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A new visual problem: phenomenic folding

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Abstract. It is possible to produce outline drawings that are perceived as representations of sheets or plates folded over themselves. However, only some of the many possible representations are immediately and necessarily perceived as such. Investigations were carried out to find out which elements must be included in a drawing if a subject is to perceive folding. Four necessary, though not individually sufficient, factors were detected. Other factors which are not necessary but which can intensify the perception of folding were also found. The four necessary factors are: (i) the existence of two phenomenically overlapping figures; (ii) at least one side of the upper figure must perfectly coincide with one side of the lower figure, this common side being defined as the folding line; (iii) the two phenomenically overlapping areas must be on the same side of the folding line; (iv) three segments must converge at the ends of the folding line. Some cognitive processes which appear to be involved in the phenomenon are also discussed.

1 Introduction

Graphic images drawn in outline may be produced so as to be immediately perceived as bidimensional surfaces folded over themselves. Figure 1 shows some examples derived from sets of emblems and trademarks drawn in Japan over the centuries. Such configurations raise two main problems. First, assessing the nature of the stimuli which induce an immediate perception of folding, ie the factors that must be present and their interrelation. Second, determining the cognitive processes which give rise to the phenomenon.

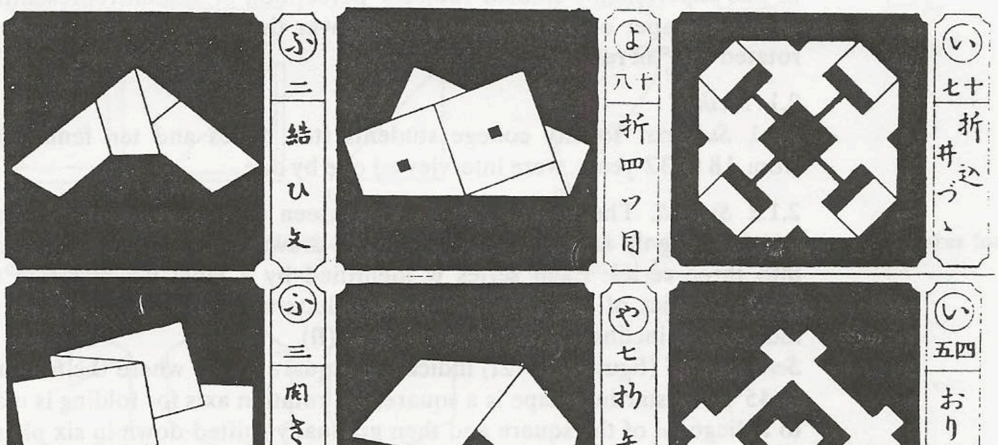


Figure 1. Some emblems by noble Japanese families on their ceremonial gowns (from Matsuya Piece-Goods Store compilation of traditinal Japanese heraldic crests c.1913; available in English as *Japanese Design Motifs* with Introduction by Fumie Adachi (1972, New York: Dover); the emblems shown here are taken from pages 145, 87, 5, 145, 128, and 6 of the book, respectively].

Some aspects of the folding effect may be associated with two phenomena studied by Gestalt psychologists: (i) amodal completion (Metelli 1940, 1960; Michotte et al 1962, 1964; Kanizsa 1981; Kanizsa and Gerbino 1981), and (ii) phenomenic causality (Michotte 1946; Minguzzi 1961; Massironi and Bonaiuto 1966).

Each of the images in figure 1 is perceived as being made out of two parts placed at different depths: one part being in the foreground and the other in the background. The latter seems to continue phenomenically behind the former and then to join with it again in part of its outline. The connection between the two parts induces one to perceive each configuration as being derived from a bidimensional shape which is less articulated, more regular, but still recognizable. One perceives immediately that a part of the bidimensional shape has undergone a rotation, whereas the other part has remained fixed. This rotation, ie the folding, is seen by the observer as the cause of the modification. Massironi and Bonaiuto (1966) have pointed out that this perception actually originates, in the absence of real movements, through the presence of a partial and limited nonhomogeneity or discontinuity in a definite part of a structure which is otherwise homogeneous. The nonhomogeneity is perceived as a consequence of a past event, isolated in space and time, which has induced partial modification in the structure while still keeping it recognizable.

The above-mentioned remarks clearly show that the perception of folding may be conceptually reduced to a set of problems which have already been studied in the field of perception, such as depth perception and the perception of connections between parts of an object. The new aspect of the problem is the phenomenical evidence that the representation of folded sheets necessarily gives to the observer, in other words the fact that it is not a matter of producing separate or related perceptive experiences of depth in space and connections between parts, but a matter of producing a different experience that deserves to be studied as a separate problem. Two experiments were devised in an attempt to define the factors which determine phenomenic folding.

2 Experiment 1

In this experiment I studied subjects' perception of stimuli representing bidimensional sheets of paper or metal plates folded over themselves, in which the folded part was rotated 180° in relation to the fixed part.

2.1 *Method*

2.1.1 *Subjects.* Twenty college students (ten males and ten females), ranging in age from 18 to 32 years, were interviewed one by one.

2.1.2 *Stimuli.* The stimuli comprised sixteen cards (17.5 cm × 25.0 cm), each with a figure taking up an area of about 50 cm² drawn in the middle. The cards were divided into three series. Each series is identified by a label which refers to the structural characteristics of the configuration; the letters define the figure, the numbers (if any) indicate the inclination of the folding line (fl).

Series Sq/45 (figures 2a–2f) indicates a square figure where the folding line is inclined at 45°. The starting shape is a square, the rotation axis for folding is maintained parallel to a diagonal of the square and then gradually shifted down in six phases from the top-left corner to the diagonal line; when they coincide (figure 2f) the two overlapping surfaces collapse into one.

Series Sq/not45 (figures 3a–3f) indicates a square figure where the folding line has an inclination other than 45°. The starting shape is again a square. Two points equidistant from the vertices, p_1 and p_2, are chosen on each of the horizontal sides of the square, and the line connecting them, parallel to the vertical sides, becomes the rotation axis. The result is a figure with two juxtaposed areas (figure 3a). Then, while the point on the upper horizontal remains fixed, the one on the lower horizontal is shifted to the left, in three phases, until it coincides with the bottom-left vertex of the square (figures 3b–3d). The line joining p_1 and p_2 sets the inclination of the rotation axis. Figure 3d shows that, once again, only one visible area is formed.

Series P (figures 4a–4f) indicates a polygon. The folded figure is a hexagon (figures 4a–4c) or a pentagon (figure 4d–4f). One side of either of the two polygons coincides with one side of a phenomenically overlapped triangle. The triangles are different from one another. Figure 4a is a particular case because the sides of the triangle, if unfolded, would become the continuation of two sides of the hexagon.

In the first experiment my aim was to assess the significance of certain components of the configuration concerned:

(i) The regularity of the starting shape (unfolded figure) or of the final shape (folded figure). The action of folding may destroy a 'good' figure or 'make good' a figure that would not be so if unfolded.

(ii) The area ratio between the folded and the fixed part of the figure. Figures 2 and 3 show the progression taking place.

(iii) The number of visible areas resulting from folding. There are one or two in figure 2; one, two, or three in figure 3; and always two in figure 4.

(iv) The position of the rotation axis with regard to the structural features of the starting figure. This axis is either parallel to or coincides with the diagonal of the square (figure 2); parallel to one side of the square (figure 3a); neither parallel to the sides nor to the diagonals (figures 3b–3d); coincides with one side of the hexagon or pentagon (figure 4).

(v) The modal completion of the whole outline of the two surfaces. The outline is totally invisible in figures 2a–2e, partially obstructed in figures 3b–3c, and has parts coinciding, beyond the folding line, in figure 3a.

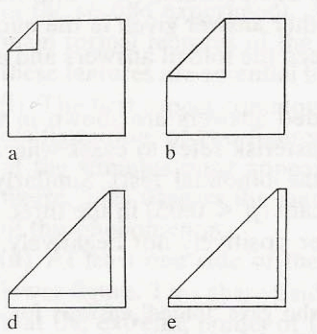


Figure 2. Series Sq/45 stimulus figures for experiment 2.

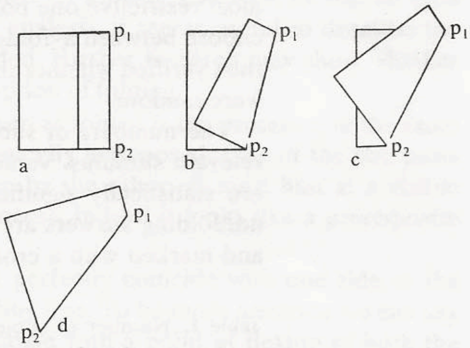


Figure 3. Series Sq/not45 stimulus figures for experiment 1.

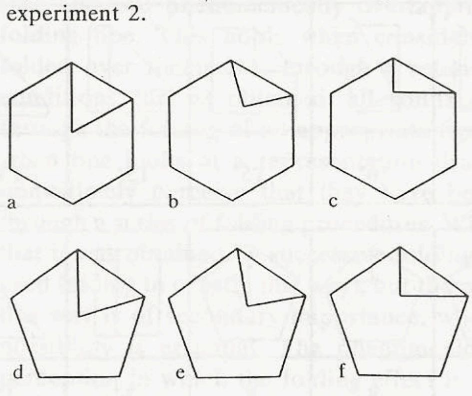


Figure 4. Series P stimulus figures for experiment 1.

Since this was a first explorative approach, no precise hypothesis was made on the influence of the individual aspects, but the test was administered so as to gather useful information on their influence.

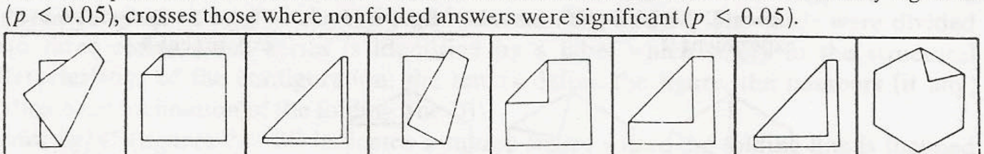
2.1.3 *Procedure.* One stimulus at a time was presented to the subjects, who had to define it through their answers to four questions. No time limit was fixed. The order of the cards, as well as the order of the questions, was chosen at random and was different for each subject. The questions asked of the subjects were the following:
(i) Is it a figure folded over itself?
(ii) Is it a configuration made of two independent overlapping or juxtaposed figures?
(iii) Is it a simple regular or irregular figure (meaning that no modifications can be seen)?
(iv) Other answers?
The subjects had no difficulty in performing this task except for the second question, where the options "overlapping" and "juxtaposed" appeared together. In the second experiment this question was split into two, thereby eliminating those rare cases of indecision.

Once this part of the task had been completed, each subject received again the cards he or she had defined as cases of folding, and was asked to order them according to the intensity of the folding effect. The answers thereby obtained made it possible to rank the stimuli and to verify the level of concordance in the subjects' assessments.

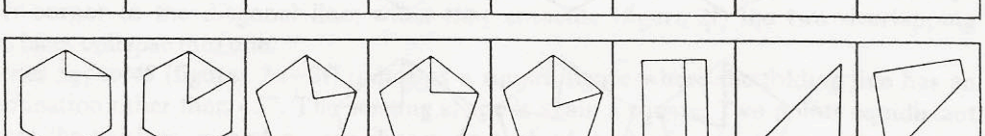
2.2 *Results*
The data were grouped so as to obtain only two values for each stimulus: one representing the number of subjects who reported 'folded' answers, the other the total number of subjects who chose any of the other answers given in the questionnaire. The data thus obtained could be verified by a binomial test. The starting hypothesis was the most restrictive one possible: ie that it was equiprobable ($p = 0.5$) that subjects would choose between a 'folded' answer or any other answer given in the questionnaire. It was then verified whether the differences between the folded answers and any other answers were random.

The numbers of subjects who gave folded answers are shown in table 1 under the relevant stimulus. Values marked with an asterisk refer to cases where folding answers are statistically significant ($p < 0.05$ in the binomial test). Similarly, the number of nonfolding answers are statistically significant ($p < 0.05$) in the three stimuli of table 1 and marked with a cross. Folding is neither positively nor negatively significant for all

Table 1. Number of subjects (out of twenty) who gave 'folded' answers for each of the stimuli used in experiment 1. Asterisks indicate cases where folded answers were statistically significant ($p < 0.05$), crosses those where nonfolded answers were significant ($p < 0.05$).



18^{*}	18^{*}	17^{*}	16^{*}	15^{*}	15^{*}	13	8



8	8	8	8	8	3^{+}	1^{+}	1^{+}

the other stimuli. This suggests that these configurations are somewhat misleading since some subjects perceive them as folded and others as not folded. It may be inferred that in figures 4a–4f there coexist favourable and unfavourable elements for folding.

The chi-square test applied to data from series Sq/45 shows that larger folded areas gave rise to no significant increase in the perception of the phenomenon ($\chi^2 = 0.81$).

The second part of the task performed by the subjects, namely the ranking of the stimuli according to the intensity of the folding effect, was analyzed by means of the Kendall's W concordance test. The aim was to verify whether the subjects had chosen at random or whether they had followed a common criterion in ranking the stimuli according to the more or less evident folding effect. The results (obtained by applying correction in cases of ex aequo observations) proved to be highly significant ($W = 0.51$, $\chi^2 = 122.4$, $p < 0.001$).

2.3 *Discussion*

Analysis of the results shows that the figures fell into three groups: those assumed folded with a great degree of certainty; those assumed not folded with the same degree of certainty; and those which could be either, depending on the subject.

First of all it must be noted that all the stimuli used represented real foldings, made by following precise procedures on differently shaped plates, as indicated in section 2.1.2. On the other hand, it can be argued that the perception of folding may not depend on the stimulus actually being the representation of physically and geometrically possible folding. Theoretically, any shape drawn in outline, and not made up entirely of curved lines, could represent some sheet folded over itself. The most interesting aspect, from the cognitive point of view, however, is that only some images are immediately perceived as folded and that one can generate configurations, perceived as folded by the subjects, which cannot be physically obtained by folding a surface, as will be seen in the second experiment. At this first level of analysis, it seems useful to describe the main formal features of the figures seen as folded. Further research may show whether these features are essential to produce the perception of folding.

(i) The first aspect common to all the stimuli seen as folded is the presence, in the same configuration, of two figures that are phenomenically juxtaposed. One of the two parts of the stimulus must appear as partially hidden by the other—it must hint at a visible figure. This triggers the amodal completion process, indeed it looks like a prerequisite of this phenomenon.

(ii) At least one side of the upper figure must perfectly coincide with one side of the lower figure. This shared side becomes the folding line. To be more accurate we can say that the extreme points of the folding line coincide with a point of flexion of both the upper and the lower figure.

(iii) The two phenomenically overlapping figures must be on the same side of the folding line. This holds when considering representations of bidimensional sheets folded over themselves through a rotation of 180°. In practice, many other folding conditions can be obtained: all solids delimited by flat surfaces may be obtained through the folding of an appropriate figure cut from a bidimensional sheet. However, when one looks at a representation drawn in outline of these solids, one does not immediately perceive that they have been obtained, or could have been obtained, through a series of folding procedures. When observing a Necker cube, one can imagine that it was obtained by successive foldings of square surfaces (Shepard and Feng 1972 used folding in exactly this way), but the possibility that the cube was in fact obtained in this way is of secondary importance, whereas in considering phenomenic folding this possibility is essential. The phenomenic folding event defines the occurrence of a perception in which the folding effect is not added by a mental inference on the data perceived, but is totally embodied in them.

(iv) Three segments must converge at the ends of the folding line in an arrow-like configuration in either of the two following ways: (a) all three segments are visible, or (b) only two of them are visible and a part of the third segment can be modally seen. This part (if extended) would reach the point of convergence of the other two segments. Such an extension is amodally completed by the observer (figures 3b and 3c). No arrow-like configuration is produced if a part of two of the segments is superimposed close to the convergency points, as in figure 3a.

The arrow-like configuration has been found to be of importance in research into how an artificial intelligence system can analyze drawing (Guzman 1969; Winston 1973, 1975). In 1968 Guzman prepared a programme, called SEE, that extracted information on the position of objects in space by means of an analysis of the connections between the lines that represented them. The solution proposed by Guzman was based on the classification of the vertices produced by the interaction of surfaces circumscribed by straight lines. It was noted that arrow-like vertices usually determine two adjacent regions, separated by a segment internal to the convex angle. Similarly, the T-junctions provide important information on whether one object is hiding another. The arrow-like and T-junction configurations, together with the L-vertices, provide all the relations among the lines used in our stimuli. It is therefore likely that arrow-like configurations are responsible for the observer's perception of a connection between the phenomenical figure in the foreground and the one in the background. With regard to this, it is also important to point out a difference. In Guzman's case the arrow defines a solid angle where the noncoplanar sides of a tridimensional object meet, and these sides have in common the segment internal to the convex angle. In our case, however, the folding line, namely a segment internal to the concave angle of the arrow, is the connection between two juxtaposed surfaces. It is very likely that the arrow-like configuration conveys information on the connections between the different sides of an object. However, information on the tridimensionality of the object represented, and data on the position in space of the connected surfaces, are provided by the position of the shared edge.

3 Experiment 2

My aim in this experiment was to verify the facts which seem to be important for the occurrence of phenomenic folding, namely: (i) the convergence of three segments at the ends of the folding line so that they form an arrow-like configuration; (ii) the kind of similarity there must be in the shape or structure of the two overlapping areas and the increase in homogeneity the figure would gain if unfolded; and (iii) the straightness or not of the folding line. Since a straight line is necessary for the actual geometrical folding, it was asked whether it was still necessary at a phenomenic level.

3.1 *Method*

3.1.1 *Subjects.* Thirty-six college students (eighteen males and eighteen females), ranging in age from 18 to 35 years, were presented with thirty-two cards and were individually tested.

3.1.2 *Stimuli.* There were thirty-two stimuli, drawn in outline on white cards (17.5 cm × 25.0 cm) and divided into seven series.

Series K (figures 5a–5d) is the first series, made up of twelve stimuli representing situations typically related to the definitions used in the questionnaire submitted. It includes three cards (figure 5a) showing unequivocally simple configurations, as defined in the first experiment; three cards (figure 5b) showing three out of the four stimuli that in the first experiment had received the highest positive responses for 'folded' answers; three cards (figure 5c) showing some specific cases of overlapping; and three cards (figure 5d) showing obvious cases of juxtaposition.

As in experiment 1, the labels used to identify the various series refer to the structural features of the configurations.

Series ARO (figure 6) indicates figures with an articulated rectilinear outline. It includes three cards: ARO.a, "graphic representation of the actual folding of part of the unfolded shape K2 in figure 5a, where S is the geometrical folding line; ARO.b, which has characteristics similar to ARO.a, but was made using Z in shape K2 in figure 5a as the folding line; ARO.c, which shows a regularization of the folded part of ARO.b, becoming half a square, thereby producing a perfect coincidence of three segments at the extremes of the folding line, unlike ARO.a and ARO.b, where there is no arrow-like configuration at the ends of the folding line (see areas within the dotted circles in figures 6a and 6b).

Series ACO (figure 7) indicates figures with articulated curved outlines. The cards in this series derive from the unfolded shape K1 in figure 5a and can be divided into two groups: ACO′ (ACO.a, ACO.c, and ACO.d), in which the differences between the stimuli concern the outlines of the figures phenomenically situated above and below.

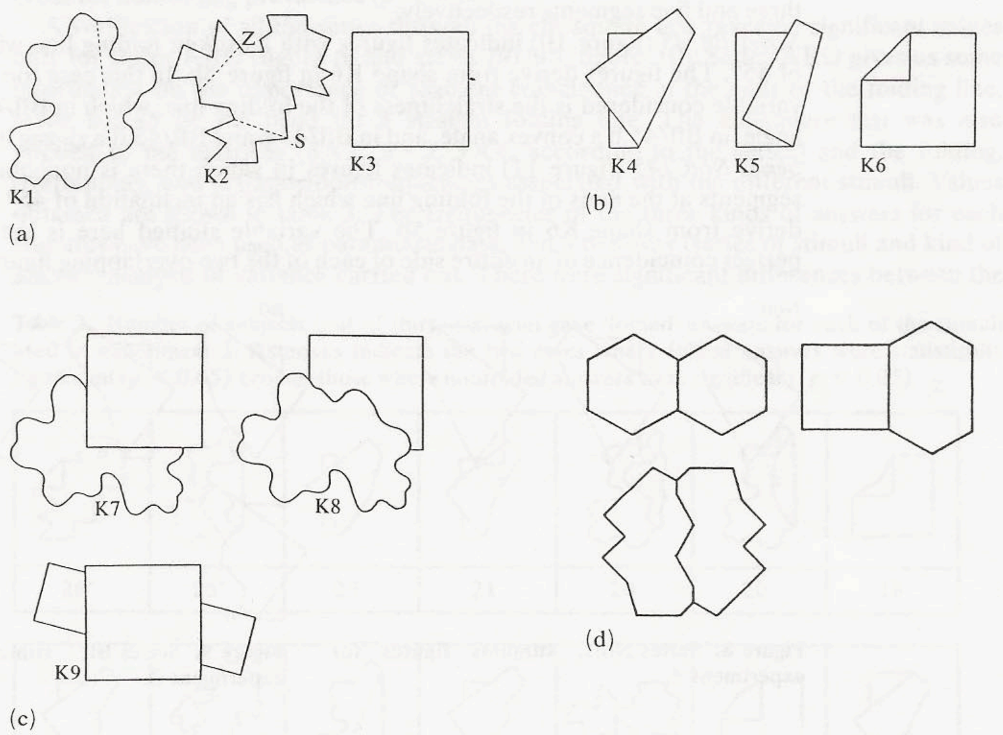


Figure 5. Series K: (a) three simple figures; (b) three folding cases; (c) three overlapping cases; (d) three juxtaposition cases.

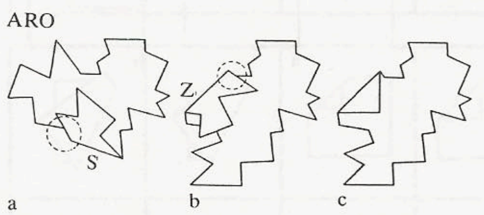


Figure 6. Series ARO stimulus figures for experiment 2.

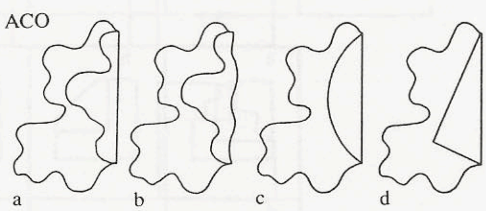


Figure 7. Series ACO stimulus figures for experiment 2.

The latter always maintains the same irregular curved outline, whereas the outline of the upper figure is irregular and curved in ACO.a, curved but regular in ACO.c, and rectilinear in ACO.d. The folding line is always rectilinear. ACO″ (ACO.a and ACO.b), where the difference between the upper and lower figures lies in the nature of the folding line—rectilinear in ACO.a, curved and irregular in ACO.b.

Series NotC (figure 8) indicates figures where there is noncoincidence of three segments at the ends of the folding line. The figures in this series derive from shape K4 in figure 5b. The phenomenically overlapping parts are the same in the three figures but the two horizontal segments are shifted so that if they were extended they would not reach the flexion points of the superimposed trapezium. In NotC.c, the upper horizontal segment coincides with a flexion point of the trapezium in the case of a nonrectilinear folding line.

Series Bfl (figure 9) indicates figures with a broken folding line. These figures also derive from shape K4 in figure 5b, but in this case the folding line is geometrically impossible because it is not a straight line. In Bfl.a the folding line has been replaced by a convex angle, in Bfl.b by a concave angle, and in Bfl.c and Bfl.d by a zigzag line with three and five segments respectively.

Series Bfl/45 (figure 10) indicates figures with a broken folding line with an inclination of 45°. The figures derive from shape K6 in figure 5b. In this case too the independent variable considered is the straightness of the folding line, which in Bfl/45.a is a concave angle, in Bfl/45.b a convex angle, and in Bfl/45.c and Bfl/45.d a zigzag line.

Series NotC/45 (figure 11) indicates figures in which there is noncoincidence of three segments at the ends of the folding line which has an inclination of 45°. The figures also derive from shape K6 in figure 5b. The variable studied here is the actual need for perfect coincidence of an entire side of each of the two overlapping figures.

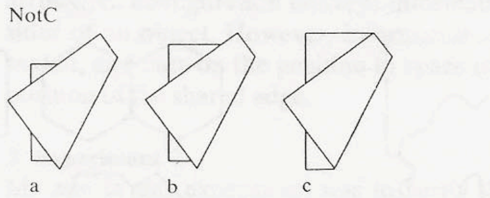


Figure 8. Series NotC stimulus figures for experiment 2.

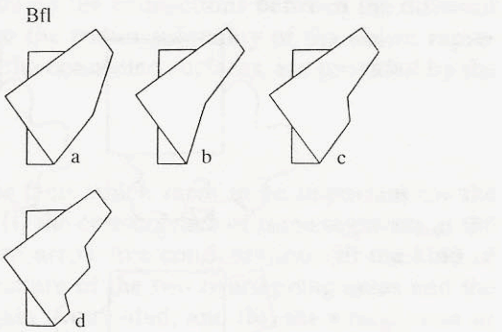


Figure 9. Series Bfl stimulus figures for experiment 2.

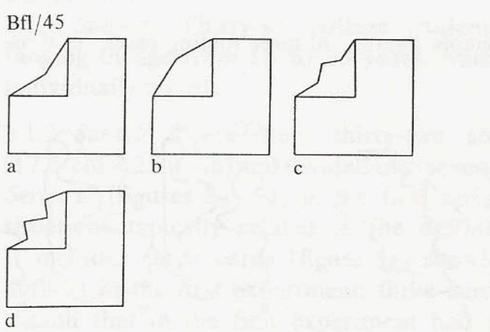


Figure 10. Series Bfl45 stimulus figures for experiment 2.

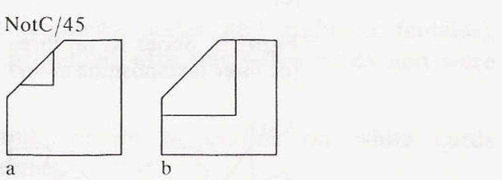


Figure 11. Series NotC/45 stimulus figures for experiment 2.

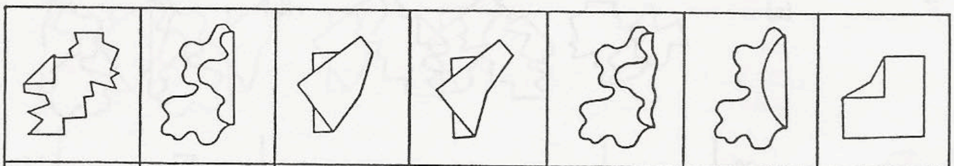
3.1.3 *Procedure.* The method used here was the same as in the first experiment. The questionnaire was slightly modified and now read:
(i) Is it a simple regular or irregular figure?
(ii) Is it a configuration resulting from the folding of a bidimensional figure?
(iii) Are there two overlapping figures?
(iv) Are there two or more juxtaposed figures?
(v) Other answers?

3.2 *Results*
The numbers of subjects who reported folded answers are shown in table 2. Series K stimuli are not included in this table because, as expected, they obtained the highest frequencies for those definitions of which they were clear examples.

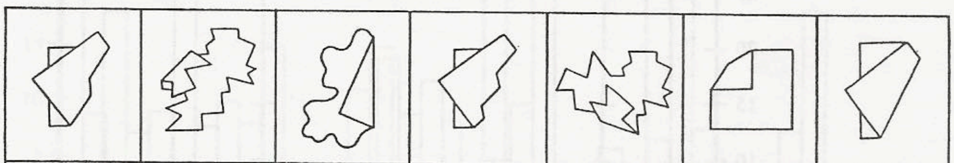
As in the first experiment the answers for each stimulus have been divided in two groups: folded and nonfolded. The binomial test was used to verify whether the difference between the two groups was indeed a random one. The statistically significant cases are marked: with an asterisk for folding prevalence ($p < 0.05$), with a cross for nonfolding prevalence ($p < 0.05$).

A verification of all the series through the chi-square text revealed significant values only for series ARO (figure 6) and series Bfl/45 (figure 10). Series ARO gives us some information on the importance of segment coincidence at the ends of the folding line, series Bfl/45 on the need for a straight folding line. The chi-square test was also applied to the matrices (3×2, 3×3, 3×4, according to the series) and the folding, overlapping, and juxtaposition frequencies associated with the different stimuli. Values obtained are shown in table 3. The frequencies of the three kinds of answers for each stimulus have been used as parametric data, and a two-way (series of stimuli and kind of answer) analysis of variance carried out. There were significant differences between the

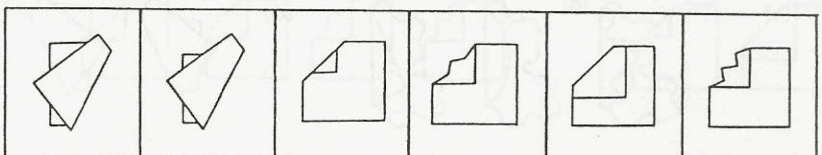
Table 2. Number of subjects (out of thirty-six) who gave 'folded' answers for each of the stimuli used in experiment 2. Asterisks indicate the two cases where folded answers were statistically significant ($p < 0.05$), crosses those where nonfolded answers were significant ($p < 0.05$).



26*	25*	23	21	20	20	18



15	14	12⁺	11⁺	11⁺	10⁺	9⁺



9⁺	8⁺	7⁺	4⁺	3⁺	2⁺

three kinds of answers ($F_{2,42} = 4.62$, $p < 0.02$), and also differences for the interaction series by kind of answer ($F_{10,42} = 6.3$, $p < 0.001$). The second result proved to be the most important, because it pointed out that the different kinds of answers were distributed differently—not at random—according to the series considered. The histograms in figures 12a–12g show the trends of these distributions. The variables in each series of stimuli caused variances in answer frequencies, which I shall now analyze with reference to figure 12.

Series ARO (figure 12a). There is a change between a slight prevalence for overlapping answers (ARO.a) and a clear prevalence for folded answers in ARO.c, where the folding line and the shared side of the two shapes perfectly coincide.

Series ACO′ (figure 12b). The folded answers are numerous when the outline of the upper figure is transformed into an arc of a circle or is curved and irregular, but decrease sharply, clearly overtaken by the juxtaposition answers, when the outline of the upper figure becomes rectilinear.

Series ACO″ (figure 12c). Here, although the folding line is not rectilinear in ACO.b, there is only a moderate decrease in the number of folded answers. However, a configuration such as ACO.b may be thought of as being made out of nonrigid material,

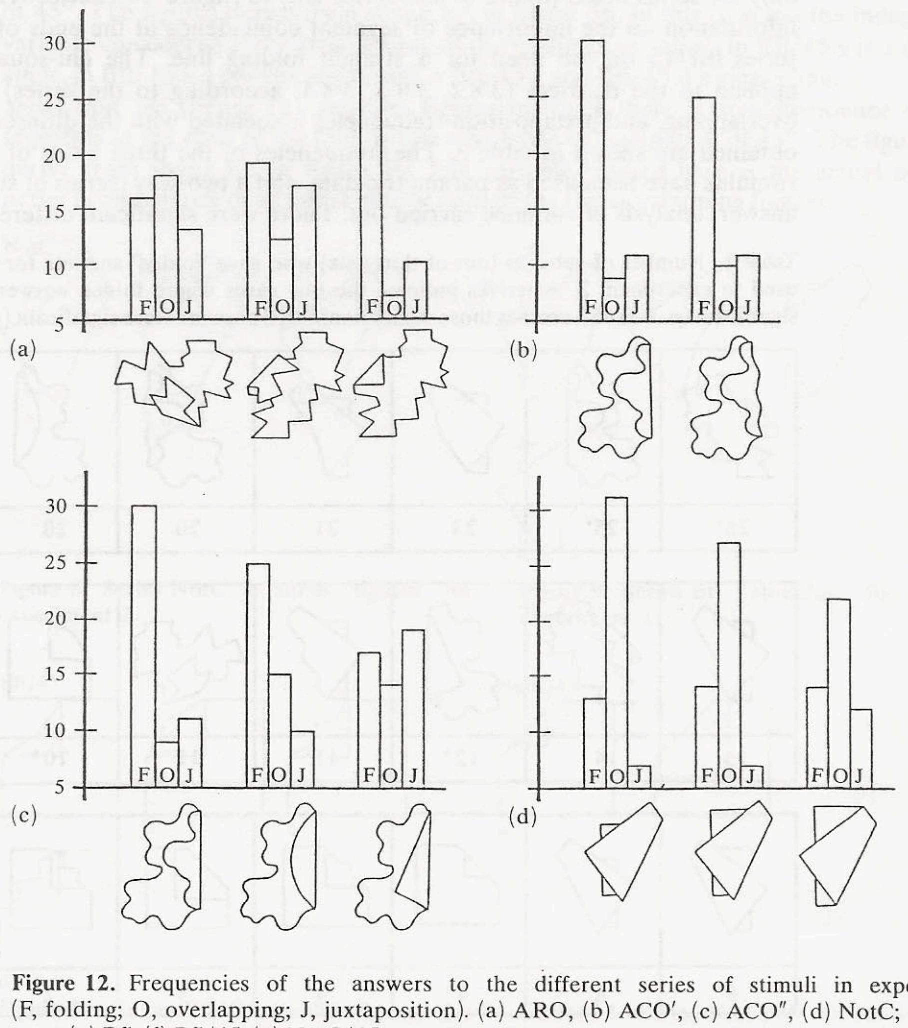


Figure 12. Frequencies of the answers to the different series of stimuli in experiment 2 (F, folding; O, overlapping; J, juxtaposition). (a) ARO, (b) ACO′, (c) ACO″, (d) NotC; on facing page: (e) Bfl, (f) Bfl/45, (g) NotC/45.

folded and curled along the folding line. This kind of perceptual result (supported by the arrows at the ends of the folding line) certainly is defined by folded answers.

Series NotC (figure 12d). Here there is a net prevalency of overlapping answers when there is no convergency at the ends of the folding line.

Table 3. Results of chi-square test on data from experiment 2.

Stimuli	χ	Degrees of freedom	$p < 0.05$
Series ARO (figure 6)	18.64	4	S
Series ACO' (figure 7)	13.06	4	S
Series ACO" (figure 7)	0.42	2	NS
Series NotC (figure 8)	6.38	4	NS
Series Bfl (figure 9)	9.68	6	NS
Series Bfl/45 (figure 10)	22.71	6	S
Series NotC/45 (figure 11)	10.90	2	S

S, significant; NS, not significant

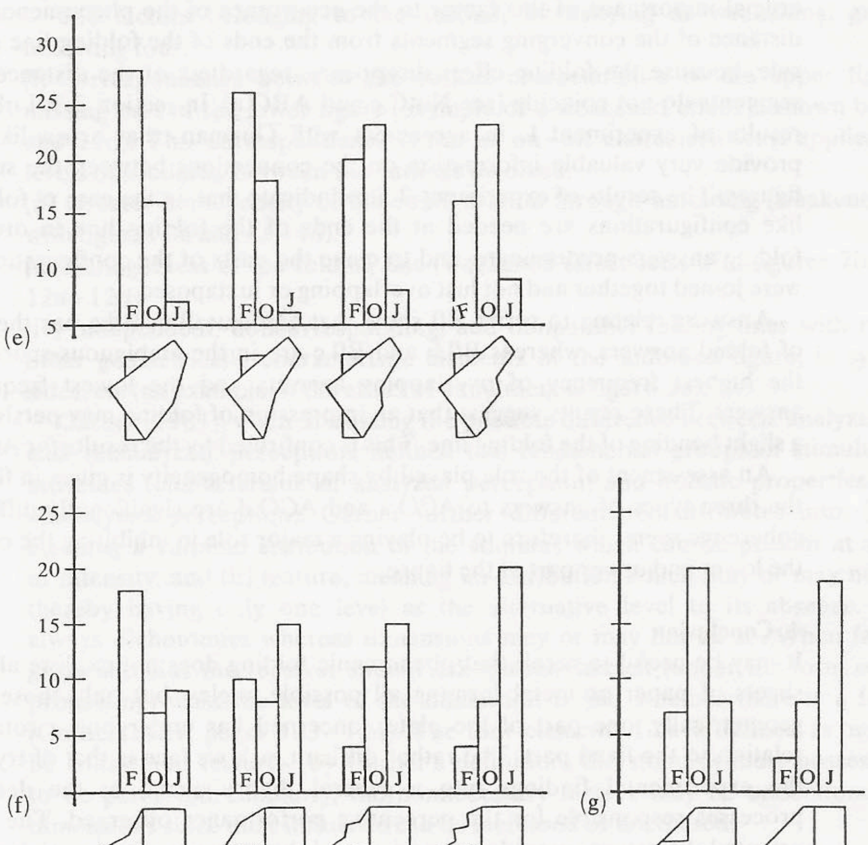


Figure 12 (continued).

Series Bfl (figure 12e). A slight complexity of the folding line has a minor influence on the frequency of folded answers, whereas a strong complexity leads to a prevalence of overlapping answers.
Series Bfl/45 (figure 12f). Increasing complexity of the folding line gives rise to a consequent fall in folded answers and an increase in juxtaposition answers.
Series NotC/45 (figure 12g). Here there is a low frequency of folded answers and an interesting shift from overlapping to juxtaposition prevalence.

3.5 *Discussion*

I shall discuss the findings series by series. In series ARO the difference observed between ARO.a and ARO.c suggests that the visible coincidence of an entire side of each of the two configurations along the folding line is a necessary condition for production of the phenomenon. A lack of correspondence, even if at only one of the extreme points (see also NotC.a and NotC.b in figure 12d) produces a sharp decrease in folded answers.

Series NotC and NotC/45 are the two series which contain all the stimuli significant to nonfolded answers. As the hypothesis involved is the correspondence of three segments at one point at the ends of the folding line, the results obtained suggest the crucial importance of this factor to the occurrence of the phenomenon. Moreover, the distance of the converging segments from the ends of the folding line seems to play no role, because the folding effect disappears, regardless of the distance, as soon as the segments do not coincide (see NotC.c and ARO.a). In section 2.3, I observed from the results of experiment 1, in agreement with Guzman, that arrow-like configurations provide very valuable information on the connections between the surfaces of drawn figures. The results of experiment 2 also indicate that, in the case of folding, two arrow-like configurations are needed at the ends of the folding line in order to make the folding answers predominate, and to make the parts of the configuration look as if they were joined together and not just overlapping or juxtaposed.

Answers relating to series Bfl show that configuration Bfl.a has the highest number of folded answers, whereas Bfl.b and Bfl.c are in the ambiguous-score rank; Blf.d has the highest frequency of overlapping answers and the lowest frequency of folded answers. These results suggest that an impression of folding may persist even if there is a slight bending of the folding line. This is confirmed by the results for ACO.b and Bfl.a.

An assessment of the role played by shape homogeneity is given in figure 12b, where the three types of answers to ACO.a and ACO.d are significantly different. Structural coherence seems therefore to be playing a major role in inhibiting the cohesion between the lower and upper part of the figure.

4 Conclusion

It may be useful to recall that phenomenic folding does not explore all cases of folded sheets of paper or metal forming all possible angles, but only those cases in which, geometrically, one part of the plate concerned has undergone a rotation of 180° in relation to the fixed part. The rather difficult task we face is that of trying to introduce the experimental findings into a general theory aimed at the detection of those processes responsible for the perceptive performance observed. The recent cognitive oriented literature provides theories and hypotheses on the elaboration of visual information and a variety of other information obtained by subjects. Many (Minsky 1975; Norman 1979; Moates and Schumacher 1980; Shepard 1981) have noted and experimentally recognized the need to assume the existence of organizational schemes of knowledge acting as a comparative element on the data in experiments on sense organs. Therefore we will assume the existence of several visual information organizational schemes involved in the whole set of changes in bidimensional surfaces which are described by the term 'folding'. The results reported seem to suggest that in the case of phenomenic folding, the scheme responsible for the effect is at the same time both a generalization and a simplification of the possible manifestation of the actual physical event. Some structural elements, present in the stimuli used in the experiments, could by their presence or absence produce or obliterate the phenomenic result of folding. Other elements could, by their presence, either intensify or weaken such a perceptive event. It is still too early to state which of the factors are absolutely essential for production of the phenomenon. All of these elements are briefly listed below.

The factors belonging to the first, necessary, group are the following four:
(1) The existence of two phenomenically overlapping figure areas (figures 2f, 3d, and to a certain extent 3a in experiment 1 are examples of the annulment of the effect).
(ii) At least two flexion points of the upper figure must coincide with two flexion points of the lower figure (annulment examples are figures 6a, 8a, 8b, 8c, 11a, and 11c).
(iii) The two overlapping figures must be on the same side of the folding line (examples of effect annulment are not reported because they are self-evident).
(iv) Three segments must converage at the extreme points of the folding line in the ways described in the discussion of the first experiment (significant annulment examples are figures 2f, 3a, 3d, 8a, 8b, 8c, 11a ,and 11c).

The factors belonging to the second, intensifying or weakening, group are the following four:
(i) Correspondence between the outline characteristics of the upper figure and the missing part of the lower figure (example of a weakened effect is shown by figures 10c and 10d). This correspondence is not an on-off characteristic: it applies to different levels of similarity between the outlines involved.
(ii) Greater homogeneity of the configuration through unfolding (weakened effect seen with figures 3a and 4a-4d).
(iii) Straightness of the folding line (weakened effect seen with figures 7b, 9a-9d, and 12a-12d).
(iv) Independent, noncorresponding, and nonparallel folding lines with respect to the other geometrically characteristic elements of the unfolded figure, ie symmetry axis, sides, etc (an example of the effect of annulment is figure 3a).

Garner (1981), when discussing the possible difference between 'analyzed' perception and 'unanalyzed' perception, defined two fundamental groups of stimulus properties: attributes (characteristic of analyzed perception) and holistic properties (referring to unanalyzed perception). Garner further differentiated attributes into: (i) dimension, meaning a variable attribution of the stimulus which can be present at various levels of intensity, and (ii) feature, meaning an attribution which may or may not be present, thereby having only one level as the alternative level to its absence. Features are always dichotomies whereas dimensions may or may not be so. When faced with any given stimulus the receiver should ask himself/herself (under the form of information processing) what the level of the dimension is and whether there is a feature or not (Garner 1981, pages 123-124). The four elements I have defined as 'necessary' may be considered features (by Garner's definition) the stimulus must possess if folding is to be perceived. Similarly, the nonnecessary factors may be understood as Garner's dimensions since their influence can be increased or decreased.

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