CONTRARIETY AS A PERCEPTUAL RELATIONSHIP

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The main hypothesis which our work is based on (see Bianchi & Savardi, 2008a) is that contrariety is a *basic perceptual relationship.* It is a self-organized perceptual structure just like other kinds of perceptual relationships traditionally studied by gestalt psychologists (for example, figure/ground organization, unilaterality of boundaries, amodal completion, perception of identity in different spatial and temporal conditions, perception of unity, perception of causality, perceptual constancy, perception of similarity between patterns or figures etc.).

This, we believe, is true despite the fact that contrariety does not belong to the classic research themes developed by gestalt psychologists and that the study of this relationship, since the seventies, has been instead developed exclusively within the field of linguistics and psycholinguistics (e.g. Jones, 2002; Leech, 1974; Lyons, 1977; Croft & Cruse, 2004; Cruse, 1986, 2000; Fellbaum, 1995; Mettinger, 1994; Murphy & Andrew, 1993; Paradis, 1997, 2000a, 2000b, 2001; Willners & Paradis, 2006). This lack of investigation into *the perceptual conditions* underlying contrariety occurred even though von Ehrenfels (1890), as we'll see, included this relationship in the set of Gestalt qualities, and even though a very considerable work was developed by Ogden in the thirties showing the need to base the linguistic study of opposites on their underlying phenomenal structure (Ogden, 1932).

To be brief, we suggest that extending the need to "ground" cognition in perception and action (see Coventry & Garrod, 2004; Pecher & Zwaan, 2005) to the case of antonyms will help to understand the reason for the 'unique status' of this relationship in human language. This would simply reflect the fact that contrariety is a basic principle of organization in perception.

Our task, as psychologists of perception, is to seek the "phenomenological laws of contrariety" by means of experiments conducted on various kinds of phenomena showing the characteristics of the structures we perceive as being "contraries". This is how we did it: we gathered many observations from the literature and we started planning a wide range of experiments to be used (as our maestro Paolo Bozzi used to say) as "pieces of reasoning". These experiments resulted in a great deal of data which helped us to understand whether any "rule" about the perception of contraries would emerge.

In this paper we will start with the questions which originated our experiments and observations. We will discuss the main results obtained from empirical investigations or based on insights gleaned from literature on the subject. We will then briefly mention further extensions that we believe are worth considering in order to develop this first series of studies.

1) Are there any Indications that Contrariety is a Basic Structure for Perceptual Organization?

There are at least three ways of proving the hypothesis that contrariety is a basic perceptual structure.

A) Philogenetic Observations

An initial series of considerations can be derived from the literature. Namely, by considering that:

a) the relevance of contrariety when organizing our *perceptual experiences* was clearly described by Pre-socratic philosophers (Thales, Anaxagoras, Anaximenes, Heraclitus) where contrariety was presented as a primitive ontological principle for the existence of the empirical world;

b) contrariety played a basic role in the "Categories", where Aristotle presented what can be considered the first attempt at classification of empirical reality in western scientific tradition. This classification was made by taking into account the *perceptual qualities of the world.* In fact, Aristotle based his classification mostly on the directly perceived identity of things, i.e. on self–evident features. If one considers the criteria used by Aristotle when he was deciding whether to include something in one class or another or to create a different class, one discovers that these criteria were explicitly concerned with the identification of *common* and *contrary features.* Contrariety was the key relationship when organizing any phenomenal variation. This is a very thought provoking suggestion for cognitive scientists interested in understanding natural classification processes (see Savardi & Bianchi, 1996; 1997, 141–164);

c) contrariety was not only referred to by these earlier thinkers as a qualitative aspect (space, shape, color, motion, active or passive dispositions...), but also as a quantitative feature. The contraries 'odd-even' were introduced for the first time by the Pythagoreans, as part of a list of 10 contraries (Aristotle, *Metaphysics*, A 5 985b 22): limited and unlimited, odd and even, one and many, left and right, male and female, still and moving, straight and bent, light and dark, good and bad, square and oblong.

Since the definition of odd and even numbers was figuratively based on a series of visual structures (the square and rectangular gnomons in Fig. 1), we wondered if it is also the case that the contrariety between odd and even is perceptually grounded on the characteristics of these structures. Gnomons are geometric configurations used to construct series of figure-numbers. The gnomonic series show an evident geometric similarity between the figures in the series (geometric aspect). The same series can be described by the number of unity added to the previous shape in each increasing gnomon (the algebraic aspect). As shown in Fig. 1, the series of numbers relative to the square shapes is the series of odd numbers; the one relative to the rectangular or oblong shapes is the series of even numbers.

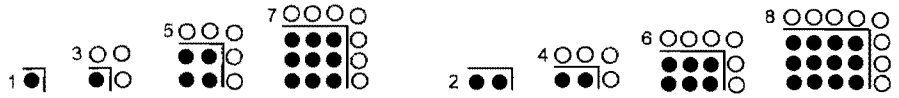

Fig. 1 A representation of the series of square numbers (left) and rectangular or oblong numbers (right). The series is constructed according to the rule of gnomonic increase. The increasing structure, the gnomon, is in white. The algebraic description of each increase corresponds to the series of even and odd numbers.

We developed a simple experiment (Bianchi & Savardi, 2001) in order to verify whether the opposition between "odd" and "even" has a perceptual basis in the structure of square and oblong gnomons. The ten pairs of opposites used by the Pythagoreans were used as ten scales of semantic differential. Adult participants (33 undergraduates from the Faculty of Mathematics and 33 undergraduates from the Faculty of Philosophy) were asked to describe 1) the concepts "odd" and "even"; 2) rectangular and square *dot lattices* (representations of the *square and oblong shapes*); 3) rectangular and square *margins* (representations of the two right angled segments making up the *gnomons)* by means of these scales.

The results demonstrated that "odd" and "even", as words, turned out to be opposite in many of the ten scales, but this semantic description is inverted with respect to that described by the Pythagoreans (*even* is polarized on the positive side of the scales, while *odd* is negative). This confirms the influence of cultural factors in these "conceptual" characterizations of the two contrary types of numbers.

When the description was based on visual structures, the profiles of both dot lattices and margins turned out to coincide for almost all the scales, suggesting that the set of Pythagorean contraries did not directly describe geometric features of square and oblong shapes. The lattices were both described as even, while they were different for oblong-square and one-many. What is interesting is that when considering the gnomonic *margins*, the two shapes were described as contraries in the scale odd-even.

This research suggests, therefore, that contrariety between odd-even is *perceived* when looking at the specific configurations which the Pythagoreans used.

B) The Historical Foundations of the Gestalt Theory of Directly Perceived Relationships.

Another observation supporting the hypothesis that contrariety belongs to the class of basic relationships derives from what Ehrenfels (1890) and Meinong (1882) - the founders of the Gestalt theoretical approach to relationships - had to say on the subject. In both Meinong's (1882, sect. 5) and von Ehrenfels' (1890) works, we can find traces of the relationship of contrariety, discussed together with the other basic relationships: identity, similarity, diversity, and causality. Surprisingly (there is a "stimulus error" hidden here!) neither Meinong nor Ehrenfels treated contrariety as a relationship emerging from the *comparison between two* qualities or objects as they

did for the other relationships mentioned, but instead described it as a relationship of incompatibility, and thus limited to the condition of the *co-presence* of two attributes in the same time and place.

Meinong admitted that contrariety "concerned foundations that are perfectly accessible to being compared. (...).", that "round and square are not incompatible as such or by themselves (...) The round table is perfectly compatible with the square box...." and even that "a round thing can be transformed into a square thing" (Meinong 1882, in Grossmann (1974), 27). He admitted these conditions were different from the attribution of "both qualities to the same thing at the same time", but in the end his analysis (and definition) referred to this latter condition. He consistently treated contrariety more specifically in terms of "incompatibility" and arrived at syllogisms, the deductive process, and the Principle of Non-Contradiction.

Christian von Ehrenfels, while agreeing with Meinong in not considering this *as a comparison relationship* between two qualities or events, clearly disagreed with him when presenting it as "another phenomenon of the highest importance which can be considered a Gestalt quality" (Ehrenfels 1890, in Smith (1988),102). Thus he reintegrated it into the class which included other directly perceived relationships (sameness, similarity, causality, etc.).

It must be noted, however, that he still limited himself to looking at contrariety through the keyhole of the principle of non-contradiction (although redefined in its psychological guise) failing to examine the various ways in which contrariety yields itself perceptually.

C) Ontogenetic Observations (Space Perception in the Ganzfeld).

A third area where we found support for our hypothesis concerns the experiences of observers in the Ganzfeld. Perception in the Ganzfeld can be considered the most basic perception that a human being can have in terms of simplicity in the stimulation condition. No variations (no chromatic contrast) are in fact present at the stimulus level and the corresponding experience can be considered as the minimum perceptual organization (Gibson, 1979, it. transl. 239; Kanizsa, 1980, 214; Masin, 1989, 29). We analyzed the reports referred to by Metzger (1930) to understand if this very simple and maximally invariant perceptual experience succeeds in definitively erasing contrariety from the observer's perceptual experience. Of course, the same analysis might be extended to the studies on the Ganzfeld which came after Metzger's research, in order to strengthen the validity of the statement. However, it is worth noting that the experimental apparatus varied, even significantly, in subsequent studies (see, for instance Avant, 1965; Cohen, 1956, 1957; Gibson & Waddel, 1952; Hochberg, Triebel & Seaman, 1951; Miller & Hall, 1962; Miller & Ludvig, 1960), but this did not lead to significant changes in the perceptual experiences reported.

The analysis of Metzger's reports (see Bianchi & Savardi, 2002; 2008a, 50-54) revealed that variations are still perceived and that these variations are formed according to contrariety. For example, they refer to fog being thicker vs. sparser

when moving away from vs. towards the observer; space filled with fog vs. empty transparent space; big vs. very little figures in motion; straight vs. curved surfaces: widening vs. narrowing of space; compact vs. flexible surfaces.... Notice that in stating the presence of contraries, we were not simply referring to the use of opposite terms but contrariety had been identified by focusing on the characteristics of the perceptual content.

Thus, contraries are perceived by observers even when the most primitive meaning of "perception" is considered (i.e. given the simplest possible visual structure).

2. Is Contrariety a Spatial Relationship?

Once we found some elements supporting our first hypothesis, we asked ourselves where an investigation of contrariety as a perceptual relationship could significantly begin (i.e. where the influence of cultural aspects is weaker). We decided to start with an analysis of spatial properties. Four areas of investigation were considered.

A) The Phenomenal Structure of the Basic Contrary Properties of Space

What are we referring to when we say that we perceive something as curved, straight, wide or narrow? An initial area of investigation concerned the relationship perceived between variations of 37 pairs of spatial contraries (Savardi & Bianchi, 2000; Bianchi & Savardi, 2008a, 50-77; Savardi, Bianchi & Kubovy, in preparation).

Given that we intended to come up with a general description of the perception of ecological space, in both experiments participants were asked to focus on as many different spatial experiences concerning daily environments they could think of. They were asked to look at things around them - in the room and through the windows - and also to refer to objects or environments they could not see at that moment (i.e. the staircase outside the room, or traveling on an underground train, or standing in an elevator, or on top of a hill....) while making sure that all the members of the group understood and "shared" the same spatial reference.

In order to understand whether the structure of all the variations of a property from one pole to its contrary was the same for all 37 pairs, we asked participants to give quantitative and qualitative descriptions of the two contrary poles and the intermediate region.

In the *quantitative task*, participants were presented with bars representing the 37 spatial dimensions (see for instance Fig. 2) and were asked to think of the space between these contrary properties as a representation of all visual experiences that are variations of these two properties. (For example, everything you perceive as 'small', having different levels of 'smallness'; everything you perceive as 'big', having different levels of 'bigness'; and everything you would call 'neither big nor small', considering, also in this case, if different levels of intermediateness are present.) In top first bar they marked a line that divided the space between 'small' and 'large' in two to show how many things between them they would call 'small' and how many would be called 'large'. In the bottom bar they marked two lines, on either side of

the line drawn in the first row, to indicate how many things they would call 'neither small nor large'.

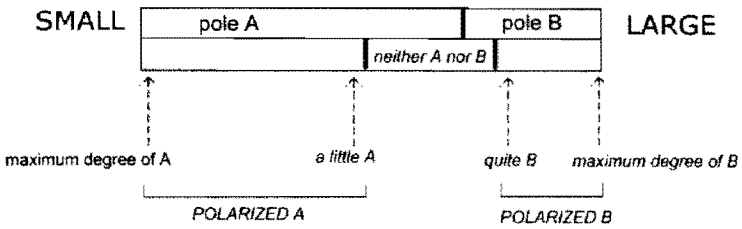

Fig 2. Example of the table used in experiment 1. The thicker lines simulate participants' responses; broken lines and arrows show the measurements obtained by participants' responses.

In the qualitative task, participants were asked to describe whether their perception of each pole consisted of a range of different experiences (bounded or unbounded) or of properties referring to individual experiences. In the case of intermediates, participants were asked to define, for each dimension, the existence or non-existence of properties being 'neither one pole nor the other' - and in that case, to describe them in terms of a range of properties or a single property.

Different structures emerged from the data from these two experiments and based on
- the asymmetry/symmetry of the two poles,
- the presence/absence, extension and anisotropy of intermediates
- the fact that each property (poles and intermediates) refers to a single property or to a range of properties (bounded or unbounded).

We proposed representing these structures by means of three curves describing each dimension (see Fig. 3).

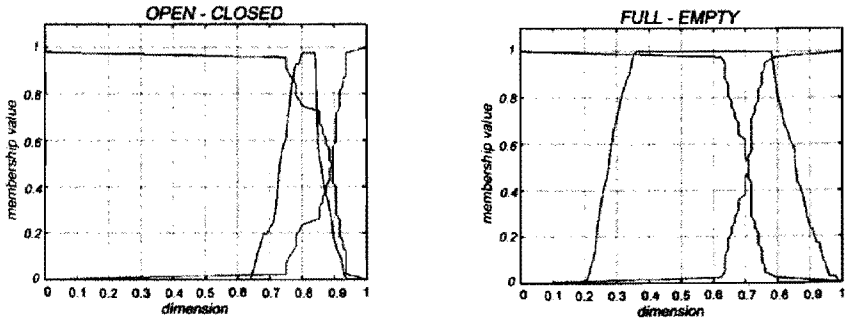

Fig. 3 - Example of 2 different fuzzy structures. The three curves refer to the phenomenological description of the two contrary properties and of the intermediate region. The extension of each curve in the x axis expresses the proportion covered by each component. The shape of each function (reaching 1 or close to 1 in the y axis) represents whether they are single properties or bounded or unbounded ranges of properties (from Bianchi & Savardi, 2008a, 77).

We think that this investigation can be extended to all perceptual properties (not only spatial) as well as to actions. This is in fact one of the developments in our research project in the very near future.

B) Contrariety Perceived Between Simple Geometric Figures.

In prototype studies dealing with relationships as perceptual data (Goldmeier, 1936; Medin, Goldston & Gentner, 1990; Palmer, 1978; Rock, 1973; Tversky, 1977), recognition tasks and simple visual configurations were used in order to identify the rules underlying the perception of two configurations as similar or different. We used essentially the same methods to investigate the characteristics of the pair of figures which people recognize and describe as contrary and how they differ from the pairs recognized and described as similar or different (Savardi & Bianchi, 2000; see also Bianchi & Savardi, 2006; 2008a, sections 4.1, 5.1 and 5.2). We studied various transformations, with regard to shape (equilateral vs. elongated, rounded vs. angular); size (small vs. large); surface (textured vs. empty) and orientation (vertical vs. horizontal, figures pointing/not pointing in a direction). Shape, Orientation, Surface, and Size can be considered the basic properties of a figure. They are the same Wertheimer used in 1923 to study the effect of similarity in visual organization. Four experiments were carried out, with both adult and child participants:

- Experiment 1: 50 children aged 7-8 and 50 undergraduates were given 16 figures (Fig. 4), in random order, and asked to draw the contrary figure.

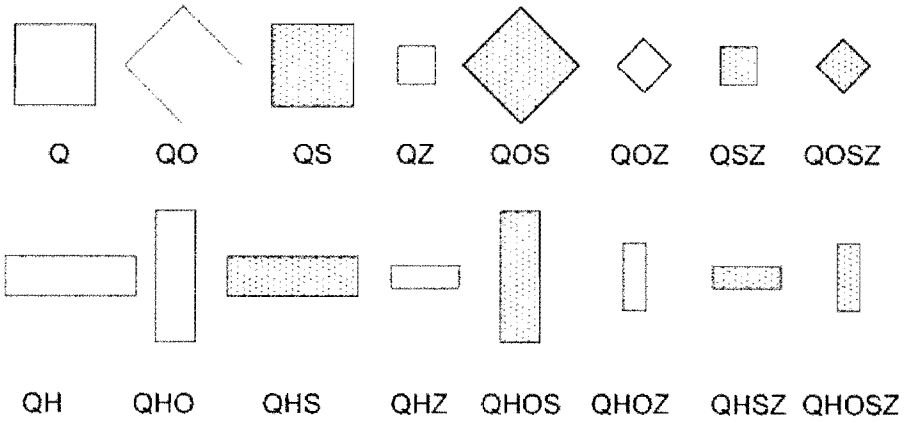

Fig. 4 The 16 stimuli used in the experiment 1. The initials indicate the type of variation (Shape = H; Orientation = O; Surface = S, Size = Z) applied to a square (Q).

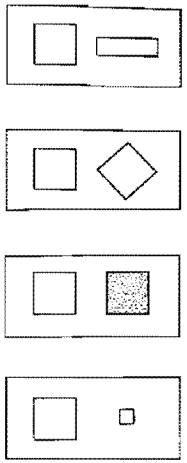

Fig. 5 One of the 16 sets used in experiment 2. The standard figure of each set is on the left of each pair and remains constant within the set.

Experiment 2: 50 children aged 6-8 and 70 undergraduate students were given 16 sets of four pairs of figures and asked to rank them from the most contrary to the least contrary (Fig. 5 presents one of the 16 sets used).

- Experiment 3: 60 undergraduates divided into 2 groups were presented with 14 pairs of directionally oriented figures, each one presenting one of the 6 initial figures on the left and one of its variations on the right (variations of 1 to 3 properties). The pairs were presented on a computer screen in random order (3 trials for each pair). The task consisted of rating the degree of contrariety (group 1) or of diversity (group 2) perceived between the two figures of each pair on a min-max scale.

- Experiment 4: 50 undergraduates, divided into 10 inter-observational groups, were presented with 3 series of 14 pairs (the same 14 variations as in experiment 3 – see Fig. 6). Participants were asked to *classify* each pair by assigning it to the class of "similar figures", "contrary figures" or "different figures" and then to *rank* the pairs within each class (from maximum to minimum degree).

What did we learn about contrariety from these studies? In brief:

I) orientation transformations were associated with perception of evident contrariety. This was found particularly in the case of axis transformation with non-directionally oriented figures and direction transformations with directionally oriented figures;

II) a general non-additive effect of combined transformations on the perception of contrariety was found, while an additive effect was associated with the perception of diversity. Figure 8 (which refers to experiment 4, but is useful in terms of the main results for the other experiments too), shows that high rankings of contrariety are present in direction transformations (with the further addition of size increase admitted) while combined transformations of shape and axis or shape-axis-size are associated with the perception of diversity rather than contrariety;

III) various anisotropies were identified, i.e. contrariety perceived in reverse transformations is not necessarily the same (as transformations from small to large and vice versa, from empty surface to filled-in surface and vice versa revealed).

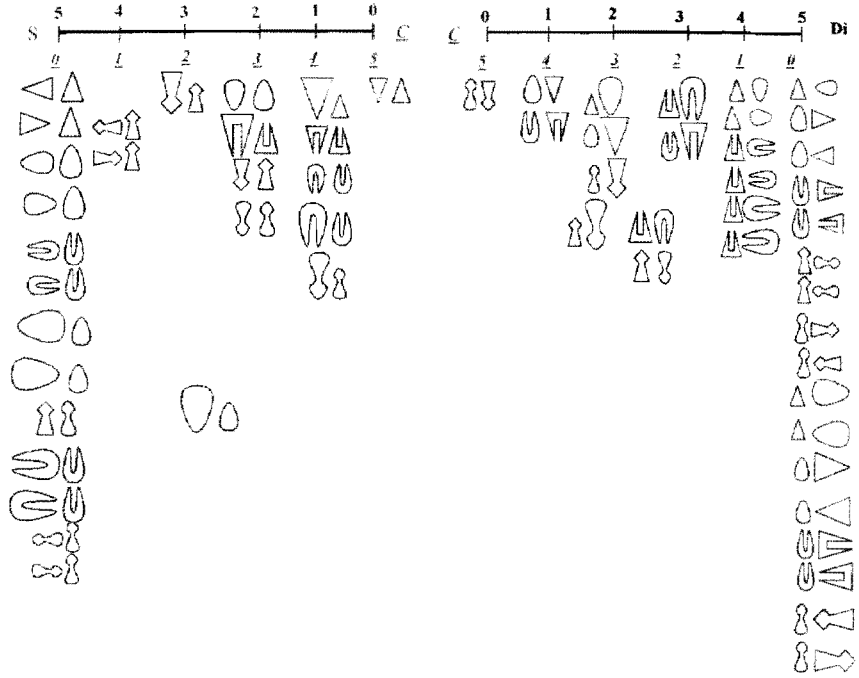

Fig. 6 Classification of the 3 series of 14 pairs of figures (used in experiment 4) in terms of "contrariety" (C), "similarity" (S) and "diversity" (Di), for the 5 groups.

C) Contrariety Perceived Between Simple Gestures.

C) The body of the observer and the bodies of other subjects are part of the ecological environment, as well as millions of other species of animate or inanimate objects. In three different experiments we studied contrariety between postures and gestures using imitating tasks as control (Savardi & Bianchi, 2000, 2001; see also Bianchi & Savardi, 2008a, section 4.2).

- Experiment 1: 23 children aged 6 to 8 were presented with 14 simple gestures (performed by a model using arms and legs) and were asked to do "the same" or " the contrary". Different positions of the subject with respect to the model (in front, behind, on the left, on the right) and different orientations (either both facing the same way, or facing opposite directions (Fig. 7) were considered.

- Experiment 2: 36 children, aged 6, were positioned in front of and facing the model and were asked to do "the same" and "the contrary" for 48 gestures. The gestures differed in terms of lateralization (right or left arm), direction of gesture (up, down, on the left , on the right, in front, behind), position of the arm (extended or flexed), the position of the hand (open or closed fist).

- Experiment 3: the same as Experiment 2, with adult participants (50 undergraduates).

Results revealed that both imitation and contrary responses were based on exocentric space or on relative interpersonal space, not on egocentric coordinates.

In doing the "contrary gestures", responses changed based on the position of the subject and of the gestures, but in agreement with the principle of preserving the general "gestalt" of the gesture and changing the exocentric direction into its contrary (they almost never changed a gesture done with the arm to one done with the leg and they very rarely added other transformations, for example bent arm-straight arm or open hand-closed fist). In fact they changed only one or two properties. For gestures in the sagittal direction, subjects sometimes replaced the exocentric direction transformation with a lateralization transformation (left vs. right arm). This again was consistent with predictions based on exocentric (not egocentric) space and with the fact that a violation of the general gestalt would be implied in a front-behind transformation.

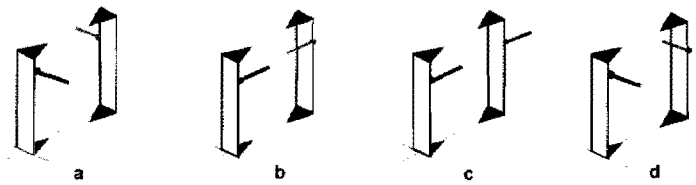

Fig. 7 - An example of gestures studied and of participants' responses. The model is on the left, with a black "arm".
Conditions a and b represent two examples of the most frequent contrary gesture produced. In the case where simply producing the contrary direction in the exocentric space would imply an evident violation of the "shape" of the initial gesture (as in conditions c and d), participants did not produce these responses and simply used the other arm, thus maintaining the shape of the gesture.

D) Contrariety Perceived in Mirror Images.

There is an intriguing variant of the contrariety between human postures and gestures in the relationship that observers perceive when looking at their or at another person's reflection in mirrors. We analyzed this in three experiments (Bianchi & Savardi, 2008b; Savardi & Bianchi, 2005; see also Bianchi & Savardi, 2008a, chapter 6):

- Experiment 1: 46 undergraduates (divided into small inter-observational groups and introduced into a mirror room) were asked to look at four different reflections in single and double (90°) plane mirrors, with different mirror positions and making different gestures. They were asked to say whether the reflections were identical, similar, different or opposite in terms of global relationship, orientation and lateralization (left-right arm).

- Experiment 2: 50 undergraduates, participated individually in the same mirror room as experiment 1. They were presented with 8 sets of reflections, resulting from combinations of mirrors set in different positions and with the subject performing different gestures (moving or static). A series of questions were asked aiming at

finding which reflections participants perceived as being identical, similar, different or contrary with respect to their gestures.

- Experiment 3: the same as experiment 2, but participants (20 undergraduates) were now looking at and describing the relationship perceived between the gestures of another person in front of the mirror and that person's reflection.

Results revealed that similarity and contrariety were the two relationships most frequently described in comparisons between virtual and real bodies. In contrast to the emphasis in the literature on left-right reversal in single plane mirrors, our results demonstrated the importance of the exocentric frame of reference in influencing how observers react to their reflections.

When contrariety was experienced, it was attributed mainly to contrariety in the exocentric frame of reference.

The left-right reversal was not commonly experienced, although it was reported more frequently when the mirror was placed in front.

3. Further questions and studies

Other questions and relative investigations which we are currently working on and which are at the stage of pilot experiments concern the following aspects:

I) How Does Contrariety Change in Terms of Perceptual Anchoring?

In the experiments carried out up to now, we noticed that responses vary partially (but with a high degree of agreement between subjects) when production tasks and recognition tasks are compared. For instance, the efficacy of the change in orientation (direction and axis) was consistent over the two tasks, both with simple geometric figures and body gestures, but changing the size or color of the figures was a more frequent transformation in production tasks than in recognition tasks. In recognition tasks the outcome of these transformations was less likely to be perceived as contrary. Because of this difference between the two tasks, it is very important to use both of them when studying "contrariety" in perceptual, motor and cognitive processes. If we only focus on production tasks we will not be able to fully understand how the recognition of contrariety works. On the other hand, using only recognition tasks would not allow us to understand what people do in order to transform something into its contrary.

II) Is Contrariety a Significant Component of Symmetry Perception?

The close association between perception of contrariety and axis or direction spatial transformation that emerged from the sets of experiments related to simple geometric figures and the study of mirror reflections with human bodies suggest that recognition of contrariety, together with identity recognition, are the two key components in recognition of a configuration as symmetrical.

A pilot study carried out with simple line drawing configurations confirms this hypothesis (see Bianchi & Savardi, 2008a, section 8.1).

III) Are Contraries Basic Structures in Auditory Perception as Well?

Expert participants listening to very short excerpts of jazz music demonstrated high inter-subject agreement in both detailed and global descriptions of the basic contrary properties within the piece of music and of the points in the music where a property changed to its contrary (Bianchi, Savardi & Cattazzo, 2002; see also Bianchi & Savardi, 2008a, section 8.3). A study of naïve subjects is also worth considering.

IV) Are Two Opposites Unidimensional?

We need to consider whether two contrary properties are part of the same dimension as 'complementary properties' or not. For example, it is tempting to imagine that "small" and "large" lie along the same continuum and are simply complementary extremes of the dimension "size". In one case we express the size of the object in terms of how *small* it is and in the other case in terms of how *large* it is. These might be two alternative ways of measuring the same characteristic (length), but it might also be that the two properties do in fact refer to different characteristics which are not part of the same linear continuum. We started to analyze this on the basis of metrics constructed by means of the recognition of the degree of a certain property in a sample of different objects (see Burro, Savardi & Bianchi, 2008). The independence of the scales emerging from a first set of data referred to the pairs high/low, small/big, large/narrow and long/short suggests this is an interesting aspect to investigate.

V) Can the Different Perceptual Structures of Contrary Properties Predict the "Rules" of Negation in Common Language?

If I describe something (e.g. a building) as being "not big", is there an inter-subject agreement on the "size" of the object we are talking about? And what if you hear someone saying that "the door is not closed"? What do you expect? That the door is ajar, wide open or open to around 30°, 45°, 90°? We hypothesize that the descriptive use of negation can be easily predicted if we take into account the perceptual structure of the dimensions to which the negated property belongs.

First findings in a pilot experiment suggested that, despite the fact that responses seemed to depend in part on the specific event and situation being considered, specific biases also seemed to emerge with pairs of contraries which had a similar structure (see Bianchi & Savardi, 2008a, 80-85).

Conclusive remarks

Some evidence emerging from the analysis of "contraries" in psychology today indicate the lack of an analysis of contrariety as a directly perceived relationship within cognitive sciences. By shifting attention from the analysis of antonyms as

a linguistic structure to the analysis of perceptual conditions on which cognition is grounded, new questions and new methods of analyzing the issue emerge. This is what this presentation has tried to show, even though briefly.

Among the necessary conditions for an empirical "theory" to be defined is the availability of a great deal of experimental data and the emergence of some rules in the phenomena being studied. The experiments carried out up to now have demonstrated that contrariety has a particular place in the set of "perceptual relationships", alongside sameness, similarity and diversity. Moreover, rules have been found, not only in terms of individual fields of investigation but also between different fields. This suggest that perceptual laws of contrariety can be formulated considering the term "law" or "principle" in the phenomenological sense according to Wertheimer (see Savardi & Bianchi, 2000; Bianchi & Savardi, 2008a, chapter 7). We recommend the papers mentioned in this paper to those who want further information on the research conducted and on the principles identified.

Summary

This paper presents a brief overview of an experimental research project developed by the authors over the last 10 years. The project investigates contrariety in terms of perceptual experience. The methods and results of our research will be not analyzed individually, but rather discussed in general terms, with respect to some main questions. These questions will help to explain and bring together the various observations and studies, thus demonstrating the hypotheses forming the basis of this research project.

Keywords: Contrariety, perceptual relationships, grounding opposition in perception.

Zusammenfassung

Der vorliegende Beitrag skizziert ein von den Autoren in den letzten 10 Jahren entwickeltes experimentelles Forschungsprojekt zum Thema „Gegensätzlichkeit" im Bereich der Wahrnehmung. Dabei werden die Forschungsmethoden und Ergebnisse nicht im Detail dargelegt, sondern hinsichtlich der Hauptpunkte in ihren Grundbegriffen erörtert. Verschiedene Beobachtungen und Studien lassen sich so übergreifend erklären und die zu Grunde liegenden Forschungshypothesen veranschaulichen.

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COORDINATION DYNAMICS OF THE COMPLEMENTARY NATURE

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1. Prolegomenon

This essay introduces a novel perspective of contrariety that we call the "philosophy of complementary pairs" (Kelso & Engstrøm, 2006). Complementary pairs are those things, events and processes in nature that may appear to be contraries but are mutually related and inextricably connected. Such complementary aspects are dynamic and relational; both aspects of a complementary pair are required for an exhaustive account of phenomena. The symbol of the complementary nature relating contrarieties, opposites and their kin is the tilde or squiggle (~). A most intriguing and motivating aspect of this perspective is that it has been successfully grounded in the science of coordination dynamics, and is closely tied to its signature set of phenomena, especially *metastability.* In this context, we study the significance of metastability to complementary contraries and vice-versa. Interest in metastability both as an important observable phenomenon and as a useful conceptual framework is growing rapidly, especially in the neurosciences where it appears to be the result of the brain's self-organizing nature. According to coordination dynamics, nonlinear coupling among heterogeneous individual coordinating elements is necessary to generate the broad range of observable brain~behavior that includes self-organization, pattern formation, multistability, transitions, switching without switches, hysteresis and metastability (Kelso, 1991, 1995). In the so-called extended HKB model of coordination dynamics (Kelso, Delcolle & Schöner, 1990) metastability is produced as a result of broken symmetry in the relative phase equation that models patterns of coordination between nonlinearly coupled, nonlinear oscillators (Haken, Kelso & Bunz, 1985; Kelso, et al., 1990; Schöner, Haken & Kelso, 1986). Behaviorally speaking, the metastable regime of coordination dynamics appears to reconcile the tendency of specialized brain regions to express autonomy (segregation) and the simultaneous tendency for those same regions to work together as synergies (integration). While integration~segregation is an important and representative complementary pair, it is just one of many complementary pairs to emerge in the science of coordination dynamics.

2. Complementary Pairs

The human sense of contrariety is ubiquitous. Human experience teems with perceived contraries, like whole~part, self~other, nature~nurture and body~mind. Because contrariety is so pervasive in human experience, it has been widely believed throughout history that understanding its basic nature should lead to a deeper understanding of how nature works. As such, interpretations of contrariety have played an important role in the history of ideas. For example, the dualist stance