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Rapid figure – ground responses to stereograms reveal an advantage for a convex foreground

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Abstract. Convexity has long been recognised as a factor that affects figure – ground segmentation, even when pitted against other factors such as symmetry [Kanizsa and Gerbino, 1976 *Art and Artefacts* Ed.M Henle (New York: Springer) pp 25 – 32]. It is accepted in the literature that the difference between concave and convex contours is important for the visual system, and that there is a prior expectation favouring convexities as figure. We used bipartite stimuli and a simple task in which observers had to report whether the foreground was on the left or the right. We report objective evidence that supports the idea that convexity affects figure – ground assignment, even though our stimuli were not pictorial in that depth order was specified unambiguously by binocular disparity.

1 Introduction

The principles of figure – ground organisation include a factor generally called convexity: other things being equal, convex regions tend to be perceived as figures and concave regions as background. The original idea can be traced back to Rubin (1915) and Metzger (1953—see Palmer 1999, 2002), and a well-known example is in Arnheim (1954)—see figure 1. The classic empirical work was carried out by Kanizsa and Gerbino (1976; see also Kanizsa 1979).

Although the idea that convex regions are seen as figures has a prima facie appeal, there are difficulties. For example, it is necessary to separate this factor from other factors such as size and regularity. In their demonstrations, Kanizsa and Gerbino (1976) put convexity into direct opposition to regularity (more specifically, symmetry) and relative area. They were able to show that convexity is the dominant factor in determining what is perceived as figure (figure 1). This is remarkable, as it makes convexity one of the most powerful determinants of figure – ground and presumably a central factor for image segmentation. Yet the study of convexity has not made as much progress as, for instance, the study of symmetry (for a review, see Wagemans 1997).

Kanizsa and Gerbino (1976) used a phenomenological method. Observers simply had to choose what side of a display they perceived as figure. Here, we report results from an indirect test of the power of convexity to influence what is judged as figure. By 'indirect' we mean that observers perform a task (depth discrimination) in which there is a clearly defined correct and incorrect answer, and observers can respond correctly independently of the shape of the stimulus. Nevertheless, we expect shape to affect the speed of depth discrimination because we believe that shape analysis is obligatory.

On every curved contour there is locally a convex side and a concave side, and only by knowing which side is figural can we label the contour as either convex or concave. In turn, the assignment of figural status may be biased towards the convex side (Kanizsa and Gerbino 1976). One might call this a tendency to maximise convexity, or a convexity assumption revealed under conditions of uncertainty. In our depth discrimination experiments we combine an ambiguity at the level of shape analysis (only a segment of the contour is visible, with the remaining contour being occluded) with

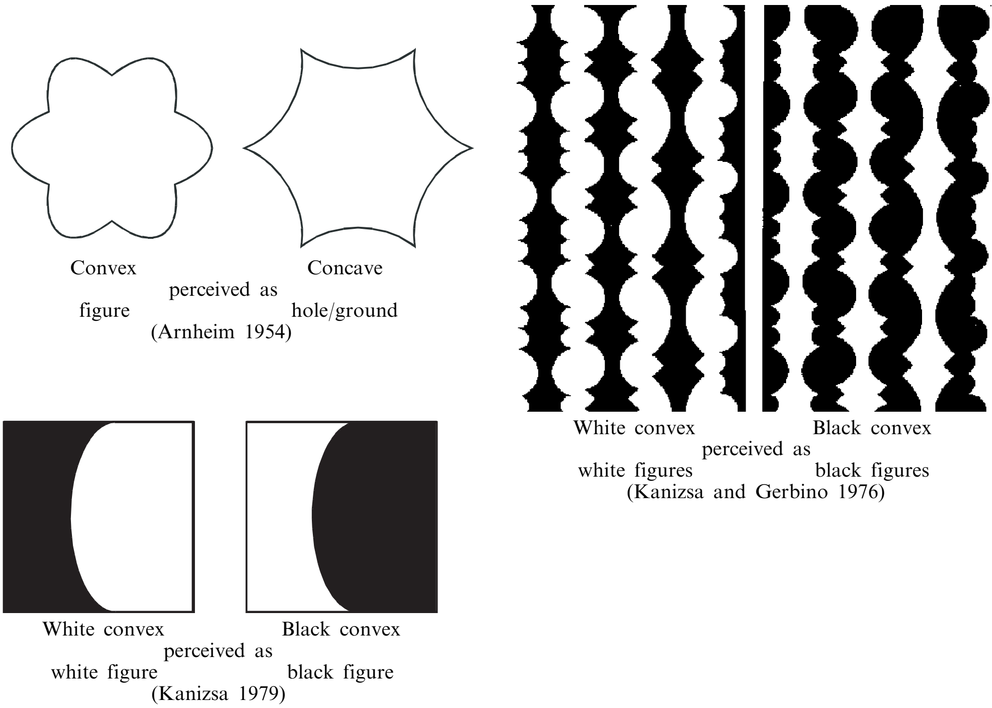

Figure 1. Examples of some classic demonstrations. Using a phenomenological method, the authors claimed that most observers would see the convex side as the figure. As Rock (1983) pointed out, we assume here that contours are seen as edges of surfaces (otherwise convexity is undefined). Note also that, at least in the first two examples, what is classed as a convex shape is not strictly convex in a mathematical sense. More importantly, with complex shapes it is impossible to equate convex and concave shapes for both area and perimeter length. We have drawn Arnheim's shapes with equal area, but to do so the perimeter of the one on the right is 10% longer. Therefore they differ in compactness (usually defined as area divided by squared perimeter) and the question arises whether compactness and convexity are always correlated. For more on how to compute convexity for complex shapes see Rosin (2000) or, for a different approach, Pao and Geiger (2001).

an unambiguous specification of the information required for the task, namely which region is in front (defined by binocular disparity). We used random-dot stereograms to be sure that participants had extracted this relative depth information before contour information was available, since the contour was defined solely by binocular disparity. In other words, figure–ground assignment was not necessary to perform our depth discrimination task (in contrast to the phenomenological tasks mentioned earlier used by Kanizsa and Gerbino and others). Nevertheless, we predicted that an obligatory bias to assign convex regions to be figure would influence image segmentation. Our hypothesis is that the effect of convexity is powerful and capable of affecting early image segmentation even in the absence of luminance information about shape. Incidentally, both Bertamini and Mosca (2004) and Fantoni et al (2004) found that convexity effects originally found with luminance-defined contours generalise to contours defined within random-dot stereograms.

In the existing literature, convex and concave parts have been shown to affect shape matching (eg Attneave 1974), visual search performance (eg Humphreys and Müller 2000), and positional judgments (eg Bertamini and Croucher 2003). These studies are important in demonstrating that this information is salient, but do not directly answer the question how powerful convexity is in determining figural status. A recent study by Vecera et al (2004) has shown better performance at matching the convex side of a split display, even though observers were asked to try and remember both sides. However, a problem with memory tasks is that shapes with clear convex parts may be easier to remember and match, independently of whether they were seen as a figure more often or more clearly than the concave shapes. In addition, the experiment by Vecera et al is typical of the literature in using complex shapes for which a definition of global convexity is problematic (see figure 1).

An interesting study of convexity was carried out by Liu et al (1999). They argued that the stronger the grouping between two regions, the harder it will be to resolve their relative stereoscopic depth. They then compared regions with (occluded) convex and concave vertices. Liu et al concluded that convexity plays a strong role in perceptual grouping because with convex stimuli it was harder to resolve relative depth. Their results are consistent with the idea that concavities separate regions (the opposite of grouping). As Liu et al (1999) we used stereograms in our experiments. However, our task was quite different as there was only one foreground region, because we were not interested in grouping of different figural regions, but in figure – ground stratification.

Our stimuli were similar to those introduced by Kanizsa (1979; see figure 1), but we modified them so that only a section of a contour was visible through a square aperture (figure 2). This is important because the contour shared between the inner stimulus and its surrounding frame is assigned to the frame, so that all but one region of the inner stimulus is occluded. This therefore isolates the critical central contour. There is a parallel here with the manipulation used by Gillam and Cook (2001) in which the perception of slant of a surface seen through an aperture was not affected by the shape of the aperture. For other examples of the fundamental difference between intrinsic and extrinsic contours see, among others, Nakayama et al (1995) and Bruno et al (1997).

In our experiments, depth separation was the only information available to define the shape of objects. It would be possible to run analogous studies to those which we report here which, for example, tested whether performance was better for convex-as-dark than concave-as-dark shapes when people had to report if the dark area was on the right or left of the display. However, the bias to see dark areas as figure and light areas as ground is relatively weak, whereas in a stereogram foreground areas are quite unambiguously perceived as figure and background areas as ground. Such studies would therefore be less powerful tests for a convexity advantage than our present studies. Moreover, we have no reason to expect that such studies would produce results different from those reported here.

It is interesting that, within a large literature on contour curvature effects, there have been reports of a concavity advantage as well as a convexity advantage. Some authors have hypothesised that concavities attract attention and are processed as basic features, or that they are "inherently more salient" than convexities (eg Barenholtz et al 2003, using shape matching; and Humphreys and Müller 2000, using visual-search data). Humphreys and Müller go as far as to suggest the existence of concavity 'detectors'. However, an alternative interpretation of the evidence for a concavity advantage (also noted in the literature) is that such findings can be understood in terms of the indirect effect of concavities on part structure. We favour the latter explanation (Bertamini 2001, 2006; Bertamini and Lawson 2006), as it is consistent with evidence of a convexity advantage in other tasks. For example, Bertamini and Croucher (2003) and Bertamini and Mosca (2004) have reported an advantage for judging the position of a vertex when the vertex is perceived as convex as opposed to concave.

Although the experiments reported here are about the role of convexity in depth stratification, there is one way of looking at them which is relevant for the issue of what information guides attention. If concavities per se attract attention and are more salient,

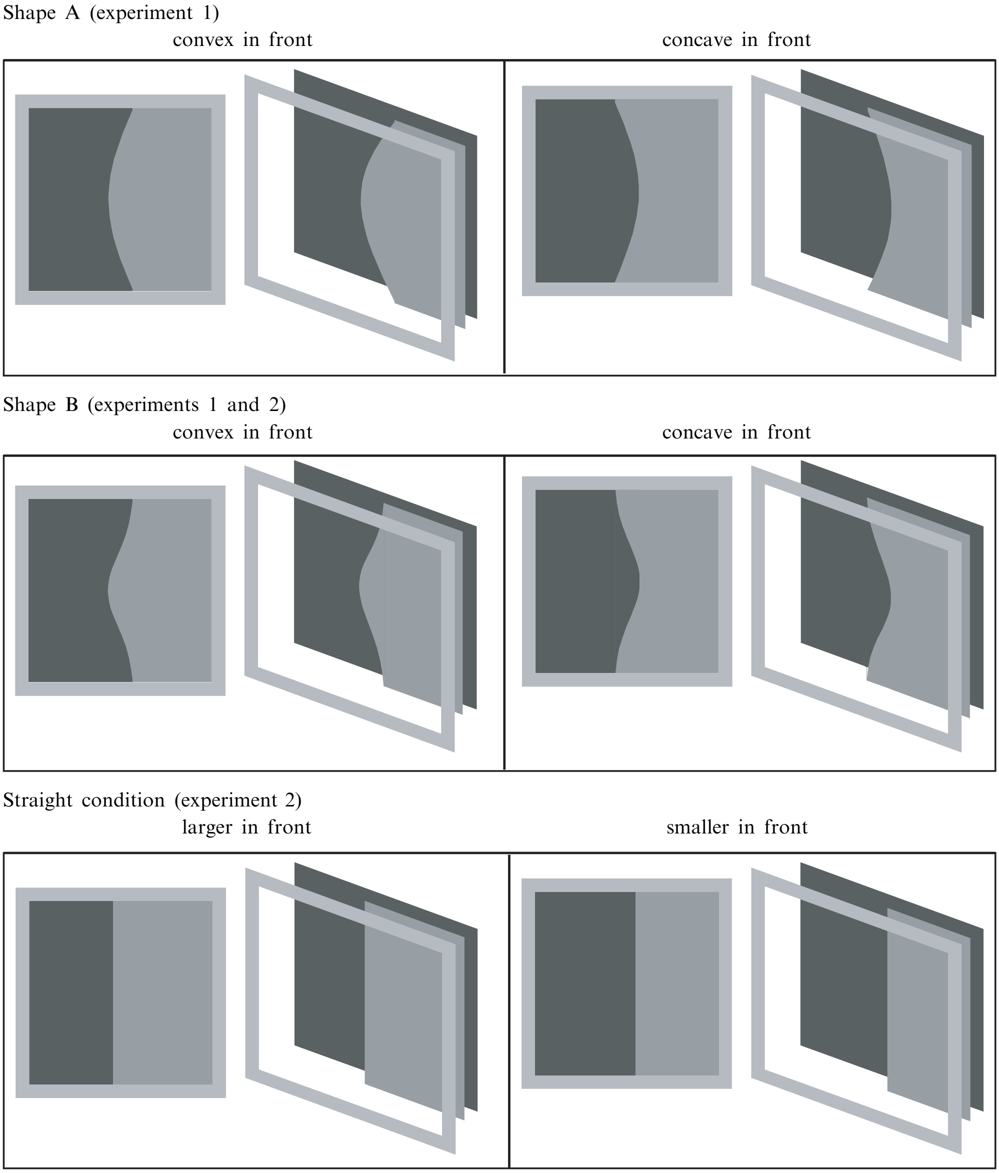

Figure 2. Stimuli presented in experiments 1 and 2 illustrated here with different grays to specify different planes. The shapes and proportions are accurate but the actual stimuli used were random-dot stereograms. Note that for shapes A and B the display has two regions of equal area, and a shared contour that has a convex and a concave side. For each display the diagram on the right illustrates the depth order. For simplicity, only stimuli for which the front surface is on the right are shown here.

then one would predict faster responses for concave stimuli for most tasks, including depth discrimination. However, on the basis of the Gestalt principle that convexities tend to be seen as figures (Kanizsa and Gerbino 1976; Palmer 1999; Rubin 1915), we predict faster responses for convexities. This is because convex regions will tend to be perceived as figures which, in turn, tend to be perceived to be in front. If the disparity is consistent with this interpretation, responses will be faster. If, though, the convex region is behind, responses will be slower, since the implied relative depth of the convex region due to figural assignment conflicts with that indicated by the binocular disparity.

To summarise, the convex-in-front/concave-behind stereograms are consistent with the role of convexity in figure–ground organisation. Conversely, the concave-in-front/convex-behind stereograms present a conflict. If convexity automatically affects figure–ground organisation we predict faster responses for the former, consistent stimuli. Note that, if we compare just these two conditions, as was the case in experiment 1, we will only be able to conclude that there is a relative difference. This difference may originate from either faster responses to convex-in-front stimuli or slower responses to concave-in-front stimuli.

2 Experiment 1: Depth discrimination

The observer judged whether the right or the left of two surfaces was in front. Depth order was specified by binocular disparity only, within a central region of random dots. Two disparity values were tested, both of which were above threshold levels, and observers performed the task with few mistakes. As illustrated in figure 2, the two central surfaces were seen through a square frame, which appeared as an aperture. The critical contour in the middle of the stimulus contained information about depth order, with the remainder of this contour occluded by the frame. The hypothesis was that performance would be affected by whether the convex or the concave side of this central contour segment was specified as in front. If, in terms of shape analysis, the convex side of a contour tends to be perceived as figural (other things being equal), and figures are assumed to be in front, this tendency generates a conflict when the concave side is in front (as specified by binocular disparity). We expected this to lead to longer response times (RTs) compared to when the convex side was in front.(1)

2.1 *Method*

2.1.1 *Participants.* Thirty students at the University of Liverpool participated. They were naive with respect to the problem and the hypotheses until after the data were collected. They were also screened for stereoacuity with the TNO stereotest (acuity ranged between 15 and 120 s of arc).

2.1.2 *Stimuli and procedure.* The factors were order (convex-in-front versus concave-in-front) and disparity of the foreground region (1.68 and 3.36 min of arc). They were factorially combined in a within-subjects design. Two different shapes were used in two versions of the experiment (see figure 2). The central contour of each shape was modeled by the following formula: $f(x) = k\exp(-0.5x^2)$ between the values of -1 and 1 for the A shape, and -2.5 and 2.5 for the B shape. We did not expect a difference between the A and B shapes but they are important because they have different advantages and disadvantages. The A shapes are more similar to those used by Kanizsa (1979). Their advantage is that the contour never changes curvature type, so it can only be perceived as either strictly convex or strictly concave. However, where the A shape is occluded (at the T-junction) it has tangents that create a closure effect favouring the convex side. This confounds convexity with closure. The B shapes, like the A shapes, have a central convex bump (or concave dent), but in addition they have two flanking flex points (at -1 and 1) and a change of curvature. The advantage of the B shapes is that the tangents where the contours are occluded by the frame are approximately vertical. The disadvantage is that the contours are not strictly convex/concave. We do not expect the flanking regions with a reversal in curvature to play a significant role, not only because they are not central, but also because they are unbound segments. Only the central bump (dent) is bounded by two flex points and is

(1) A different but similar logic has been adopted by Yin et al (2000) in a study of grouping effects on stereoacuity. In their experiments, when a region was perceived as grouped together with another region, but binocular disparity was in conflict with such grouping, sensitivity to depth order was reduced.

therefore a salient region. Recent evidence supports this view that convexities bound on both sides by concavities are perceived as salient parts (Bertamini and Farrant 2005).

Stimuli were generated on a Macintosh computer, and presented on a Sony F500T9 monitor with a resolution of 1280×1024 pixels at 120 Hz. Two stereo images were presented with the use of a NuVision infrared emitter and stereoscopic shutter glasses. The effect of interleaving left and right images was that effective vertical resolution and refresh rate were halved (512 pixels at 60 Hz).

Figure 2 illustrates the stimuli with two types of diagrams, one showing the configuration straight on, and the other with a side view that clarifies the depth manipulation. Figure 2 also illustrates the convex-in-front and the concave-in-front stimuli. Figure 3 provides examples of stereo pairs for the A shape. The height and width of the display were both 9 cm, and the square region inside the frame had a height and width of 8.4 cm. The surface in front had a disparity of either 1.68 or 3.36 min of arc. The square frame always had a disparity of 4.20 min of arc, and the background region had zero disparity.

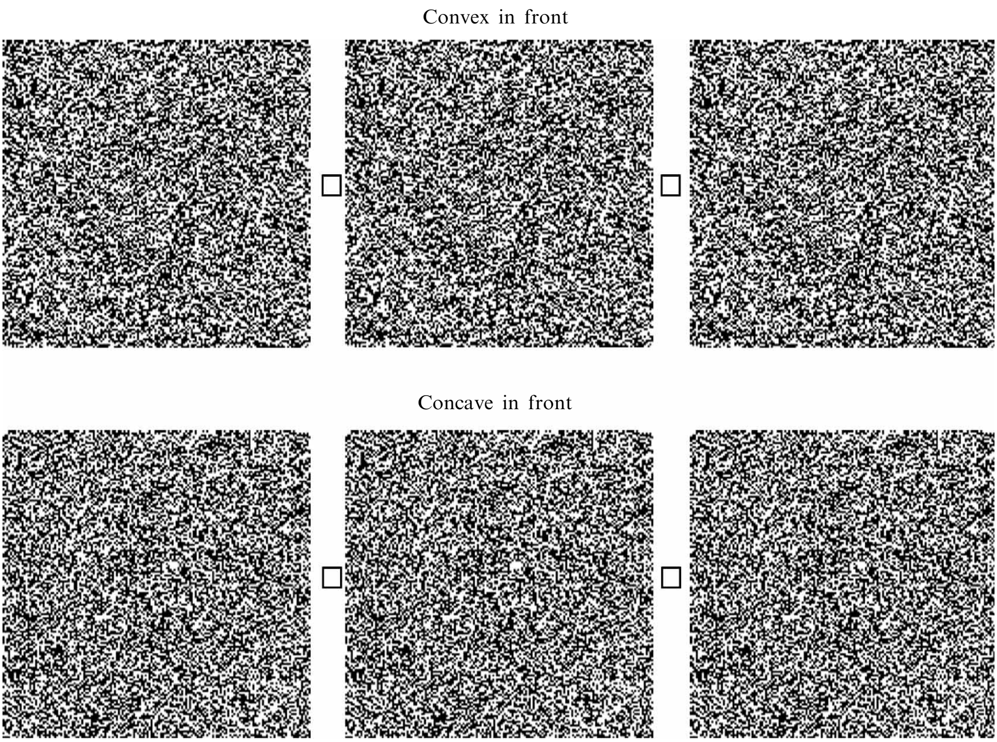

Figure 3. Stereograms used in experiment 1. These examples contain shape A and the front surface is on the right. The left and right pairs are for divergent and convergent fusers respectively. New random-dot textures were generated for each trial.

Each observer sat in a dimly illuminated room at a distance of approximately 57 cm from the monitor. In half of the trials the convex side was specified as in front, and for the other half the concave side was in front. In half of the trials the surface was located to the right, and in the other half of the trials it was on the left. Observers were instructed to respond with the right or left hand, to indicate that the surface in front was on the right or the left respectively, using a game pad. They were told that the actual shape of the surface in front was irrelevant for the task.

Once the session started, 24 trials formed a practice phase and were not analysed, after which each observer performed 576 trials. The trials were presented in rapid succession.

After every 144 trials a block ended, and the observer was allowed time to rest. The start of subsequent blocks was self-paced. The computer recorded response times and controlled the presentation of the stimuli with the VideoToolbox subroutines (Pelli 1997).

2.2 *Results and discussion*

The following steps were taken in the analyses for this and experiment 2. Only trials with correct responses were used in the analysis of RTs. The RTs were logarithmically transformed to normalise the distribution and meet the ANOVA assumptions. A mixed ANOVA on (transformed) RTs for order (convex-in-front versus concave-in-front), disparity and shape (A and B as shown in figure 2) confirmed that responses were faster for the convex-in-front condition ($F_{1,28} = 25.51$, $p < 0.001$), and that responses were faster when a larger disparity separated the two surfaces ($F_{1,28} = 42.16$, $p < 0.001$). No other main effects or interactions were significant.(2)

The means for RT can be seen in figure 4. Overall, errors were made in only 3.4% of the trials, without any indication of a speed – accuracy trade-off. Using the same design of ANOVA as was performed on RT, a second ANOVA on the percentage of errors confirmed a significant effect of disparity ($F_{1,28} = 5.95$, $p = 0.021$): fewer errors were made for the larger disparity. No other effects were significant.

The results confirmed the prediction: when the convex region was in front responses were faster than when the concave region was in front. This effect did not depend on the amount of disparity or the type of contour (both A and B shapes showed a similar convexity advantage, see figure 4).(3)

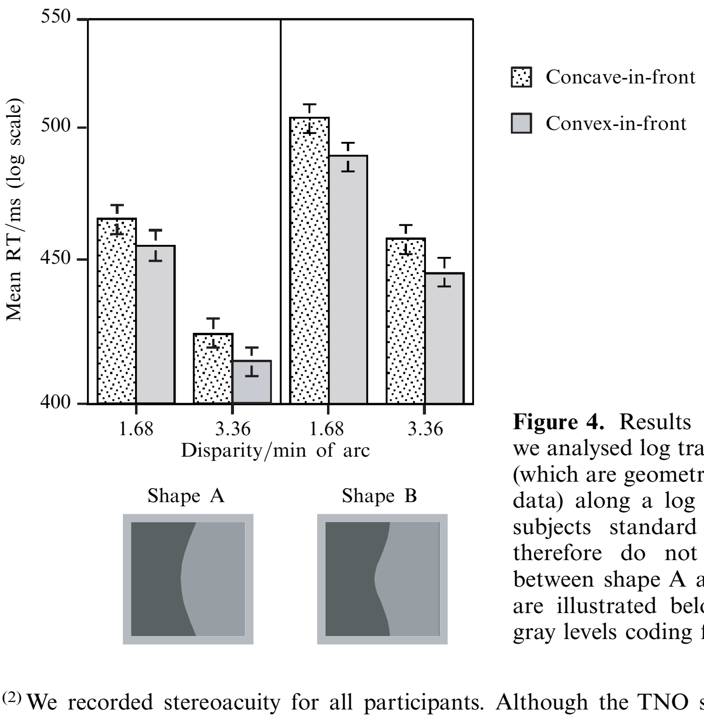

Figure 4. Results from experiment 1. Because we analysed log transformed RTs we plot means (which are geometric means of non-transformed data) along a log axis. Error bars are within-subjects standard errors of the mean, and therefore do not apply to the comparison between shape A and shape B. The two shapes are illustrated below the graph with different gray levels coding for different depth planes.

(2) We recorded stereoacuity for all participants. Although the TNO stereotest gives only a coarse estimate of stereoacuity, when we analysed this variable it was indeed the case that better acuity significantly reduced RTs, and more so for the smaller of the two disparities used. However, acuity did not affect nor interact with the order variable or any other variable.

(3) The reader should look at figure 2 to see the similarity between shapes A and B. It is in itself interesting that they look similar given that in B the contour changes curvature. As argued in the text, this may be because in B only the central region is bound by two flex points; for more on contour parsing by singularities see Richards and Hoffman (1985).

3 Experiment 2: Depth order and straight contours

In experiment 1 observers responded faster when the surface in front was bound by a convex contour. We argue that this shows a convexity advantage. However, an alternative explanation exists. If observers were fixating the centre of the display, they would be fixating the front surface when the convex side was specified as in front but the background surface when the concave side was in front. This inevitably follows from the fact that the two regions were matched for area. However, this confound could account for the faster responses to the convex-in-front condition.

In experiment 2 we introduced two changes to test this alternative account. (i) We mixed together trials presenting stimuli with straight contours, and trials with stimuli like the B shapes used in experiment 1 (figure 5). When the surface had a straight edge, it was offset to the left or to the right and either the smaller half or the larger half was specified as in front. The rationale was that if observers respond faster when they are looking at the surface in front, there should be an advantage when the larger surface is in front. (ii) We varied the horizontal extent of the B stimuli whilst keeping the overall area of the figure and ground the same on both sides of the contour (figure 5). This allows a comparison between two shapes that are identical except for a horizontal stretch. The total extent of the curved part of the stimulus was either 13% or 17% of the total stimulus extent. If looking at the front surface provides an advantage, then the stimuli that extend more should have an advantage over the stimuli that extend less. A more important reason for this manipulation is that contour polarity is, by definition, a dichotomous variable (only two values are possible). In contrast, the amount of curvature varies continuously. The two versions of the B shapes that we presented in experiment 2 varied in amount of curvature. Because we believe that the effect found in experiment 1 is due to contour polarity, we predicted a convexity advantage of similar size for both B shapes. No interesting difference was found between the two disparity values used in experiment 1, so only one value of disparity was used in experiment 2 (1.68 min of arc).

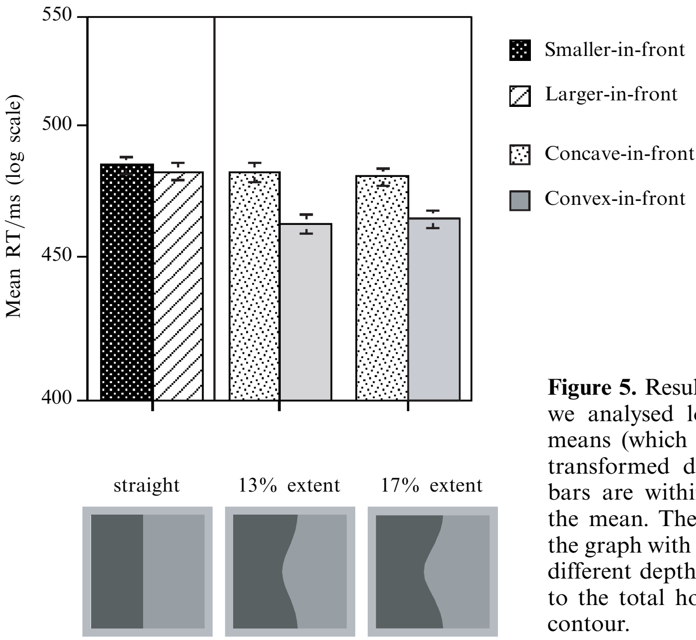

Figure 5. Results from experiment 2. Because we analysed log transformed RTs we plot means (which are geometric means of non-transformed data) along a log axis. Error bars are within-subjects standard errors of the mean. The stimuli are illustrated below the graph with different gray levels coding for different depth planes. The percentages refer to the total horizontal extent of the curved contour.

3.1 *Method*

The method and procedure were similar to those in experiment 1 except for the shape of the stimuli and the use of only the lower, 1.68 min of arc, disparity. The design was more complex because three shape conditions were interleaved: curved 13% extension, curved 17% extension, and straight. As before, there were two orders of foreground and background. For the straight stimuli these were smaller-in-front and larger-in-front. For the curved stimuli these were convex-in-front and concave-in-front. There were 768 trials in total. Eighteen students at the University of Liverpool participated. They were naive with respect to the problem and the hypotheses until after the data were collected. They were screened for stereoacuity with the TNO stereotest (acuity ranged between 30 and 120 s of arc).

3.2 *Results and discussion*

As in experiment 1, we analysed logarithmically transformed RTs for trials with correct responses. In a first analysis we compared the straight stimuli to the curved ones. We ran an ANOVA with shape (straight and curved) and order (which surface was in front) as factors. Responses to curved contours were significantly faster ($F_{1,17} = 21.13$, $p < 0.001$), but there was also a significant interaction between shape and order ($F_{1,17} = 4.84$, $p < 0.05$). In the straight condition, order means smaller or larger; but in the curved condition, order means convex or concave. Therefore to understand the effect of order we analysed the difference between the smaller-in-front and larger-in-front conditions (which are specific to the straight contours), and found no significant difference ($F_{1,17} = 0.41$, $p = 0.53$). In another ANOVA run on the curved-contours data, we analysed the effect of horizontal extent (1.25 and 1.40 cm, corresponding to 13% and 17% of the square region inside the frame) and order (convex-in-front and concave-in-front). Responses were faster for the convex-in-front condition ($F_{1,17} = 12.99$, $p = 0.002$). There was no effect of extent ($F_{1,17} = 0.01$, $p = 0.97$) nor an interaction between extent and order ($F_{1,17} = 0.37$, $p = 0.55$).

The means for RT can be seen in figure 5. Overall the average error rate was only 3.7%. There was no indication of a speed–accuracy trade-off. Moreover, when we analysed the percentage of errors there was no significant main effect or interaction.

Experiment 2 included the straight-edge condition to control for the importance of the location of the contour relative to the centre of the display. We concluded that there was no effect of where the contour was located. We conducted a further experiment in which the curved contours (shape A) were shifted inwards and outwards by an amount equal to the total extension of the curved contour (therefore all the contour was either on one half or the other of the display). These data confirmed that there was no significant difference between the small and the large conditions (ie inward and outward shifts). Because experiment 2 already tested this possibility, we do not report this experiment in full. In this final study, the difference in area between the small and large foreground surface conditions was larger than in the straight condition of experiment 2, and the non-significant trend was for faster responses when the foreground surface was smaller (579 versus 592 ms; $F_{1,9} = 3.18$, $p = 0.108$). Under the hypothesis that observers only focus on the very central region of the display, then, even if an advantage for smaller regions exists, it would have favoured the concave stimuli in experiments 1 and 2. Thus, any confound due to the area and location of the foreground regions tested would work against the convexity advantage that we found in both experiments 1 and 2.[4]

[4] We cannot claim that there was a significant advantage for smaller regions, but this may be an interesting subject for a future study. Given that size is believed to be a factor in figure–ground organisation, and that smaller regions tend to be figural, an advantage for smaller surfaces would be consistent with the general effect of figure–ground factors on RT in our task.

We have so far discussed the straight condition as a control. In addition, one could consider it as a baseline to answer the question whether it is convexity in the foreground that speeds up responses or concavity in the foreground that slows performance. The use of the straight stimuli as a baseline should be taken with caution. These stimuli could be considered to be at the midpoint of a continuum in-between convex and concave curvature, at a point at which curvature is zero. However, it is impossible to equate the length of the contour and its complexity when comparing straight and curved stimuli. Having said that, the results of experiment 2 support the view that there is a convexity advantage without a concavity cost (see figure 5).

4 Conclusion

Convexity is often cited as a factor that affects figure–ground segmentation, but its study has been hampered by the difficulty in isolating it from other factors such as size, compactness, or symmetry. Here we report findings of experiments in which we used a depth discrimination task combined with a square frame that creates an aperture and therefore isolates a segment of a contour. We believe this combination makes our stimuli ideal to test for convexity effects. When observers had to report depth order and the convex side of a contour was specified as in front, responses were significantly faster. Moreover, the effect was robust across different types of curved contours (shapes A and B, experiment 1, see figure 4) and across two extents of the central feature with different curvature (experiment 2, see figure 5).

This clear-cut result is evidence against the idea that a concavity per se is inherently more salient, as hypothesised, for instance, by Humphreys and Müller (2000) and Barenholtz et al (2003). The advantage for finding a concavity in visual search (Hulleman et al 2000; Humphreys and Müller 2000) or in change detection (Barenholtz et al 2003) is more likely the result of the role of concavities in determining perceived part-structure (Bertamini 2001).

If the straight condition in experiment 2 is used as a baseline, one could argue that convex foregrounds are unambiguously perceived as in front and are therefore privileged in a foreground detection task relative to both concave and straight foregrounds. This may be due to the unique contribution of the protruding convexity. This protrusion is probably perceived as a part, and is absent in both the concave and the straight stimuli.

Our finding is also consistent with the recent informational analysis proposed by Feldman and Singh (2005). Feldman and Singh provided a measure of information (called 'surprisal') that increases monotonically with the magnitude of contour curvature and is scale-invariant. They have suggested that information is greater at concavities because they are less likely to occur than convexities. Specifically, the surprisal value is proportional to $-\cos(\alpha - 2\pi/n)$, where α is the change in tangent direction (turning angle) over a small segment of contour, and n is the total number of segments. If n is fixed, the segment is a fraction of the total length. It follows that the resulting measure is scale-invariant. Because of the negative sign, surprisal is smallest for small positive turning angles ($2\pi/n$), ie for convexities, consistent with the assumption that the contour is closed and therefore the total turning angle is 2π and that there are n steps. In other words, contours are expected to turn in the positive direction, and therefore convexities (positive α) have a lower surprisal value than concavities (negative α).

The basis of this argument is the fact that polygons with total concave angle (summed over all vertices) greater than total convex angle cannot be closed (see also Massironi 2002). Concave vertices require convex vertices but the reverse is not true, so a polygon can have only convex vertices but cannot have only concave vertices. With the assumption that contours tend to be closed, the visual system might therefore have a prior expectation that convexities are more likely to occur than concavities in natural scenes. If so, other things being equal, and from purely local information, the default assignment of contour curvature should be convex rather than concave. Clearly, this preference could be reversed by other contextual information (which is why we put "other things being equal"). The correlation works both ways: figural contours tend to be convex and convex contours tend to be figural.

Convexities likely have a higher probability of occurring in a scene than concavities, so under conditions of uncertainty (such as in the current studies where a surface is seen through an aperture) there is a preference for assigning figural status to the convex side of a contour and hence for assuming that this side is nearer. This speeds (slows) responses when this preference to make the convex side as figural and in front is supported (contradicted) by other sources of information (binocular disparity in the current studies).

One word of caution is necessary with respect to the task. We believe that the most likely reason for slower responses is the cue conflict, but there is more than one possible mechanism for this effect. At one extreme, information from configural factors (ie convexity) and from binocular disparity may be integrated, leading to reduced performance on an image-segmentation task. Perceived metric depth may even be depressed as a consequence of such conflict. Burge et al (2005) have recently reported that another configural factor, that of familiarity, affects perceived metric depth. At the opposite extreme, observers may simply be surprised by the fact that the convex region is not at the front and the delay in response may emerge at a later, response-selection stage. It seems unlikely, however, that cognitive expectations should survive after 24 trials of practice (not included in the analysis) and during hundreds of experimental trials. In conclusion, our results confirm a powerful role of convexity with respect to figure – ground organisation; we are currently studying in our lab whether convexity also affects the amount of perceived depth.

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