

# GESTALT



# THEORY

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## EDITORIAL

In Gestalt psychology the study of relationships from a perceptual point of view has been an important issue since the very beginning. Given that the direct perception of relationships is precisely what the definition of "Gestalt qualities" (Ehrenfels, 1890) recognizes, we might even say that this formed part of the foundation of Gestalt theory itself. It has also been a fundamental issue in experimental investigation ever since Wertheimer's work on stroboscopic motion (1912) and the perceptual laws of organization (1923). Indeed almost all the initial work carried out using this approach, as well as later work with a gestalt-like approach, reveal the influence that relationships between individual features or parts of a configuration have on the global structure perceived. Just think of chromatic contrast, the various laws regarding the perception of motion, the unification and segregation of static and dynamic elements or optical-geometric illusions for example. Significant contributions to this area of research were made by Italian scholars working in the tradition of Gestalt psychology using an approach that was later identified as the Experimental Phenomenology of Perception. Metelli's model of achromatic transparency (1974), Minguzzi's analysis of the "braking effect" (1961) and Bozzi's contribution to "Unity, Identity, Causality" (1969) are just some examples.

The papers presented in this issue aim to show exactly what contributions have been made in recent years to support a perceptually based theory of relationships and which methodologies have been used<sup>1</sup>. This will be demonstrated in the first part of this issue of the Journal by means of a variety of articles which consider formal approaches and experimental findings on specific relationships with a twofold intention: a) presenting up-to-date critical studies and experimental contributions concerning specific domains of research, which will help to make clear the role that specific relationships have in perceptual organization; b) showing fruitful new ground that research on the issue has covered over the past few years.

All of the first three papers presented in this issue focus on a relationship which has been almost totally forgotten by Gestalt psychologists. A great deal of attention has been given to the perception of identity with regard to various kinds of phenomena;

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<sup>1</sup> The contributions presented in this issue are article versions of some of the contributions presented to the Perception Session of the 15th international GTA Conference Relations and Structures. Developments of Gestalt Theory in Psychology and Adjacent Fields held at the University of Macerata, May 24-27, 2007.

# AN EXPLORATIVE STUDY OF PECULIAR CUE OF RELATIVE DISTANCE IN PERCEPTUAL FOLDING

*Daniela Bressanelli, Manfredo Massironi & Luigi Burigana*

## Introduction

The presented work is an explorative study on a new cue to relative depth, which is specifically associated with phenomenal folding (Massironi, 1988). In 2002 we studied a new perceptual phenomenon: the completion by folding (CBF) (Massironi & Bressanelli, 2002). CBF is a peculiar type of amodal completion which occurs when four quadrilaterals look like a rectangular sheet of paper folded around an interposed rectangle. We founded that the perception of folding is possible even when there are not the conditions for a geometric folding (see figure 1a-c) and even when current models do not foresee such a perceptual solution (Massironi & Bressanelli, 2002).

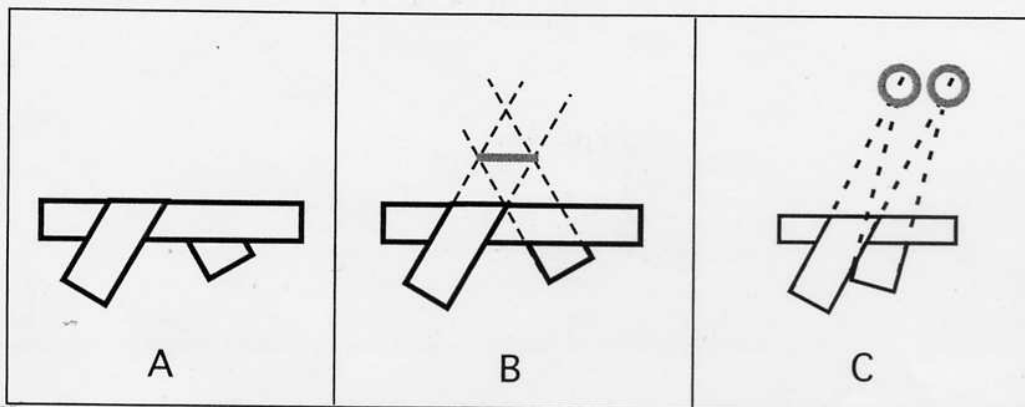


Fig 1

In fact, we have founded a certain degree of tolerance in perceiving the unification with completion in a single folded strip (Figure 1a-c). Folding is seen even when the prolongation of arms do not meet each other, as expected from the phenomenal folding constraints (see Massironi, 1998), or even when they meet each other but forming an angle little than  $90^\circ$ , a case in which, for the relatability principle, amodal completion is not feasible (see Figure 1c) (Kelleman & Shipley, 1991). In the present work we investigate whether such perceptual unification with completion may depend on a 3D interpretation, that is, if the interposed element would appear as a parallelepiped (see figure 2a).

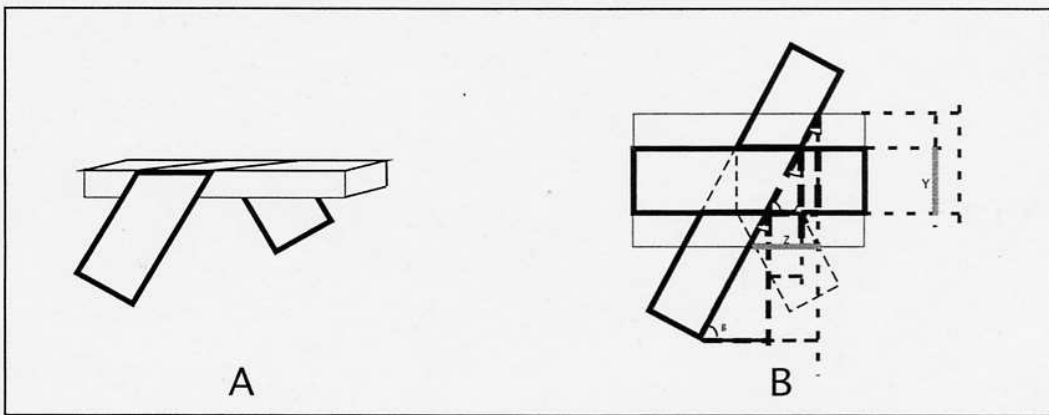


Fig 2

Thus, if the interposed element was a 3D object, then the two arms can meet with unification, as the geometric analysis of 3D hypothesis shown (see figure 2a-b). In this case, the horizontal distance between the two parts may be used as a cue to relative distance because it geometrically depends on the actual width of the parallelepiped (see figure 2b).

### Experiment 1

The aim of Experiment 1 was to test the plausibility of the 3D hypothesis and thus, the presence of perceived depth between the two arms of the strip. Since we have hypothesized a different perceived depth depending on the distance between the two arms and the role of the interposed element on their perceived unification, we manipulated two variables: 1) the degree of horizontal distance between tails and 2) the presence of an interposed element; whereas the size (high and width) of the two arms was kept constant (see figure 3).

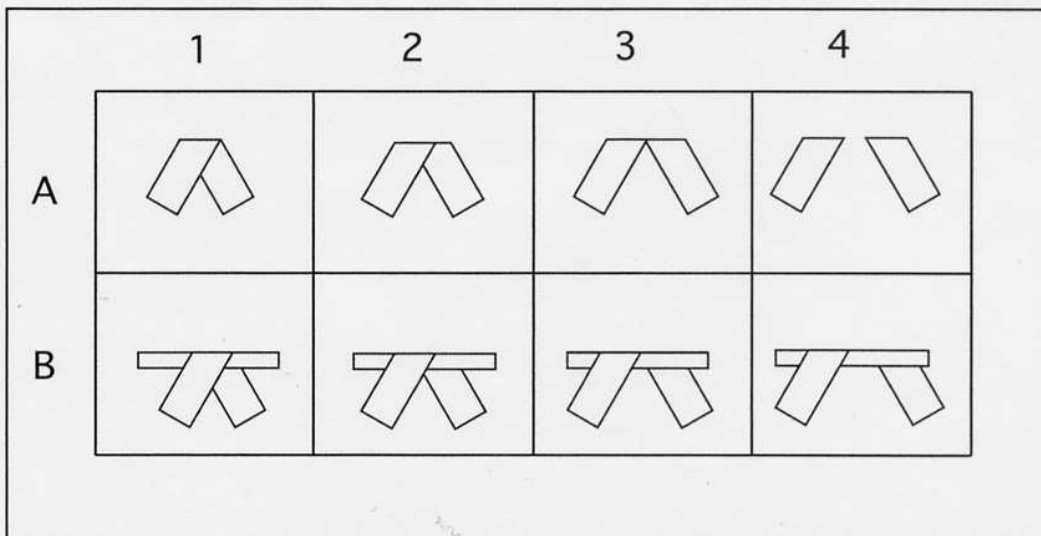


Fig 3

An indirect measure, the “size of constancy effect”, was used in order to demonstrate the presence of the perceived depth in the stimuli. Subjects (N=10) were asked to judge which one of the two arms was perceived longer. The subjects’ task was a forced choice between left/right arms. All subjects saw all stimuli and each stimulus was presented five times tachistoscopically (500ms), in order to avoid any geometrical analysis of the figure. An ANOVA for repeated measure was performed on the data. The two main effects, interposed element ( $p < 0.0001$ ) and horizontal distance ( $p < 0.001$ ), were found to be significantly different revealing that both the manipulated variables have an effect on the size illusion. A post hoc test (Scheffé) was performed on the data revealing that stimulus A3 was judged to be significantly different from stimuli B1 and B2, while stimulus A4 was judged to be different from all others, with the exception of stimulus A3. This means that the right arm, which is hidden by the interposed element, was perceived longer than the left one for stimuli A1, A2, B1, B2, B3, B4. Concluding, results show the dependence of the perceived depth on the horizontal distance between the two arms but when interposed elements permit completion, or at least, for stimuli A, when folding is still possible (A1 and A2) according to the previous study (Massironi & Bressanelli, 2002).

### Experiment 2

The aim of the second experiment was to directly test our hypothesis by which the geometrical horizontal distance between the two visible arms of the strip could be a new cue to relative distance (see on depth cue, Cutting & Vishton, 1995). We tested if the perceived depth would increase as a function of the horizontal distance between the two arms, and if the presence and width of interposed element would have a role on the perceived depth, improving the unification. We manipulated the following two variables: 1) the degree of horizontal distance between the two arms and 2) the width of interposed element, we obtained the experimental stimuli shown in figure 4.

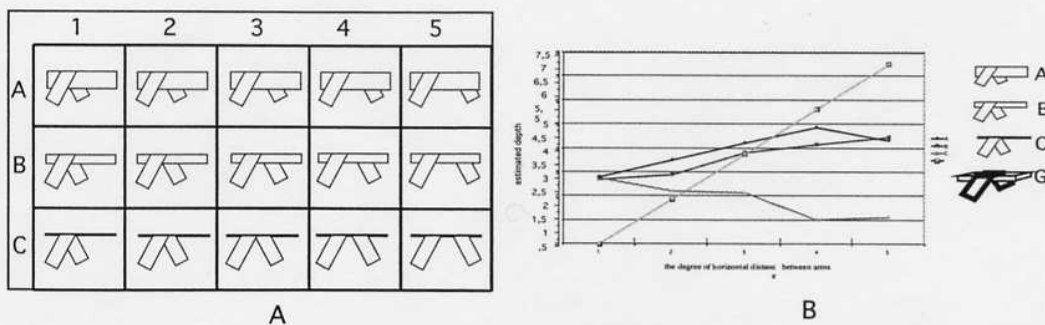


Fig 4

The subjects’ task was to estimate the perceived depth between the two arms on a 10 step scale, where zero represents “to be on the same plane”. All subjects (N=24)

saw all stimuli. An ANOVA was performed on the global data, which shows that the main effect, interposed element ( $p=0.0001$ ), was found to be significant: group A ( $p<0.0001$ ) and B ( $p<0.0001$ ) are significant different from group C (see Figure 4b). A second ANOVA was calculated for each group (A ( $p=0.02$ ) B ( $p<0.02$ ) C ( $p<0.005$ )), which shows the dependence of the perceived depth on the variable horizontal distance. This means that the perceived depth increases when the distance between the arms increases in group A and B, but decreases in group C. This result is in agreement with the previous work on the role of the shape of the interposed element on CBF (Massironi & Bressanelli, 2002). Finally, the post hoc (Tukey test) was calculated for each group, showing a significant difference between stimuli A4 and A1; B5 and B1; C4 and C1, C5 and C1.

### Conclusion

This work presented the results of a preliminary experimental study investigating a geometrical property of pictorial stimuli (called "lateral separation"), which, in suitable conditions, may act as a cue for relative distance in depth. This property may be considered as pertaining to the class of pictorial (monocular and static) depth cues, and is a rather peculiar type, given that it is contingent upon the perceptual emergence of a folding effect in the observational context. This effect in turn is dependent on the presence of conditions for perceptual grouping and amodal completion. Results of these preliminary observations provide first evidence for the real occurrence of the presumed effect. The data shows the possibility that the horizontal distance between the tails can be a new relative cue to distance and confirms the direct dependence of perceived depth on the physical distances of the two arms. If adequately supported by further experimental data, our conjecture might represent a detail of interest for both the theory of depth perception and the theory of perceptual folding and related phenomena.

### Acknowledgements

We thank van Lier for a similar suggestion on 3D interpretation when commenting Massironi & Bressanelli (2002).

### Summary

This work is a widening of findings concerning a peculiar case of amodal completion, the completion by folding. It occurs when four quadrilaterals look like a rectangular sheet of paper folded around an interposed rectangle, even when there are not the conditions for a geometric folding (Massironi & Bressanelli, 2002). In this work a simple geometrical measure, the lateral separation between the left and right visible parts of the strip, was considered as a possible cue to distance, that is, the measure might be a cue to separation in depth between the two parts of the strip. Two experiments were conducted in order to verify the presence of perceived depth separation between the two parts of the strips and the role of the different lateral separations on the depth perception. In experiment 1 we use an indirect measure of depth: the size constancy effect. In experiment 2 we directly rate the apparent separation in depth between the two parts of the folded strip. Results lent support to the experimental hypothesis.

**Keywords:** Shape perception, optical illusion, size illusion.

### **Zusammenfassung**

Die vorliegende Arbeit erweitert die Befunde zu einer besonderen Art von amodaler Ergänzung, der Ergänzung durch Faltung. Diese tritt auf, wenn vier Vierecke wie ein rechteckiges Blatt aussehen, das um ein dazwischen liegendes Rechteck gefaltet wurde, selbst wenn die geometrischen Bedingungen für eine solche Faltung nicht erfüllt sind (Massironi & Bressanelli, 2002). Hier betrachten wir ein einfaches geometrisches Maß, den seitlichen Abstand zwischen links- und rechtseitigen Streifenanteilen, als mögliches Entfernungskriterium, d.h. als ein Maß für die anschauliche Tiefe zwischen den Streifenanteilen. Diese Annahme wurde in zwei Experimenten untersucht: (1) unter Verwendung der Größenkonstanz als indirektem Tiefenmaß und (2) mittels direkter Schätzung des anschaulichen Tiefenabstands zwischen den gefalteten Streifenanteilen. Die Ergebnisse stützen die Versuchshypothese.

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