Florence Production Ltd, Stoodleigh, Devon, UK

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ACKNOWLEDGEMENTS

The editors are deeply grateful to all the members of the team who have brought this anthology to completion, translating and commenting with the enthusiasm and commitment that Paolo Bozzi's work deserves. Paolo himself would have been enormously touched by this joint effort.

We would also like to thank the Department of Humanities of the University of Macerata and the Department of Letters, Philosophy, Communication of the University of Bergamo for putting at our disposal funds to cover the permissions fees charged by the original publishers of the papers that first appeared in English. Among those who have given us particular support and guidance in the process of finding an appropriate home for Bozzi's work, we would like to recall our gratitude to Lothar Spillmann, Gerhard Stemberger, Benedetto Scimemi, Alan Costall, Tim Crane, Douglas Hofstadter and Linden Ball. Special thanks go to Margarethe Braitenberg Bozzi for many reasons, not least for her charming trust in us.

—*IB*
—*RD*

SOURCE TEXTS AND CHAPTER ACKNOWLEDGEMENTS

Chapter 1

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Ivana Bianchi thanks Hilary Wilson for her stylistic suggestions.

Chapter 2

'On some paradoxes of current perceptual theories' in S. Masin, (ed.). *Foundations of Perceptual Theory*, North-Holland, Amsterdam, NL, 1993, pp.183–196; re-elaborated by I. Bianchi and R. Davies; republished by permission of North-Holland. Sergei Gepshtein thanks Paolo Portoghesi for permission to reprint Figure 1 in his commentary (originally in R. Arnheim, *The Dynamics of Architectural Form*, University of California Press, 1971).

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'Esperienza fenomenica, esperienza epistemica ed esperienza psicologica. Appunti per l'epistemologia del metodo fenomenologico sperimentale', in G. Siri (ed.). *Problemi epistemologici della psicologia*, Vita e pensiero, Milan, Italy, 1976. pp. 73–87; subsequently entitled 'Appunti per una discussione con gli epistemologi', in Bozzi's *Fenomenologia sperimentale*, Il Mulino, Bologna, Italy, 1989, pp. 155–173.

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INTRODUCTION

Ivana Bianchi and Richard Davies

Paolo Bozzi (1930–2003) was one of the most fully-rounded and subtle thinkers in Italian experimental psychology, who, in addition to his laboratory work, was a philosopher, a violinist, a musical composer and an essayist.

After graduating in philosophy from the University of Trieste, Paolo Bozzi began as an assistant to the leading Italian Gestalt psychologist Gaetano Kanizsa (1913–1993) in the Institute of Psychology at Trieste, around which his academic career was centred (though he also taught for brief periods at Padua and Trento), where he occupied the Chair of Methodology of the Behavioural Sciences, from which he retired in 1990. Throughout his career, he kept close ties with the laboratory at Trieste in a series of experiments that were the first outings in what later came to be known as "naïve physics" beginning in the late 1950s, with studies of the perception of pendular motion and of bodies in free fall. In collaboration with his friend and colleague Giovanni Bruno Vicario (1932–), Bozzi published a seminal paper in 1960 on auditory streaming and on factors for the unification of musical notes. In the early 1960s, he isolated the function of directionality as a factor in the unification of visual events. In the 1970s, he proposed and defended the method of interobservation as an experimental approach to the study of vision, and in the following decades, he continued to bring to light interesting perceptual behaviours, such as achromatic transparency using simple lines and the dynamic behaviour of coloured after-images.

In parallel with this rich range of experimental discoveries concerning sight and hearing, of which we reproduce some of the leading results in Part IV, Bozzi was continuously engaged in elaborating a theoretical programme for his research. The resulting anti-metaphysical and anti-psychophysical stance underpinned an Experimental Phenomenology *iuxta propria principia* ("by means of its own principles"). As a point of methodology, his approach was to view his experimentation as an ethology of objects and events, and, as a point of epistemology, he regarded his results as a branch of natural science, of a piece with and a foundation for a naturalistic conception of knowledge. In what we might think of as an extreme version of Bozzi's view, for all that it is balanced and thoroughly argued for, Experimental Phenomenology is neither a science of the perceptual process nor indeed a science of the appearances, but is rather a science of how things are.

In Bozzi's writings, descriptions of phenomena are intertwined with descriptions of methodological matters and with theoretical elaborations of those very descriptions. Likewise, the observations that he made "in the laboratory" are intertwined with the observations that he made in the natural laboratory that is the world outside the laboratory, for Paolo Bozzi was an experimental phenomenologist in life as lived outside the walls of academe. As we gather from his writings, he was an acute observer of the passing scene, an attentive reader of the classics and a day-to-day experimenter so that a characteristic move in his writing and in his theoretical thought is a recurrent back-and-forth between laboratory observations and observations of everyday life.

The reciprocity between experimentation and reflection is perhaps the architectonic feature of Bozzi's approach to his chosen field of study. Just as he loved to manipulate the look of the facts under observation ("I change this here, to see what will happen there."), with the same pleasure and sense of need that a musician varies the ways of plucking the strings of a violin, with the fingers or with the bow, so as to hear what difference it makes, so he always kept before his mind the motto that "experiments are bits of reasoning". And these reasonings and reflections, binding together his experimental procedures, are of interest not only to the vision scientist who is seeking to manipulate the structure of the facts so as to bring out the perceptual structure or to the cognitive psychologist who is looking for the perceptual grounding of various cognitive phenomena concerning imagination, language, memory and thinking, but also to the thinker who is seeking a theoretical understanding of the reality of the perceived world. They are likewise of interest to philosophers of perception who are concerned with teasing apart (theoretically and methodologically) cognitive and phenomenal dimensions in visual experience, with the role of introspective reports, understood as descriptions of direct experience of the world in contemporary vision science as well as to anyone committed (for theoretical or practical reasons) to bringing out the structural isomorphism between any given conceptual field and what is often these days rather vaguely known as "common sense".

Out of Bozzi's output of about 100 articles, book chapters and monographs, the present anthology presents a selection of 18 items aimed at giving a taste of the complexity and richness of his thought. Only three of the papers have previously appeared in English, and are here presented in slightly revised form. Some of the others have appeared in various versions in Italian, in journals and in anthologies, or as re-worked by Bozzi himself in his most accessibile and wide-ranging statement of his overall position in *Fisica ingenua* [Naïve Physics] (Garzanti, Milan, 1990), a work that brings together, as its subtitle says, "studies in the psychology of perception", with many more personal musings on Bozzi's practical and theoretical engagements with music as well as with the questions that he already posed for himself as a child about the relation between words and things, between meaning and value, between sounds and objects, between observation and deduction, and between perception and imagination.

In his lifetime, Bozzi was reluctant about having his works translated out of the supple and trenchant Italian that is so noteworthy a feature of his performances – and so rare a feature of academic writing, not only in Italian. In collaboration with the translators, the editors have reviewed and revised all the texts singularly and as a whole, with a view to ensuring not only closeness to Bozzi's originals but also a certain degree of stylistic and terminological consistency from one chapter to the next. Despite the inevitable loss of some literary merit, we trust that our efforts will be redeemed by making his thought accessible to a wider readership. By "a wider readership", we mean not only the larger Anglophone world to which the name of Bozzi may be little known, but also a disciplinary broadening beyond the confines of the specialist publications in which many of the items first appeared, primarily dedicated to technicalities of the psychology of vision science. For those working in that field, many of these contributions to Experimental Phenomenology will suggest fresh theoretical ideas and methodological insights that call out to be integrated with the theories of perception of Gestalt and neo-Gestalt psychology (for a review, see Wagemans, Elder et al. 2012; Wagemans, Feldman et al. 2012), of Michotte (1946; see also Wagemans, van Lier and Scholl, 2006) and Gibson (1950 1968, 1979), as well as to be brought into dialogue with the more recent debates about the possible profiles for a science of experience that are also reflected in the current renewal of interest in Experimental Phenomenology as evidenced, for instance, by the reprint of the invaluable volume first edited in 1990 by Thiné, Costall and Butterworth, *Michotte's Experimental Phenomenology of Perception* (2014), by Albertazzi's *Handbook of Experimental Phenomenology* (2013), by the new edition of Don Ihde's *Experimental Phenomenology: Multistabilities* (2012) and by Niveleau and Métraux's *The Bounds of Naturalism: Experimental Constraints and Phenomenological Requiredness*. Bozzi's Experimental Phenomenology can contribute to investigating the structures and functions of mental simulation, commonly understood as "the re-enactment of perceptual motor, and introspective states, acquired during experience with the world, body and mind" (Barsalou, 2008, p. 618, 2010). In particular it can contribute to exploring the distinctiveness and at the same time "derivative" relationship between perception and imagination, perception and language (discussed, for example, in Gallagher and Zahavi, 2008; Thompson, 2007a, b; Bloomberg, and Zlatev, 2014; and empirically addressed in Pecher and Zwaan, 2005, but also in most of the psychological literature on naïve physics or naïve optics). It offers a useful perspective for those engaged in the development of experiential view in cognitive semantics and in promoting a cross-fertilisation between cognitive linguistics and phenomenology (e.g. Bloomberg, and Zlatev, 2014; Zlatev, 2010; Woelert, 2011). Moreover Bozzi's approach may be a source of stimulus in neighbouring research projects, such as those into visual and auditory scene analysis of complex environments or into robotics that use naïve-physics models rather than AI. Further afield, researchers with other interests in naïve observers' experiences, will find much that favours a realist theory of experience and a realist ontology, as well as providing thought-provoking insights into experimental philosophy and experimental epistemology.

The scheme of the present anthology aims at giving pride of place to Bozzi's own words and thus to open a free dialogue between the author and the reader in the hope of stimulating fresh thoughts and new ways of understanding whole sets of questions – or reinforcing reasons for dissent from the views that Bozzi put forward. The team of experimental psychologists and philosophers who collaborated on the anthology offered brief comments on the texts, in many cases continuing discussions that they had been carrying forward with Bozzi himself. The approaches taken in these comments have been left entirely up to the single scholars, so as to reflect the very different ways one might "dive into" these writings and come up with new observations, reflections and ideas for further research work. The hope is that these *intermezzi* will help the reader to get a feel for the debates to which the papers are still vibrant contributions.

The lead editor, Ivana Bianchi, is responsible for the selection and structuring of the material here presented, which is articulated into four parts plus a section of "afterthoughts".

The basis for this choice of the core themes derives from suggestions that Bozzi made in the course of a cycle of discussions held with a select group of friends and collaborators at the University of Verona in 2001 (two years before his death) focusing in each session on one or other of the writings that Bozzi had chosen to be commented on by and with him. It may be helpful to summarise the underlying architecture and some of the many interconnections that hold the parts together as follows.

The three papers that open the volume in Part I delineate an overall picture of Bozzi's standpoint. They set out the framework for the writings that follow and that go more deeply into one or another issue. Experimental phenomenology (Chapter 1) is one of Bozzi's last writings, to which the Verona discussions we have just mentioned were a spur. It is certainly *the* paper in which he presents an overview of his Experimental Phenomenology of Perception (henceforth, EPhP). If Chapter 1 defines what Bozzi expects EPhP to do, in Chapter 2, On some paradoxes of current perceptual theories, he highlights the drawbacks of alternative perceptual theories. He does this by discussing the paradoxes that are embedded in these alternative theoretical positions. Once the programme of Bozzi's EPhP has been clarified, one still needs to understand what "phenomenal experience" means for him. In Chapter 3, Phenomenal experience, epistemic experience and psychological experience. Notes towards an epistemology of the phenomenological experimental method, he sets out the differences among phenomenal experience (i.e. direct experience or "reality"), epistemic experience (i.e. the kind of experience described by means of operations or measurements, which is the object of a specific discipline) and psychological experience (i.e. the biological and psychological processes occurring in the brain).

One of the main conclusions reached at the end of Part I is that the contents of EPhP are "what is directly under observation" (i.e. "phenomenal experience" or "reality"). The next chapters in Part II define what is "under observation" according to Bozzi. Chapter 4, The stream of consciousness, or the events under observation, answers the question: what is "under observation" in temporal terms? This is a brilliant discussion of the temporal edges of the phenomenal present full of interesting references and observations. Chapter 5, Untimely meditations on the relation between self and non-self, clarifies what is "under observation" in spatial terms. Is it just what is strictly speaking "visible" (meaning the portion of space that occupies my visual field right now, given the position of my head and my eyes)? Or does it extend to the space which is not in front of my body but is behind me or out in the corridor which is just beyond the door of the room where I'm sitting and so on? The relation between these facts and the psychophysical chain, which is apparently the necessary framework for any analysis of the perceptual process, is addressed in chapter 6, Logical analysis of the psychophysical (L-R) scheme. In discussing the independence of the phenomenal world from the underlying mechanical processes, Bozzi adds a strong argument in support of his idea of an EPhP *iuxta propria principia* and at the same time provides a strong logical argument to avoid any type of physical reductionism or neuro-reductionism.

Related to the idea of EphP *iuxta propria principia* are the two warnings that he gives in the next two chapters: Do not confuse what we see (phenomenal experience) with the "stimulus" (Chapter 7) and do not confuse seeing with interpreting (Chapter 8). In Chapter 7, Five varieties of stimulus error, five variants of the stimulus error are presented and discussed. As often happens with Bozzi's writings, this paper highlights both the methodological implications for the experimental researcher of what is being pointed at and the epistemological implications of the issue discussed for a theory of perception. Chapter 8, Seeing As, presents

Bozzi's discussion of one of the descriptions Wittgenstein gives in *Remarks on the Philosophy of Psychology I* §1–29. The distinction between what we see and what we know about what we see is a key point in Bozzi's definitions of "phenomenal reality", i.e. the world that we interobserve and inter-subjectively share, over against the "cognitive integrations" or interpretations of it (which might indeed be subjective) that we apply to it.

Once Parts I and II have clarified what "phenomenal experience" (the subject of EPhP) is, according to Bozzi and what it must not be confused with, we can take a step further and define the basic tools to be used in order to produce an uncontaminated analysis of phenomenal experience. This is what is developed in Part III. Chapter 9, Phenomenological descriptions and physical-geometrical descriptions, defines the minimum criterion to be applied in describing the characteristics of the phenomenal world. The discussion focuses on the basic geometry of the phenomenal world, but the issues addressed here lead to a more general question concerning the relation between formalisms, technical constructs and vocabularies in the EPhP. Since the phenomenal world is not one's private world, it can be interobserved. In Chapter 10, Interobservation as a method for Experimental Phenomenology, Bozzi puts forward a new experimental approach, which he calls "interobservation", as an alternative to the classic experimental method adopted in psychology prescribing reports from independent subjects. He discusses the bases of this method, its advantages and the conditions under which its use is recommended.

With all these premises and tools in hand, which define the theoretical and methodological background of Bozzi's EPhP, we follow him into the laboratory in Part IV and consider some specific phenomena that he brought into focus.

Chapter 11, Phenomenological analysis of pendular harmonic motion and the conditions for "natural" motion along inclined planes presents two studies of the phenomenology of motion which are two inaugural works in what, twenty years later, came to be called Naïve (or Intuitive) Physics (McCloskey 1983; McCloskey, Caramazza and Green, 1980). Chapter 12, A new factor of perceptual grouping: demonstration in terms of pure Experimental Phenomenology, is an excellent discussion that adds a new law of unification to the list of factors initially identified by Wertheimer (1923/1938). The structure of its arguments emphasises the role of perception of couplings (i.e. direct relationships) in EPhP demonstrations. If the foregoing chapter represents an example of how Bozzi contributed to the development of Wertheimer's laws of organisation in vision, Chapter 13, Two factors of unification for musical notes: closeness in time and closeness in tone, shows an innovative development of these laws in the field of acoustics. Here Bozzi analyses two factors separately and in conflicting conditions: proximity in time and proximity in tone.

In Chapter 14, Observations on some cases of phenomenal transparency obtained with line drawings, in the tradition of Metelli's transparency law (Metelli 1974, 1985), Bozzi draws attention to another way of conveying the perception of transparency that derives from outlines rather than grey surfaces. Besides providing an opportunity to demonstrate the spectacular behaviour of chromatic after-effects (which led Bozzi to talk of a "hydraulic model"), Chapter 15, Original observations on certain characteristics of afterimages, shows EPhP at work on observations that lie at the boundary of the genuinely phenomenal distinctions between what appears to be subjective and what appears to be objective. This is a descriptive distinction in Bozzi's view.

In Chapter 16, Tertiary qualities, Bozzi addresses two questions. The first is: What is the place of tertiary qualities (or expressive qualities) in phenomenal experience? Drawing on

Gibson's account of affordances (1979), Bozzi suggests that these qualities cut across the traditional subjective-objective divide. The second: Do they share the same factual identity of what we mean by "reality"? Bozzi's answer is "yes".

The last section, Afterthoughts, is aimed at those readers who, having got to the end of the book, might be wondering how Bozzi located himself relative to the traditions of experimental psychology of which he was undoubtedly an heir. In Chapter 17, Experimental Phenomenology: a historical profile, Bozzi presents a look backwards over his discipline, tracing its philosophical roots in post- (and, in some key moments, anti-) Kantian philosophy as well as stressing the wealth of laboratory results on which the experimental programme was based; and Chapter 18, What is still living and what has died of the Gestalt approach to the analysis of perception, clarifies his relationship with key theoretical presuppositions of classical Gestalt psychology and at the same time as relaunching its methodological approach as a contribution to new trends.

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2

ON SOME PARADOXES OF CURRENT PERCEPTUAL THEORIES

P. Bozzi

Researchers in the field of perception make frequent reference to epistemology. When we discuss research in progress, new models, or theoretical innovations, we always assume a shared philosophy. However, our assumptions are seldom made explicit so that they may be challenged.

My claim is that in our conceptions sometimes one hears a sort of false note. Although understanding the cause of this impression is no easy matter, its implications are fairly clear: one has probably the feeling that serious discussion of these assumptions might reveal ideas in clashing contrast or plain contradiction. It is my deep conviction that in the "epistemological subconscious" of most scientists of perception there dwell a number of paradoxes. In this essay, I intend to bring some of them to light and to elucidate their logical structure.

By way of introduction, I shall first briefly overview six assumptions that are often implicit in psychological or philosophical discussions.

1. Consider all objects and events that we experience when we look at a landscape, listen to music, walk in the street, or when we rummage through our papers for some lost memo jotted down some time ago. These objects and events may be called *observables*. For the perceptual scientist it is obvious to assume that any observable *O* corresponds to a specific brain state *S*. Of *S* we can have little knowledge, good knowledge, or unreliable knowledge, but we can nonetheless distinguish it theoretically from other states *S*', *S*", . . . that are related to the observables *O*', *O*" . . . and perceived at the same time by an observer.
2. All human beings have a functioning brain. Therefore, in the course of their lives they are constantly aware of a number of observables associated to some specific brain states. We can certainly say this of their daily lives, and in a way we can also say it in relation to those observables that they dream of when they are asleep. Here, we ought to point out an important aspect of this assumption. A brain, considered as a physical system, or as an information-processing device, must be studied in the framework of physical space-time, just as one would study other devices such as a watch or a calculator. On the other hand, observables must be studied in the framework of psychological space-time,

dimensions that are prone to well-known contractions, expansions, and distortions that are not easily translated into corresponding physical parameters. Thus, for each observer there is one perceptual world, just as there is one brain for each observer.

3. The following assumption is common in the philosophy of knowledge. As there is no physically direct path connecting one brain to another, so there is no access – for any of us – to the observables *O*', *O*" . . . associated to the brain states *S*', *S*". . . . in someone else's brain. Thus, we cannot see or touch or in any way experience the perceptions of other people.
4. The fourth assumption derives indirectly from the three assumptions above. It says that observables are always private. By definition they are introspective data. Now, if we take a methodological stance, we have to recognize that introspective methods are subject to fatal objections. Perceptual science must be founded on reliable findings, and these cannot come from introspection. Data derived from introspection are only accessible by single subjects, whereas a science of perception needs data that can be shared by the scientific community. Data that can be shared are called protocols, and in this context protocols are appropriately recorded observable behaviours, measurements, multiple choices, possible descriptions, and so on.
5. The following assumption capitalizes on a number of concepts that have been developed in the field of information science over recent decades. The common sense of perceptual research assumes that brain states and the observables associated with them are enclosed within a metaphorical black box. We describe its output in terms of interpretable protocols. What happens inside the black box is the object of logically organized speculations, based on our knowledge of its input and output, and on appropriately conceived rules.

   It is important to stress that protocols, when interpretable without ambiguity, have to be considered as unquestionable evidence. In the common sense approach of perceptual researchers, protocols of any kind are prototypical factual data.
6. The last assumption reads as follows. By simulating the processes that take place in the black box in some coherent way, with appropriate logical rules, and by means of appropriate devices, we can obtain an explanation or a description of the causal preconditions of phenomena. We can understand what is described in protocols. In the best cases, we can even understand the process that maps the class of input elements onto output elements. In short, we can reach a scientific understanding of perception.

Perceptual Paradoxes

1. "Sudden healing"

The first paradox is something one not infrequently encounters in perceptual laboratories. I propose to call it the paradox of "sudden healing".

Consider a prototypical laboratory situation. An observer is asked to cooperate with the experimenter, but somehow refuses to provide the expected response. For example, the observer might not see the effect, or the response might be inconsistent with a theory. Of course, there are many possible reasons for this outcome. The experiment might be irrelevant, or not properly carried out. The experiment might lack some small detail that seemed irrelevant but turned out to be crucial. In the worst case, it may even be that one knows there is not much to be found within one's experimental setup, but in one way or another one hopes that, with the help of some more or less indirect suggestion, the observer will say or do just what the theory wants. In some rare cases, the feature being studied may not even be seen, such as when chromatic stimuli are presented to a colour-blind observer.

The paradox also arises in another case. After thirty years of experience in all sorts of experiments on perception, I can bear witness that observers quite often just want to show that their beliefs are all fibs and yarns. For example, observers may be convinced that perception is a faithful representation of stimuli. Thus they insist on denying any observation that does not correspond to what they know about visual stimuli. Such observers lie about a detail that they consider negligible, and they do so to maintain a theory-based faith in the five senses as witnesses of the physical world. They may lie in the name of an ideology that regards psychological experiments as manifestations of pseudoscientific gibberish. They know that experimenters will have to report their lies. Usually, subjects are university students who know that protocols are unquestionable and that respect for protocols is the hallmark of scientific research.

Suppose we want to show an observer a good example of apparent motion. In dim illumination, two small lights not too far from each other are turned on and off in turn, in accordance with well-known rules. In these conditions, everybody sees one single luminous spot moving back and forth.

The observer, after looking carefully, may say: "I see two lights turning on and off in alternation, in two fixed positions". The report cannot be questioned. Where is the experimenter who would dare not to take it into account?

Obviously, adding the latter result to the list of protocols will make this a probabilistic phenomenon. The experimenter will have to say: "about this many times out of the total, one sees . . .". He will have to conclude that optimal apparent motion is seen very often, but not always. Thus, one deontological rule turns into one that hinders the search for truth.

Perhaps at this point we should doubt the rules of laboratory procedures. Before recording our result on a data sheet, we should check what happens to our observer when not in the laboratory. Does the observer go to the movies? Watch television? See the multifarious motions of many-coloured lights suspended over the booths of a fair? Generally speaking, we should ask whether the observer realizes that daily life is replete with apparent motions between all sorts of lights, both during the day and at night. If we establish that the observer sees the scenes of a movie just as we do, then we can safely conclude that in the laboratory we had recorded a lie. Unless we believe that some people fall ill as soon as they enter a laboratory, that they become prey of a peculiarly fleeting disease that affects their visual systems and from which they are suddenly healed as soon as they go out of the door.

Similarly, consider an experiment on size constancy: a visible object gets progressively more distant from an observer and thus projects a retinal image that becomes progressively smaller. This object should look like an object that moves away from the observer, not like an object that shrinks. Suppose the observers are shown a variety of objects, for example surfaces with variously complicated linear structures, shrinking or expanding. If the observers claim that they just see the objects shrinking, and if they insist that they do so while remaining at the same distance from them, then on the basis of this report their driving licenses should be withdrawn.

One might say that the stimuli presented in the laboratory were oversimplified and out of context. In the laboratory, the great regularities of daily life are based on the efficacy of those very mechanisms that are reproduced in the laboratory. We should also note that almost everyone is willing to drive risky night trips on streets and highways. In these conditions, the outside world is summarized by luminous spots and illuminated stripes on the terrain that look just like the simplified stimuli presented in the lab. Yet, people drive at night. The twenty or thirty visual effects that exhaust the visual world of a night driver surely are effective, otherwise their failure would be fatal.

Given that scientific work aims at universal conclusions, theories of perception should be based much more on what people do normally than on a narrow range of data (even if motivated by rules of scientific method), because such data are just a small subset of all the reactions one could observe in similar conditions.

There is only one reasonable conclusion to be drawn: protocols are questionable.

If we believe that the rules of scientific method must still be trusted, for the sake of good relations between colleagues or for love the of reputation of science as a "rigorous" endeavour, then we must be aware of the consequences that follow. We are forced to admit that there are sudden failures in the functioning of observers, and these failures are followed by equally sudden healings.

The last, logical, consequence of this line of reasoning seems to be the following: the perception laboratory is the least suitable place for studying perceptual phenomena.

At this point, either we get rid of the unquestionability of protocols, which are falsely "objective" products of laboratory research, or we must believe that the laboratory has an unhealthy influence on observers.

2. Descriptions

I shall discuss now another paradox concerning protocols, one that arises when protocols take the form of "descriptions" of perceptual patterns. Of course, I am aware of the current trend in perceptual research of using non-descriptive responses in place of verbal descriptions. By designing methods for collecting responses that can be described by quantitative parameters, such as motor performance or the outcomes of comparisons or selections, perceptual researchers hope to eliminate the difficulties of dealing with the linguistic ability of various observers. Although non-descriptive responses are useful, it remains nonetheless true that the really important discoveries – the phenomena that open up new horizons for research – need in the first instance a verbal description. Finer-grained quantitative methods can play their role only after we have a description.

I need to recall here a fact of epistemology. Although it is commonplace in epistemological theorizing, this fact is all too often forgotten. In various fields of scientific research, observation is based on facts that are not the direct object of scientific interest. Usually, researchers are not interested in the modes of appearance of manometers, thermometers, or Geiger counters. Rather, they are interested in something that they believe is measured by these instruments, either at the time of observation or, in case of recordings, at some earlier time. Using the old terminology of Viennese Neopositivism – old but still appropriate and effective – we should always distinguish empirical statements from protocols.

In perception, however, empirical statements and protocols coincide. The object of scientific interest corresponds exactly to what the observer sees during an observation. Both for the experimental psychologist and for the observer, the observable is not a cue to something else, and above all it is not a representation of something else. The observed event is in a very precise sense a self-representation, a displaying of itself.

Of course, in practice any experimenter will ask a certain number of other observers or subjects or participants to witness the facts under observation in order to collect reliable data and to compute appropriate statistics. The involvement of a number of subjects seems to imply the general claim that the observables of our direct experience are questionable. Otherwise, there would be no justification for calling so many people to witness a perceptual event momentarily under investigation.

What is the job of observers in this context? Their job is to provide a protocol by means of a description, a classification, a choice, or a motor response. That is, by means of any form of behaviour that can be considered as an observable event. Now suppose the above thesis that all observables are questionable is sound. Then all protocols obtained from observer descriptions, being observables as well, are also questionable. If we assume that questionability can be dispelled by multiplying the observations, as we did initially, then we must call other subjects and ask them to observe the protocols previously obtained. And so on. In practice, we can put an end to this sort of infinite regress by leaping epistemologically from one side to the other of the theory. In practice, protocols are assumed to be "obviously" unquestionable. But we well know that practical convenience has nothing to do with methodological rigor. Quite to the contrary, the former is the negation of the latter.

If we go along with accepted practice, then the appearance of all objects within reach of our sight can be doubted, except for those objects that we mean to define as protocols. Naturally, the opportunities for doubt are very limited when protocols take the form of numbers or of other conventional signs; they are limited to the point of being a theoretical pretext (but philosophically sound all the same). Quite often the inspection of a perceptual event requires a gesture or a verbal description. What about the protocols that take this form?

Suppose that a subject is performing a careful inspection of two samples of photometrically equal red colours. One sample is a rectangle a few centimetres wide and with sharply cut edges. The other has approximately the same size and shape, but its edges are serrated like in a stamp. As Kanizsa found,[1] the colours of two surfaces do not look the same. The colour of the serrated surface, compared to the other, looks faded, veiled, and blurred.

Suppose the subject compares the two red samples and says: "this red sample has a more veiled, blurred, and softer colour than the other sample". If other subjects say more or less the same, it seems safe to suppose that among our observers there are individuals who have a mastery of the English language in all subtleties.

Since descriptive terms such as "veiled" or "blurred" suffer from a certain degree of semantic indeterminacy, we might wonder what the observer actually means. There is a way to disambiguate the description. One can ask our observer to indicate which surface looks veiled. At this point, after appropriate comparisons, one "sees" what those adjectives mean in that circumstance.

Perceptual researchers almost invariably adopt this tautological procedure in their pilot observations, when the discovery is still "fresh". It is through these procedures that one finds new and interesting elements that are successively subjected to codified experimental procedures.

At this point, two alternative conclusions may be drawn: either we admit that protocols based on observables are themselves observables of a new species and therefore that they require other protocols, and so on to infinity (that is, unless we apply an arbitrary, dogmatic cut by saying: "up to here, observations are questionable, but from there on, they are not") or we interpret observers' protocols by ostension, that is, by referring back to the observed objects that originated them; thus reducing the meaning of protocols to a fact.

Thus, we have either a regression to infinity or a vicious circle.

3. Inaccessibility

Along with a great number of philosophers, most students of perception agree on a thesis that was presented clearly by the epistemologist Evandro Agazzi.[2] The thesis reads: "*a nessuno consta il constare altrui*" which may be pretty literally translated as: "no one ascertains someone else's ascertaining". It is taken for granted that any human or animal observer has a private perceptual world that is, as Leibniz would have it, impenetrable and accessible only to its owner.

If the above thesis is true, and if it can be ascertained that somebody ascertains or does not ascertain something (as common sense seems to require), we should then write: "nobody can ascertain that 'no one ascertains someone else's ascertaining' ".

Let us consider the situation more closely. First of all, let us try to "enter" the environment of a solipsist. Suppose that into this environment, where the solipsist ascertains himself, there wander two ghosts A and B.

By definition, in the heads of A and B there is no private world in which percepts are ascertained or observed that the solipsist does not know. Nevertheless, they look just like two sound and refined individuals talking to each other in the presence of the solipsist. They may talk, for example, about the way they perceive a red sample on a blue background, or a tonic chord following a seventh dominant chord. In such a case the solipsist knows perfectly that, whatever they discuss, A will never ascertain how B perceives two colours or a group of notes. In the same way, B will never ascertain what A perceives. As a matter of fact, by definition, no private perceptual world is available to either A or B.

But let us move out of this "nightmare" and into another "theatre", the real common worlds of our daily experience. We just accept the existence of private perceptual worlds as an open question (they may exist or not, or exist in a thousand different ways like the possible worlds of epistemology). After all, we always do this in our ecological niche because it is very convenient to avoid intractable dogmatisms.

In this theatre, the subject is not a solipsist. The subject, called P, does not have any particular belief. At a certain point, P immediately applies this principle. Immediately, P finds out that on the basis of this principle it is impossible to say that A cannot ascertain what B ascertains, or say that B cannot have access to the perceptions of A. It would not be possible to demonstrate the contrary, even if A and B tried their best to explain, even with logical demonstrations that they actually do not have mutual access to their respective private perceptual worlds. P cannot ascertain if they are telling the truth.

The least that can be said at this point is that a perceptual researcher should never allude to the inaccessibility of someone else's perceptions for strictly logical reasons.

4. Black box

Increasingly over the past thirty years, the most widely employed metaphor for the inaccessibility of perceptions in other minds has come to be that of the black box. As cognitive psychology imported the jargon of information theory into experimental psychology, the metaphor of the black box was probably adopted in part because it seemed to dissipate or dispel the subtlest and most inconvenient philosophical problems concerning other minds.

To simplify as much as possible, this metaphor applies to the head of any person we have ever met in our daily life: it is sealed like a black box. It is not possible to see what its inside is like or what circuits it contains. It is not possible to say whether the clever devices hidden in it are electronic, mechanical, analogic, or digital. All we can do is to measure its input and output. Heads do not merely hide thoughts, fantasies, memories, and unconscious computations from our sight. They also hide those perceptions of the external world that all owners of a head have, and that let us share the world around us, at least as long as we are in the same environment.

As a scientific observer, what I can do is keep under observation external things as they obviously strike the sense organs of each owner of a head. At the same time I can observe the corresponding behaviours, either motor or verbal. But what happens inside the heads is purely conjectural, as far as an actual black box is concerned. The behavioural scientist can only record and classify actions, gestures, and words, sometimes as input and sometimes as output, for each black box or head observed from time to time.

Show me a head and I will show you a black box. We are all boxes . . . But hold on, not all of us are. For example, surely I am not a black box. True, I can observe directly all the facts and events of the surrounding world that I would consider either as input or output for a black box, including mine. However, in the world of my observation there is much more: there is, interestingly, all the material that another observer would swear is securely locked inside "my" black box. In other words, I can see perfectly well what another observer would consider as my motor or verbal output, and I can see those events of the eternal world that the same observer would classify as input for my action. But these facts are only part of a much wider collection of observables that includes a large number of things that are neither input or output, things that my colleague would consider as private processes of my mind to be approximated only by means of conjecture. Nonetheless, these things are definitely present in the large class of my observables. Thus, if we accept the definition given above, then surely I am not a black box.

Suppose then that I ask some people – some black boxes – about being black boxes. They would certainly give an "irrevocable" answer. Irrevocable and peremptory, precisely in the sense that I defined above in the introduction. They would say that they are not black boxes, and they would give the same reasons I myself give when I assert that I am not a black box.

After all, none of us believes that our shared observable world, the furnishing of the scene where both of us are acting, could depend on an analysis of our input. And even less do we believe that it depends on some conjectural interpretation of our behaviour, defined in terms of output (as our colleague's view would require).

It is particularly odd that our cognitivist colleague can nonetheless point to those things that at this moment he or she considers as input for my black box, and distinguishes them clearly from those locked inside the box. The latter are, of course, private psychic processes to be discovered by means of clever conjectural procedures but, at least in some cases, our colleague could very well point to those as well.

Consider the following case. Our colleague shows me the Michotte "launching effect". In this effect, a mobile object hits another object that was stationary before being hit. Having received the hit, this object starts moving, just like a billiard ball when hit by another.

The colleague will teach me that the two objects are the visual input for my black box, and so is their motion (speed, direction, type of trajectory). According to this colleague, however, the perception of the *collision* and the apparent causal dependence of the motion of the second object on the motion of the first are due to some input processing inside my black box. And this in spite of the fact that the colleague could witness these things, the collision and the causality, by pointing his or her finger. The very same finger the colleague uses to determine the length of the range of action of the passive motion of the second object and to measure it.

In this case, there is an odd reciprocal penetration of black boxes. After all, if we ask other people about their being black boxes, they will truthfully state that others might be, but they certainly are not.

We could conclude with the following limerick, which contains the moral of the story:

> If that oft-told old story of the black box
> really were true (not only as a paradox)
> then you could tell no story
> right or wrong (not even as a paradox)
> about that oft-told story of the black box.

5. Simulation

Finally, there is the paradox of the perfect Golem. In the cognitive approach to perceptual science, one finds the widespread belief that computer simulations provide a method for studying and explaining what is perceived. Simulations are thus said to explain precisely the facts that have been discovered, isolated, investigated, related to theories, and coordinated in general laws by the work of thousands of men and women in the last 150 years, men and women with diverse backgrounds ranging from philosophy to physics, not to mention biology and many other domains of organised knowledge.

Computer simulations are models for the processes that cause perceptual appearances. When they are successful, simulations reproduce the processes that underlie perception, that is to say, the chain of occurrences (physical, physiological, neurological) that lead to seeing, hearing, tasting, and touching things in the world, as they are defined intuitively by most people.

However, a simple fact about simulation must be borne in mind. Simulations are not literal reproductions. When constructing a simulation, one does not attempt to replicate the very occurrences described by some theory of perception or those that were conceived by God. If one goes out and buys copper cables and tin foil, assembles small magnets, and manufactures a small device to carry sounds over the cables, certainly one does not have a simulation of a telephone. What one has is an actual telephone, albeit a technologically primitive one. In contrast, if one builds an apparatus for carrying coherent light over long distances, and does it so that the light can vary in intensity as a function of certain mechanical oscillations induced by a voice, and if that light after several reflections ends up impinging on a magnetic head that will leave a trace on a tape, and if that trace, after adequate analysis, can be converted into a graph that can then be fed into a computer to reconstruct the oscillations and finally convert them into the original pressure waves, then one has a simulation of a telephone.

Note that all the various steps of the simulating process can be replaced by other equivalent steps. The causal chain can be stretched or shrunk. Teams of engineers can compete at inventing yet further steps, and certainly each will come up with a different simulation of a telephone at the end of the operation. But all that the simulations will guarantee is that if one says a word here, someone else may hear it elsewhere.

Now suppose that I have built a perfect Golem. The Golem is not to be a perfect copy of myself. If this were the case, then the Golem would be a reproduction, not a simulation. Thus, Golem hardware is completely different from physiology of actual men, but the result is a perfect simulation. The Golem will argue with me, he will tell me about Golem predilections in music or in poetry, about curiosities in the facts of perception. Eventually, the Golem will manifest an interest in a general theory of perception.

Thus, the Golem and I will start collaborating at the development of such a theory. I will show him all known optical tricks. The Golem will see them, and we will enjoy discussing them, for the Golem is perfect – as a simulation, not as a measuring device (in its imperfection as a measuring device lies its perfection as a simulation). We will observe the phenomena of perceptual constancy, discuss the fundamental properties of colour, and puzzle over apparent motion.

Being very intelligent and creative, soon enough the Golem will discover new visual and auditory effects, new problems for our theory. Every day the Golem will call me and take me to the laboratory, and show me new things, facts that I did not already know and that were not in the literature. I shall delight in taking part in the experiments designed by the Golem. We shall share observations, conceive new conditions, perform other experiments.

But the Golem knows perfectly well about simulations. I know that my perceptual system is different from the perceptual system I put into the Golem. And of course the Golem knows that too. In conclusion, we both know that the processes underlying Golem perception and complicated simulations of other processes, namely those that that underlie my own perception.

True, the Golem will start arguing that it is my perceptual processes that are simulations of the Golem perception. To this I cannot reply. At this point things have become very difficult.

Being perfect by definition, the Golem perceives the world just as I do, sharing my perceptual experience with characteristic nonchalance. And yet it is clear to both of us, again by definition, that the Golem's perceptual machinery does not resemble mine. Taken together, these two points create a certain difficulty for any attempt to explain human or animal perception by means of computer simulations.

Notes

1 Kanizsa, G. (1960). Randform und Erscheinungsweise von Oberflächen. *Psychologische Beiträge*, 5, 93–101. Translated by M. Riegle in G. Kanizsa (1979). *Organisation in Vision: Essays on Gestalt Perception* (pp.135–142). New York, NY: Praeger.
2 Agazzi, E. (1976). *Psicologia ed epistemologia* [*Psychology and Epistemology*]. Milan, Italy: Vita e Pensiero.

COMMENTS ON SOME PARADOXES OF CURRENT PERCEPTUAL THEORIES

Sergei Gepshtein

Situating Experimental Phenomenology

Paolo Bozzi's "On some paradoxes of perceptual theories" is an exposition of conceptual and theoretical difficulties of Experimental Phenomenology by one of its most brilliant exponents. To appreciate implications of these difficulties, I would like to begin by situating Experimental Phenomenology.

Let us recall that the *philosophical* discipline of phenomenology and the *scientific* discipline of Experimental Phenomenology have a common origin. This origin is the descriptive psychology introduced by Franz Brentano and promulgated by the "Brentano circle" (Jacquette, 2004) to the threshold of a new approach in the philosophy of mind and a new approach in empirical psychology. The aspiration of descriptive psychology was to develop a "science of mental phenomena." This aspiration became figurative in philosophical phenomenology and literal in Experimental Phenomenology, but the common origin left its mark on both disciplines. From the outset, their common goal was to investigate the human mind from an adamantly first-person perspective.

Let us also recall that the scientific study of the mind was the goal of another discipline that made no commitment to the first-person perspective. This discipline is sensory psychophysics, conceived just before Brentano's descriptive psychology and dedicated to investigating mental phenomena from the third-person perspective of natural science.[1]

These distinctions are important to keep in mind today as boundaries between the original commitments are being eroded by naturalization of the sciences of mind. Researchers interested in the first-person perspective of Experimental Phenomenology increasingly turn to third-person methods of natural science, as is often the case in cognitive science and cognitive neuroscience. By turning away from the first-person commitment, one is turning away from an opportunity to address one of the most urgent demands of our time, which has been articulated most vividly by adherents of philosophical phenomenology. Here speaks the Czech phenomenological philosopher Jan Patočka (Patočka, 2016), a student of Husserl:

> Modern man has no unified worldview. He lives in a double world, at once in his own naturally given environment and in a world created for him by modern natural

> science, based on the principle of mathematical laws governing nature. The disunion that has thus pervaded the whole of human life is the true source of our present spiritual crisis. It is understandable that thinkers and philosophers have often attempted somehow to overcome it, yet they have generally gone about this in a way generally meant to eliminate one of the two terms, to logically reduce one to the other, to present one – usually on the basis of causal argument – as a consequence and a component of the other. (p. 3)

The concern voiced by Patočka was also voiced by other preeminent phenomenologists, most notably by Husserl and Merleau-Ponty, to whom we return below. It appears that the mentioned naturalization of the sciences of mind amounts to exactly the elimination of what Patočka called the "naturally given" phenomenal environment observed from the first-person perspective and replacing it by the environment described in terms of the third-person natural science.

In this light, our ability to resolve paradoxes of Experimental Phenomenology acquires exceptional significance. Indeed, because of its commitment to both first-person perspective and the scientific method, Experimental Phenomenology occupies a unique position at the juncture of first-person and third-person perspectives. Attempts to resolve these paradoxes can take several forms. In the conservative mode, one will aspire to improve techniques of Experimental Phenomenology, which is to devise new kinds of experimental "protocols" that involve new sensory stimuli and new tasks respecting the first-person commitment. And in the heterodox mode, one will attempt to elucidate limitations of Experimental Phenomenology and investigate how its practice can be supplemented by, and entwined with, methods that stand outside of Experimental Phenomenology, all in the effort to derive a comprehensive account of the first-person world.

The nature of the paradoxes of Experimental Phenomenology described by Bozzi raises the questions of whether it is the latter, heterodox approach that is more likely to produce a comprehensive "science of mental phenomena." In other words, it appears that only by deploying both first-person and third-person methods will we be able to paint a complete picture of the first-person world. To illustrate this position, I will describe how a fundamentally first-person challenge can be met using a decidedly third-person method. Our goal is to develop a conception of space as it is experienced from the first-person perspective (the space of experience), in place of the third-person conception of physical space (the space of physics).

Experience of space

Echoing Patočka and Husserl, the phenomenologist Maurice Merleau-Ponty had the following to say in his 1948 lectures on French radio (Merleau-Ponty, 2004):

> The world of perception, or in other words the world which is revealed to us by our senses and in everyday life, seems at first sight to be the one we know best of all. For we need neither to measure nor to calculate in order to gain access to this world and it would seem that we can fathom it simply by opening our eyes and getting on with our lives. Yet this is a delusion.
>
> . . . the world of perception is, to a great extent, unknown territory as long as we remain in the practical or utilitarian attitude. . . . I shall suggest that much time and

> effort, as well as culture, have been needed in order to lay this world bare and that one of the great achievements of modern art and philosophy (that is, the art and philosophy of the last fifty to seventy years) has been to allow us to rediscover the world in which we live, yet which we are always prone to forget. (p. 39)

Space was Merleau-Ponty's prime example of how the "world of perception" remained an unknown territory. He made the distinction between the "space of classical science," which is:

> the uniform medium in which things are arranged in three dimensions and in which they remain the same regardless of the position they occupy, (. . .) a medium of simultaneous objects capable of being apprehended by an absolute observer who is equally close to them all, a medium without point of view, without body and without spatial position — in sum, the medium of pure intellect. (p. 50)

and the space of experience, where

> (. . .) our relationship to space is not that of a pure disembodied subject to a distant object but rather that of a being which dwells in space relating to its natural habitat. (p. 55)

One realization of this relationship between the subject and its habitat was advanced by Rudolf Arnheim (Arnheim, 1977) in his study of architectural experience from a perspective derived from the Gestalt school of Experimental Phenomenology. Arnheim used a drawing by the architect Paolo Portoghesi to illustrate this relationship (Figure 2.1) and to develop the following description of the experience of a built environment:

> In perceptual experience, the spaces surrounding buildings and similar structures cannot be considered empty. Instead these spaces are pervaded by visual forces generated by the architectural structures and determined in their particular properties by the size and the shape of their generators. Visual forces are not isolated vectors, but must be understood as components of perceptual fields that surround buildings.
>
> Visual forces (. . .) must be understood as components of perceptual fields that surround buildings. (. . .) a field of visual forces expands from the center and propagates its wave front as far into the (. . .) environment as its strength permits. (p. 28)

This is a first-person account of architectural experience taking advantage of the concept of "field" that was central to Gestalt theory. But the concept of "visual force" deployed by Arnheim is unclear. One is prompted to ask whether the visual force is real in the same sense as the forces of gravitational attraction or electrical attraction are real. Or maybe this "force" is metaphorical? Or does it constitute a unique first-person concept that has no third-person counterpart? Similar questions arise about the notions that the field has a "wave front" and that its "propagation" is dictated by the "strength" of the force. Below I consider a third-person framework from which ideas similar to Arnheim's arise, but which does not prompt one to doubt the reality of the ensuing picture.

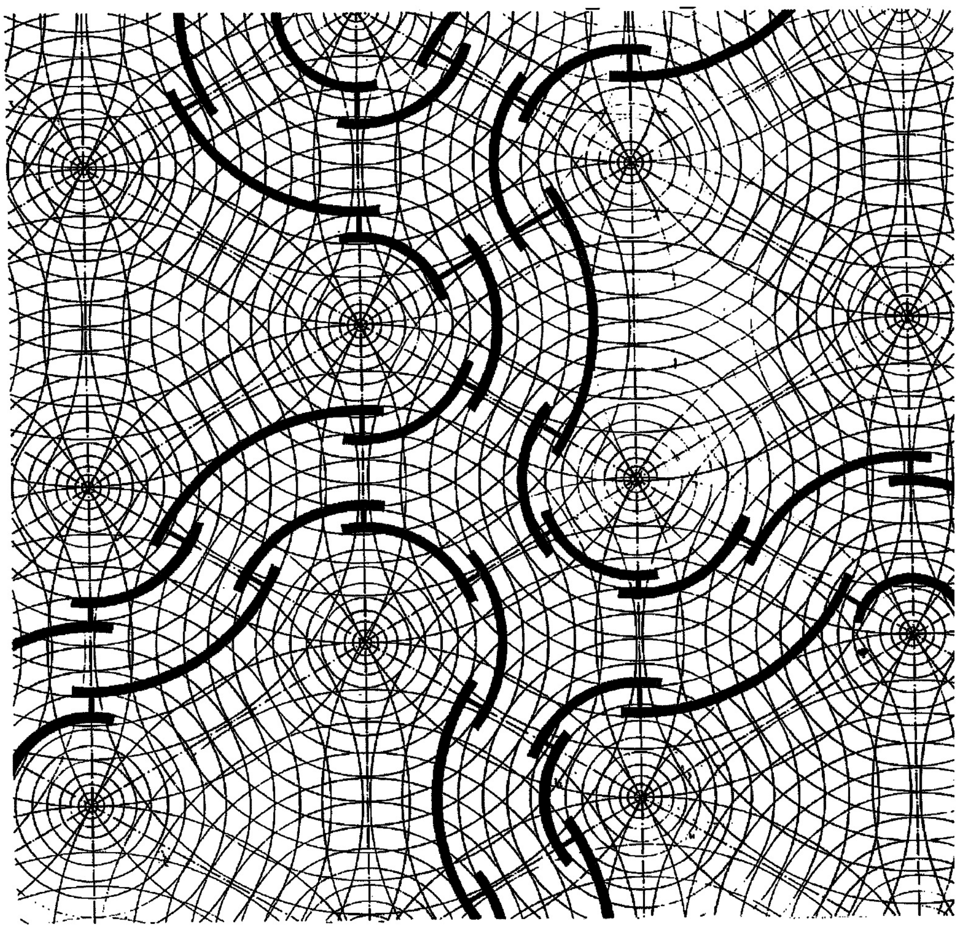

FIGURE 2.1 A hypothetical "perceptual field" of an architectural environment. The thick lines represent walls in plan view. Each set of concentric curves represents the potential effect of the corresponding wall on the viewer. Jointly, the overlapping sets of concentric curves form the "perceptual field." The drawing is by Paolo Portoghesi, reproduced from Arnheim (1977, p. 30).

Solid field of visibility

Visual scenes present the perceiver with a variety of entities: objects, surfaces, and events. Let us call them "features" of the environment. The features appear at different distances from the perceiver. Because of the selectivity of the visual system, the perceiver can experience only some features from any given location. We can reverse this argument and say that every feature can be seen from a limited set of locations even when it is not occluded by other features. The sum of such locations will make a pocket of solid space. Every visible feature of interest will have such a "chamber" of visibility attached to it. (Notice that I use the word "chamber" only as a linguistic shortcut.) The boundaries of such chambers of visibility are not visible themselves, but they are real in the sense that the perceiver will be able to see the feature of interest when inside the chamber and not see the feature when outside of the chamber.

Let us suppose that features of the environment are stationary and the perceiver is mobile. As the perceiver is moving through the environment, she will be crossing boundaries of the chambers of visibility. Since different chambers will afford visual access to different features, the perceiver will have a sequence of different visual experiences. We could predict the sequence of experiences if we knew the perceiver's trajectory and the locations of chamber boundaries.

Because many properties of visual selectivity are known from the third-person perspective, we can derive the boundaries of the chambers of visibility and from that predict the sequence of experiences (a first-person process) for any trajectory of the perceiver in the environment.

Notice that the boundaries of visibility in a stationary environment are stationary under the simplifying assumption that the perceiver's characteristics do not change as she traverses the environment. One can therefore think of the environment as partitioned in terms of potential experiences. A planar section of the environment – for example a horizontal section at the level of the floor or at the level of the perceiver's eyes – will produce a two-dimensional map of potential experiences.

Suppose we derive such a map using the contrast sensitivity function, following a procedure described in the Appendix. Contrast sensitivity is a characteristic of visual perception derived by third-person tasks, such as the aforementioned detection or discrimination. On this definition, feature visibility is a continuous function of viewing distance.

A boundary between those locations where the feature is visible and those where it is invisible can be defined several ways. An absolute boundary is found where visibility approaches zero. It is however common in psychophysics to define the boundary at some other value, called the *threshold of visibility* - for example, where the perceiver will be able to report the feature correctly 75 percent of the time. One can also entertain a third possibility, in addition to the absolute boundary and the boundary at the threshold of visibility. The boundary could be replaced by a transitional interval between low and high visibility. The transitional interval could be defined between the locations where the perceiver reports the feature correctly 75 percent of the time or more, on one side, the locations where the perceiver reports the feature correctly 25 percent of the time or less, on the other side. Now the perceiver would take some time traveling through the zone between visibility and non-visibility.

On any definition of the boundary of visibility, we have the space of the environment divided to parts. We can summarize this notion by saying that visibility of features of the environment constitutes a continuous solid field, which we partition for practical reasons. In a stationary environment, the field and its partitions constitute an objective structure of the environment: its objective spatial organization, given a visual characteristic of the perceiver derived by the third-person method of sensory psychophysics.

In the case considered here, visibility is derived from the perceiver's contrast sensitivity, which is a readily measured objective characteristic of every individual. For a perceiver with a different contrast sensitivity, or the same perceiver whose contrast sensitivity has changed, the spatial organization of the environment will be different, but it will be objective and knowable.

In general, every part of the environment can be characterized by more than one feature. For example, a person can be described in terms of her overall appearance (such as the silhouette) and in terms of her facial features. The silhouette and the face will be visible from different solid regions, which can overlap or nest in one another. What is more, the different solid regions will have different orientations relative to the person because the silhouette will be visible under angles different from those for the face. Such nuances can be readily taken into account by making the map of visibility more nuanced than in the simplified case illustrated in the Appendix (Figure 2.3), i.e., using a more refined third-person procedure.

Further generalizations of the above picture will include dynamics other than movement of the perceiver. In particular, the environment can be dynamic, when parts of the environments move or contain moving images. Perceiver's characteristics can also change, for example, because of changes of the overall illumination of the scene (sun light vs artificial light) or because of attentional fluctuations. In our illustration, where visibility is defined in terms of contrast sensitivity, the changes of visibility induced by varying illumination (or varying attention) are known, at least in part, allowing one to make testable hypotheses about the dynamics of the solid field of visibility and its partitioning.

The resulting conception allows one to predict certain aspects of the experience of architecture in first-person terms. But this conception is derived using a third-person method: measurement of contrast sensitivity. Just as in the account of Arnheim and Portoghesi (Figure 2.1), our conception concerns the impact of the environment on the person at different distances between the person and parts of the environment. But our conception only concerns boundaries of experience. The content of experience can be studied using traditional tools of Experimental Phenomenology. This way, we have developed a framework in which a complete picture of experience of space can be attained by combining first-person and third-person methods.

Note

1 Since the distinction between first-person and third-person tasks can be subtle, for the purpose of our discussion we can separate the two in terms of whether the task has a correct answer. Psychophysical tasks involve judgements of stimuli presented in two or more states known to the experimenter. For example, the stimulus can be present or absent (detection task), or the stimulus can move in one of several directions (discrimination task). Typical tasks of Experimental Phenomenology do not have a correct answer, such as in studies of perceptual grouping (where a number of tokens may *appear* to form one or another shape) or in studies of phenomenal identity (where a dot *appears* to move alone in one direction or as a part of dot collective moving in another direction).

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Appendix

In retinal images of visual scenes, the density of detail and the magnitude of luminance contrast correlate with viewing distance. Objects located farther from the eye are projected at higher levels of pictorial detail (called "spatial frequency" of detail) and at lower contrast than nearer objects.

Figure 2.2, panel A, contains the Campbell-Robson chart (Cornsweet, 1970) of visual contrast sensitivity. Here the amount of detail (spatial frequency) increases from left to right while luminance contrast increases top to bottom. This chart makes it clear that visibility of patterns depends on the amount of detail. The boundary of visibility varies from left to right, represented schematically by the continuous curved line. This boundary is the contrast sensitivity function. (Sensitivity is defined as $1/c$, where c is the amount of contrast that makes the luminance pattern just visible: the lower the contrast the higher the sensitivity.)

In panel B, an image with a fixed density of detail (fixed spatial frequency) is shown at three viewing distances. Increasing the distance will lead to increasing the density of detail projected to the eye even as the amount of detail in the image is the same. The arrows from panel B to panel A indicate how increasing the projected amount of detail is expected to correlate with visibility, illustrated in panels C-D.

In panel C, the solid curved line traces the boundary between the visible and invisible elements of the image, as in panel A. The solid horizontal line marks a fixed low contrast at which the range of visible spatial frequencies is confined to an interval marked as the "window of visibility." In panel D, the image with a fixed density of detail has a lower

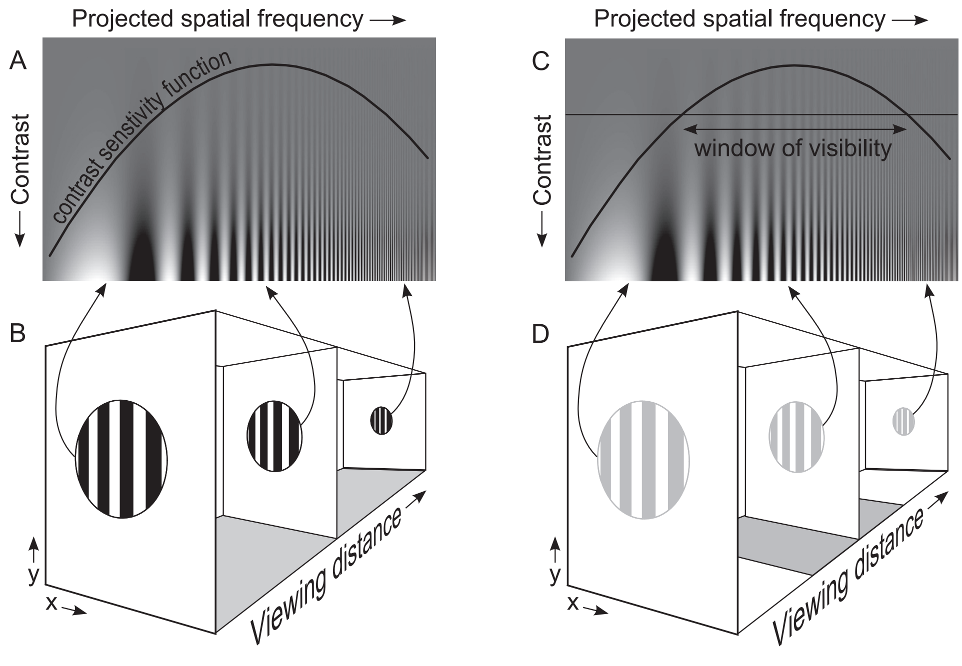

FIGURE 2.2 Pattern visibility over distance.

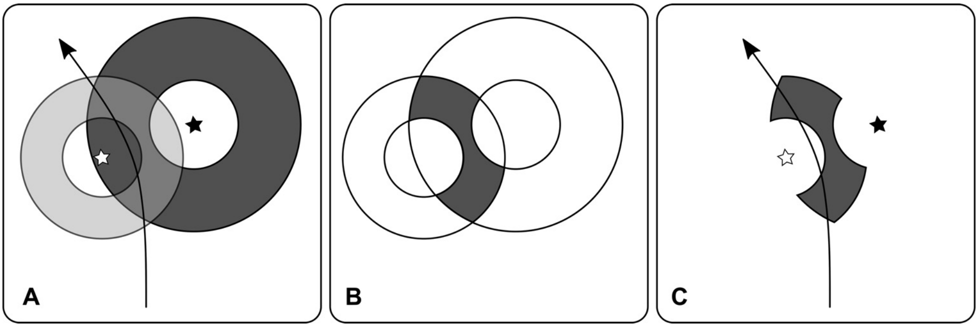

FIGURE 2.3 A map of joint visibility of two objects in plan view.

contrast than in panel B, corresponding to the contrast represented by the horizontal line in panel C. According to the "window of visibility," the image will be visible within a range of viewing distances represented by the grey area on the bottom of the panel. This limited range of viewing distances is represented in Figure 2.3 as annuli.

Panel A in Figure 2.3 contains a plan view of an area that contains two elementary objects represented by the black and white stars. The grey annuli represent the regions from which the two objects are visible as predicted in Figure 2.2D: the white object is visible from within the bright annulus and the black object is visible from within the dark annulus. The curved arrow stands for the trajectory of a mobile observer. In panel B. the dark shape represents the region of joint visibility: the intersection of the annuli from panel A. In panel C, the mobile observer on the trajectory represented by the curved arrow will intermittently enter the region of joint visibility, where the arrow overlaps with the dark shape.