Ugo Savardi & Ivana Bianchi

Coupling Epstein's and Bozzi's "Percept-Percept Coupling"

1. Introduction

In 1999 William Epstein was invited (by Ugo Savardi) to participate in a conference organized in Padua. The idea was to celebrate the work of Paolo Bozzi (1930 - 2003) and Epstein was asked to give a presentation on "percept-percept coupling". This topic was close to Bozzi's heart as it was related to his work on experimental phenomenology. Epstein had introduced the concept in 1982 in a paper which represented a milestone in the debate on this subject. Together with Sheena Rogers (Epstein & Rogers, 2003), Epstein revised his initial position, and in Padua he pointed out an important aspect (in our opinion) which regrettably remained in the background in the debate which followed. We knew Bozzi well enough to say now that if he were here he would have liked the idea of paying homage in turn to Epstein with a paper on percept-percept coupling. Our aim is to continue their conversation. We will of course rely on their writings and, naturally, our understanding of them.

On a final, personal note, this paper also represents an opportunity to put right a "mistake" made by Ivana Bianchi when she was a PhD student. Epstein asked her to translate the passages in Bozzi's book *Fenomenologia sperimentale* where there was a reference to percept-percept coupling. She responded but with a translation of only a few pages. Now, more than a decade later, she would of course once again welcome Epstein's request, but would warn him that the translation would take some months since to do the subject justice it would mean translating… the whole book! We will explain the reasons for this in a while.

Besides being a homage to Epstein, these pages aim to:

a) contextualize percept-percept coupling with regard to the Experimental Phenomenology of Perception in order to complement the work already carried out by Epstein with regard to direct and indirect theories of perception;
b) compare and rethink the two views using the psychophysical chain as a framework;
c) suggest that percept-percept coupling can be still a fruitful construct for distinguishing and classifying the structures of the various types of perceptual relations described.

GESTALT THEORY
© 2012 (ISSN 0170-057 X)
Vol. 34, No.2, 191-200

2. Epstein's View: Historical Notes, Reference Theory

Epstein's discussion of the topic publicly started in 1982, in an article published in the journal *Perception*. In that article he explicitly adopted Hochberg's (1974) expression 'percept-percept coupling' (from here on PPC) to refer to "instances in which the organization of the perceptual world seems to include links between percepts" (Epstein 1982, p. 75). For example, the *perceived* speed of two superimposed sets of dots moving in opposite directions (presented on a computer-generated display and observed monocularly, and therefore coplanar at the distal stimulation level) is coupled with the relative *perceived* distance of the two sets. Observers who were asked to match and adjust the speeds of the sets, consistently adjusted it to a higher speed when the set appeared farther away than the standard in depth and to a lower speed when it appeared nearer (McConkie & Farber 1979). As Gilchrist's studies had earlier demonstrated, the *perceived* lightness of a surface can vary from white to black depending merely on its *perceived* spatial position "without any significant change in the retinal array" (Gilchrist 1977). In apparent motion, space and time are coupled: Korte (1915) postulated that an increase in temporal separation between two alternating stimuli must be accompanied by an increase in spatial separation in order for the apparent movement to occur. "A number of observations suggest that the spatial separation in Korte's law should be taken as perceived separation rather than distal or proximal stimulation. An experiment by Attneave and Block (1973) supports this suggestion" (Epstein 1982, p. 77).

It is important to note that Epstein is very careful to provide a range of examples (in addition to the three cases mentioned here) where the link between characteristics is defined at a *perceptual* level, as evidenced also by the quotations above. This is significant since it introduces a topic which is explained further in a second paper (Epstein & Rogers 2003): couplings, as phenomena, are links between perceptual experiences and on this level they don't represent a problem, they are simply *data*. The problem arises when one considers how they impact on presupposed theories of perception.

The scenario that Epstein had in mind took into consideration, on the one hand, advocates of direct perception (Gibson 1966, 1979; Turvey 1975, 1977; Shaw & Bransford 1977; Reed 1987) and, on the other hand, advocates of a constructivist or computational approach to vision - in other words indirect perception (Fodor & Pylyshyn 1981; Rock 1977; Gogel 1979; Ullman 1980). As Epstein acknowledged, this debate between direct and indirect theories did not depend exclusively on experimental data but was laced with epistemological and logical concerns. The same can be said for PPC (considered as a paradigm not as a factual instance or phenomenon) as one is led to conclude as a result of Epstein's reasoning in his two papers. Indeed, initially he suggested that the observation that percepts are coupled is congenial to the computational or constructivist

theory of perception whereas it represents a potential embarrassment for the direct theory:

> "The data seem to implicate causal relations among percepts in the organization of the visual world. If one percept is conditional on another then the cardinal tenet of direct theory cannot be sustained. The percept in question will have been removed from direct control by information in stimulation" (Epstein 1982, p. 78).

In 2003 he separated the experimental data from the implications of these data when they are discussed in the framework of a specific theory of perception.

> "Typically the observations that form the basis for the claim of percept-percept couplings consist of covariations or correlations between observers' responses to experimental probes designed to assess the putative coupled perceptual attributes. Accordingly, the claim of percept-percept couplings might be construed as nothing more than a useful empirical generalization that embodies a summary description of data. But in fact, the claim is more than that. The claim is that the observed covariations are expressions of underlying *causal dependencies* between perceptual representations, e.g. that perceptual representation of motion *depends on* perceptual representation of depth [italics not in the original text]. (…) the claim for percept-percept coupling goes beyond the data. The claim is a hypothesis to account for the data" (Epstein & Rogers 2003, p. 97).

3. Bozzi's View: Historical Notes, Reference Theory

While Epstein sets his discussion of PPC within the framework of direct versus indirect theories, Bozzi discussed it within the boundaries of the Experimental Phenomenology of Perception. As mentioned before, this concept was fundamental to his book *Fenomenologia sperimentale* (and in fact it first appears in the introduction and then also in chapters 1, 4, 5, 9, and 11). The book is a collection of various papers written from 1962 to 1989 and it constitutes a consistent epistemological and methodological anthology of what he called the Experimental Phenomenology of Perception. The widespread presence of references to PPC in the various chapters demonstrates the importance of this issue. Utilizing Berkley's "esse est percipi" *as a methodological tool* allowed Bozzi on the one hand to operationalize various definitions of experience, clarifying the confusion between them in terms of both common sense and scientific theories of perception and on the other hand, to establish the basis of a demonstrative method of exploration and manipulation of the perceptual world which constitutes the essence of the Experimental Phenomenology of Perception. For Bozzi PPC was a central aspect of this method. As he stated, "I believe that the concept of *percept-percept coupling* has a fundamental role in the context of the phenomenological method" (1989, p. 29).

There are three consequences of using "esse est percipi" as a methodological tool. Firstly, it "teaches us to look at facts with an open mind" (1989, p. 26); secondly, it "forces us to take into account every aspect of what is under observation in

great detail and on the same level" (1989, p. 27) and thirdly,

> "(it) leads immediately to the discovery of functional relations (in a very general form: x = f (y, w, z.…), where however commas have to be replaced with (often new) relations and quantities and descriptions are merely "descriptions of state" which specify the condition of the phenomenon, reveal its dynamics and open the door to a hypothesis that will take shape in new excogitations, which can be realized on a phenomenological level" (1989, p. 27).

Since in Bozzi's *iuxta propria principia* experimental phenomenology the variables that enter into the function x = f (y, w, z…) are all exclusively characteristics and relations defined on a perceptual level, it is probably now clear why the recognition of PPC becomes a central issue. It is in effect a general rule rather than a special phenomenon.

> "when we look at things we do not only observe and describe them, but we also act on them, submitting them to transformations which are in turn observable, and noticing then that certain transformations determine other transformations on different aspects of the same thing, in areas of the perceptual field which are more or less proximal. By systematically applying these transformations (preferably more than once), according to a well defined program of hypotheses, and then observing the phenomenal modifications obtained, we can link these "Cartesian propositions" in logical structures" (1989, p. 163).

[Cartesian propositions are defined as referring to indubitable percepts. In this case they are the propositions which describe the transformations applied and the corresponding phenomenal modifications obtained.]

If one looks at the examples of directly recognized couplings between perceptual characteristics which are described in Bozzi's book (1989), one finds a collection of phenomena which are an almost complete representative sample of the percepts normally studied in experimental phenomenology. In the Müller-Lyer illusion, by modifying the angles between the arrow-heads and the lines in between, one notices "concomitant variations" (p. 28) in the length of the two critical segments. A few lines later, Bozzi specified: "it is better if we do this operation continuously and progressively. In this way we will discover how the segments react to our transformations".

Another example is chromatic induction. "Put a gray square of 2 cm^2 at the center of a blue square of at least 15 cm^2. The blue induces a vein of yellow to appear on the gray square. The yellow is a function of the surrounding blue" (p. 28).

As an addition to the list of observed couplings discovered by Rubin (1921) which were regarded as critical in figure-ground segregation, Morinaga (1941) observed that the parallelism or non-parallelism of the lines delimitating an area is visually associated with the area which is perceived as being the figure in the foreground. In Fig. 1, on the left,

> "it is clear where the figure is and where the background is. The irregular outline and the square inside it form a grid against a background.
>
> Now let us rotate the internal square by a few degrees until the parallelism between the longer segments of the irregular outline and the sides of the square is destroyed [Fig. 1 on the right]. (…). Now it is easy to see the square superimposed on a quadrangular structure (…) and the square is no longer a hole. (…). The rotation of the square thus produces a new stratification. The percept-percept coupling in this case makes the destruction of parallelism the first member of the function and the new stratification is the second member" (p. 32-33).

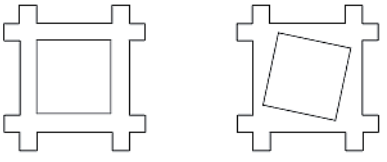

Fig. 1 Morinaga's figures (1941): the parallelism or non-parallelism of the lines is associated with the area which is perceived as being the figure.

Other variations of Morinaga's figures were also presented and discussed by Bozzi in the same chapter.

Wertheimer's laws (1923, p. 301 ff.) have a demonstrative structure similar to Morinaga's law, but in this case the second member of the function is the grouping. For example, in dot lattices where the dots are equidistant, no grouping is visible; the variation of the proximity between some of the dots is coupled with the emergence of a visually segregated unit.

In anomalous contours (e.g. Kanizsa 1955), the appropriate arrangement of the inducing elements is coupled with the emergence of visible margins, a change in the lightness of the internal area and a change in its spatial stratification.

In phenomenal transparency (e.g. Metelli 1975), perception of transparency and perception of stratification of the gray areas are coupled.

Michotte's (1954) perception of causality is a different case - when the motion of an object A ends and a second object B starts moving at a certain speed (even if the movements are stroboscopic), an observer sees the coupling between the perceived motion of A and the perceived motion of B. However, by manipulating the characteristics of the motion of A and B (e.g. their relative speeds, the direction of their movement, and the temporal interval between A making contact with B and the initiation of B's movement) one also sees the couplings between the single aspects of the event which have been manipulated and the corresponding effects they produce on the perceived motion of B. For example, whether it appears causal or autonomous, a case of pushing or dragging.

Two last notes: 1) The dependence of the characteristics coupled from external stimuli is totally irrelevant. Bozzi points out in a footnote that

> "examples of percept-percept coupling can also be found in complete absence of external stimuli: the after effect of a highly illuminated square (presented only for a moment) rapidly decreases in size and at the same time moves farther away" (p. 29).

An interesting intermediate case that Bozzi discovered (1989b) is that of the coupling between the characteristics of an after effect (e.g. its spatial evolution in time) and those of a modal percept (i.e. a rectangular boundary which is modally presented on a screen or a piece of paper and within which the after effect is seen). When the boundary is unbroken, the after effect perfectly fills the space inside, but when the boundary is broken at some points, the color of the after effect behaves as if it were a liquid and slowly bleeds out from the apertures. 2) As shown in these examples, couplings are not expected to be only one-to-one - the idea of couplings as pairs is only a simplification.

4. Comparing the Two Views Within the Psychophysical Chain.

This brief overview shows at least some basic similarities and differences between the two approaches to PPC. Epstein and Bozzi are both very meticulous in the way they define PPC *as a perceptual phenomenon* on a purely perceptual level and they both emphasize that the percepts coupled in this association are genuinely perceptual facts. If one uses the psychophysical chain as a framework to describe their two views, one might say that on this factual level both agree that PPC is part of the phenomenal stage of the chain. But when the implications of these phenomena in terms of a perceptual theory are discussed, i.e. when analyzing "beyond the data" (to use Epstein & Rogers's expression), Bozzi kept the discussion firmly on the phenomenal level. Epstein, in contrast, "moves the cursor" along the psychophysical chain and explores the implications of this phenomenon in theories which assume one or another relation between perceptions and stimulation. This relation is necessarily in the foreground in direct or indirect theories of perception but not in the Experimental Phenomenology of Perception. This was absolutely true for Bozzi, and is sufficiently in agreement with the general profile of the phenomenology of perception in Italy. We are inclined to say that it is not in disagreement with Kubovy's definition of phenomenological psychophysics either (Kubovy 2003; Kubovy & Gepshtein 2003).

The shift of the paradigm from within the boundaries of the phenomenal level to the relation between phenomena and stimuli (inaugurated by Epstein in 1982) has been further developed in subsequent discussions. For instance, Norman (2002) discusses the paper by Epstein (1982) reframing the issue of PPC within a hypothesis of dorsal versus ventral systems of elaboration, and within a perspective involving neurophysiological, neuropsychological and psychophysical evidence.

5. Concluding Observations

It seems to us that at the end one question remains and it concerns an issue which suggests a potentially fruitful future development of the paradigm. It regards the various ways in which the coupling relationship is expressed. "Causal dependencies", "conditional relations", "co-variations", "correlations", "perceptual interactions", "concurrent perceptual changes", "functional relationships", "logical dependencies", "logical implications", "temporally sequential relations" and "logically sequential relations" are all different types of relations that fall under the umbrella term of "coupling".

The question of what kind of relationship the PPC does consist of in precise terms is apparently a key point in Epstein's analyses, since his change of stance between the original article and that written 21 years later with Rogers indicates the possibility of not thinking of these couplings in causal terms, but merely in terms of co-variations. "If these cases can be reconceived, that is, given an interpretation that does not imply causal linkages among percepts, then the ecological realist will have grounds for optimism" (Epstein & Rogers 2003, p. 94). And their conclusion after discussing three significant cases is that the *observations* that form the basis for the claim of percept-percept couplings

> "consist of *co-variations* or *correlations* between observers' responses to experimental probes designed to assess the putative coupled perceptual attributes (…) transforming them into causal dependencies means going beyond the data, claiming a hypothesis to account for the data" (Epstein & Rogers 2003, p. 97).

Should one thus conclude that, on the level of phenomena (or data), only "correlations or co-variations" can be described? Is this the only type of relationship that can be used to describe PPCs when they are dealt with as phenomena? We don't know if Epstein would agree with this, but a way to maintain the potentiality, in terms of further development, of the various different terms listed above (and used by Epstein and Bozzi in their writings) is to analyze them parsimoniously within the boundaries of the Experimental Phenomenology of Perception, dealing with them as if they were Cartesian propositions.

> "Let p and q be Cartesian propositions: we can discover the relation between them $\langle\langle p \; R \; q \rangle\rangle$, and it may be that $\langle\langle p \; R \; q \rangle\rangle$ is not simply an inference built on various observations, but is really sometimes just that, a Cartesian proposition; at times, by varying p in a defined way, not only the variation of q is visible, but so is the dependence of the variation of q on that of p. In these cases, $\langle\langle q = f(p) \rangle\rangle$ is a Cartesian proposition. (However, this is a simplified schema and things are obviously more complicated than this)" (Bozzi, 1989, p. 163).

The challenge becomes, at that point, to operationalize all these different types of couplings/relationships and to define what characterizes each of them and what distinguishes one from the other.

Summary

Epstein's (1982; Epstein & Rogers 2003) and Bozzi's (1989) ideas of *percept-percept coupling* are summarized and discussed. The psychophysical chain is used as a framework to emphasize the main similarities and differences. It is suggested that a further analysis of percept-percept coupling might enable us to distinguish various types of relationships between percepts on a phenomenal level.

Keywords: Percept-percept coupling, Experimental phenomenology of perception, direct-indirect theories of perception.

Zusammenfassung

Die Konzepte des *percept-percept coupling* von Epstein (1982; Epstein & Rogers 2003) und von Bozzi (1989) werden im vorliegenden Beitrag zusammengefasst und diskutiert. Die psycho-physische Kette wird als Bezugssystem verwendet, um die wichtigsten Ähnlichkeiten und Unterschiede hervorzuheben. Eine weiterführende Analyse des percept-percept coupling könnte es uns ermöglichen, unterschiedliche Arten von Beziehungen zwischen Empfindungen auf einer phänomenalen Ebene zu unterscheiden.

Schlüsselwörter: Percept-percept coupling, experimentelle Wahrnehmungsphänomenologie, direkt-indirekte Wahrnehmungstheorien.

References

Attneave, F. & Block, G. (1973): Apparent movement in tridimensional space. *Perception* & *Psychophysics 13*, 301-307.

Bozzi, P. (1989): *Fenomenologia Sperimentale*. Bologna: il Mulino.

Bozzi, P. (1989b): Osservazioni inedite su certe peculiarità delle immagini consecutive, in: Garau, A. (ed.), *Pensiero e visione in Rudolf Arnheim*, 28-37. Milano: FrancoAngeli.

Epstein, W. (1982): Percept - percept couplings. *Perception 11*, 75-83.

Epstein, W. & Rogers, S. (2003): Percept – percept Couplings Revisited, in: Savardi, U. & Mazzocco, A. (eds.) (2003): *Figura e Sfondo. Temi e variazioni per Paolo Bozzi*, 93-106. Padova: Cleup.

Fodor, J. H. & Pylyshyn Z. W. (1981): How direct is visual perception? Some reflections on Gibson's 'ecological approach'. *Cognition 9*, 139-196.

Gibson, J. J. (1966): *The Senses Considered as Perceptual Systems.* Boston, MA: Houghton Mifflin.

Gibson, J. J. (1979): *The Ecological Approach to Visual Perception.* Boston. MA: Houghton Mifflin.

Gilchrist, A. L. (1977): Perceived lightness depends on perceived spatial arrangement. *Science 195,* 185-187.

Gogel, W. C. (1979): The common occurrence of errors of perceived distance. *Perception* & *Psychophysics 25*, 2-11.

Hochberg, J. (1974): Higher-order stimuli and inter-response coupling in the perception of the visual World, in: MacLeod, R. B. & Pick, H. L. (eds.) (1974): *Perception: Essays in Honor of J J Gibson,* 17- 39. Ithaca, NY: Cornell University Press.

Kanizsa, G. (1955): Margini quasi-percettivi in campi con stimolazione omogenea. *Rivista di Psicologia 49* (I), 7-30.

Korte, A. (1915): Kinematoskopische Untersuchungen. *Zeitschrift für Psychologie 72*, 193-296.

Kubovy, M. (2003): Phenomenology, psychological, in: Nadel, L. (ed.): *Encyclopedia of cognitive science*, 579–586. Houndmills, Basingstoke, Hampshire, UK: Nature Publishing Group.

Kubovy, M. & Gepshtein, S. (2003): Grouping in space and in space-time: An exercise in phenomenological psychophysics, in: Kimchi, R., Behrmann, M. & Olson C. R. (eds.): *Perceptual organization in vision: Behavioral and neural perspectives*, 45–86. Mahwah, NJ, USA: Erlbaum.

McConkie, A. B. & Farber, J. M. (1979): Relation between perceived depth and perceived motion in uniform flow fields. *Journal of Experimental Psychology: Human Perception and Performance 5*, 501-508.

Metelli, F. (1975): On the Visual Perception of Transparency, in: Flores D'Arcais, G. B.(ed.): *Studies in Perception: Festschrift for Fabio Metelli*, 445-487). Firenze: Martello Giunti Editore.

Michotte, A. (1954): *La perception de la causalité.* Louvain: Béatrice Nauwclaerts.
Morinaga, S. (1941): Beobachtungen über Grundlagen und Wirkungen anschaulich gleichmäßiger Breite. *Archiv für die gesamte Psychologie 110,* 309-348.
Norman, J. (2002): Two visual systems and two theories of perception: An attempt to reconcile the constructivist and ecological approach. *Behavioral and Brain Sciences 25*, 73-144.
Reed, E. S. (1987): Why do things look as they do? The implications of J.J. Gibson's 'The ecological approach to visual perception', in: Costall A. & Still A. (eds.) (1987): *Cognitive psychology in question*, 90-114. New York: St. Martin's Press.
Rock, I. (1977): In defense of unconscious inference, in: Epstein, W. (ed.) (1977): *Stability and Constancy in Visual Perception: Mechanism and Processes,* 321-373. New York: John Wiley.
Shaw, R. & Bransford, J. (1977): Introduction: psychological approaches to the problem of knowledge, in: Shaw, R. & Bransford J. (eds.) (1977): *Perceiving, Acting and Knowing*, Hillsdale, NJ: Lawrence Erlbaum.
Turvey, M. (1975): Perspectives in vision: conception of perception, in: Duane, D. & Rawson, M. (eds.) (1975) : *Reading. Perception and Language.* Baltimore, MD: York
Turvey, M. (1977): Contrasting orientations to the theory of visual information processing. *Psychological Review 84*, 67-88.
Ullman, S. (1980): Against direct perception. *Behavioral and Brain Sciences 3*, 373-381.
Wertheimer, M. (1923): Untersuchungen zur Lehre von der Gestalt. *Psychologische Forschung 4*, 301-350.

Ugo Savardi, born 1953, graduated 1976 in Experimental Psychology at the University of Padua, 1978 visiting researcher at the Experimental Psychology Lab, University of Sussex, 1984 researcher at the University of Padua and 2001 associate professor at in the University of Verona. He is currently full professor of General Psychology at the University of Verona (Department of Psychology and Cultural Anthropology). His main research interests are in the theoretical and methodological foundations of experimental phenomenology, the direct perception of relationships (similarity, contrariety, diversity), the perception of space and pictorial space perception.
Address: Department of Philosophy, Pedagogy and Psychology, University of Verona, via S. Francesco 22, 37 1 29 Verona, Italy.

Ivana Bianchi, born 1971, graduated in Psychology at the University of Padua, Ph.D. in Psychology at the University of Pavia-Milan, postdoc at the University of Verona, and is now associate professor of General Psychology at the University of Macerata. Her main research interests are in the field of the Experimental phenomenology of perception, in particular she is currently working on the perception of contrariety between visual stimuli and on naïve optics and mirror perception. She has spent some research periods in the USA working with Michael Kubovy (University of Virginia) and in the UK with Marco Bertamini (University of Liverpool).
Address (corresponding author): Department of Educational Sciences, University of Macerata, Polo Bertelli, Contrada Vallebona, 62100 Macerata, Italy.
E-Mail: ivana.bianchi@unimc.it