
A fair test of the effect of a shadow-incompatible luminance gradient on the simultaneous lightness contrast (followed by Discussion)

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Abstract. Shadow-compatibility of simultaneous lightness contrast is discussed by Alexander D Logvinenko and Paola Bressan, with examples claiming to provide a test of the hypothesis.

A pattern depicted in figure 1 produces a strong simultaneous lightness contrast effect—the alternating horizontal rows of diamonds look different though they are physically the same. Such a dramatic difference in lightness seems to be caused by a luminance gradient. Specifically, it was hypothesised that, first, being shadow-compatible, this gradient serves a strong cue for illumination, implying a vertical wave of illumination; second, the simultaneous lightness contrast in figure 1 results from discounting this wave of illumination (Logvinenko 1999).

Bressan (2001) has recently claimed that the pattern shown in figure 2 provides a counter-example to such an account, since she believes that the luminance gradient in figure 2 is not shadow-compatible; however, it produces a simultaneous lightness contrast of nearly the same strength. On the contrary, I believe that the luminance gradient in Bressan's pattern is perfectly shadow-compatible. Indeed, for a luminance gradient to be shadow-compatible means that it can be produced by a gradient of illumination. For example, the luminance pattern in figure 1 can be produced by a wall of blocks the lateral sides of which have homogeneous reflectance and which is illuminated by a sinusoidal wave of light. It is easy to see that the luminance pattern in figure 2 could also be produced by the same sinusoidal wave of light if it falls slightly from the left onto a corrugated surface with homogeneous reflectance. Given such an illumination, the left side of the fold is in highlight and the right is in shadow, the diamonds appearing to be alternately situated in the horizontal peaks and troughs of the illumination wave. Therefore the luminance gradient in figure 2 is shadow-compatible to the same extent as that in figure 1.

To make it shadow-incompatible, figure 1 was transformed as follows (figure 3). Every other cube in each row in figure 1 was turned upside down. Hence, although figure 3 consists of the same cubes as figure 1, it is shadow-incompatible since the luminance gradient goes in the opposite direction for adjacent sides of neighbouring cubes. Such a luminance pattern as in figure 3 can be produced by light being cast onto the wall of blocks with homogeneous reflectance only if this lighting is arranged independently for each side of the cubes; this is highly unlikely to occur in the natural environment. As one can see, all the diamonds in figure 3 look almost the same. In other words, the simultaneous lightness contrast effect for figure 3 is nearly gone. This implies that, for the visual system, the likelihood of independent lighting for each side of the cubes is very low—thus it treats the luminance pattern in figure 3 as shadow-incompatible.

Lightness of the diamonds in figures 1 and 3 (as well as figures 4–6) has been measured for twenty observers by using the 31 point Munsell neutral scale. Each picture printed on an A4 sheet of white paper was presented twice (in random order) during

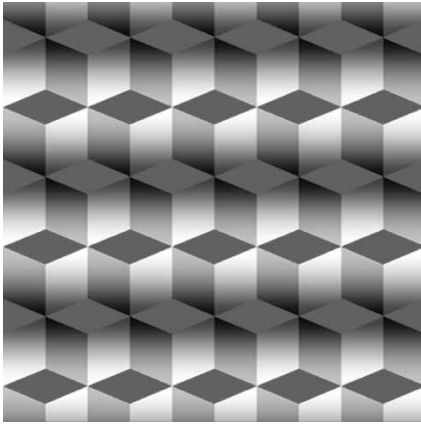


Figure 1. A wall of blocks with a shadow-compatible luminance gradient. Although all six horizontal rows of diamonds are printed with the same ink, the alternating rows look rather different (after Logvinenko 1999).

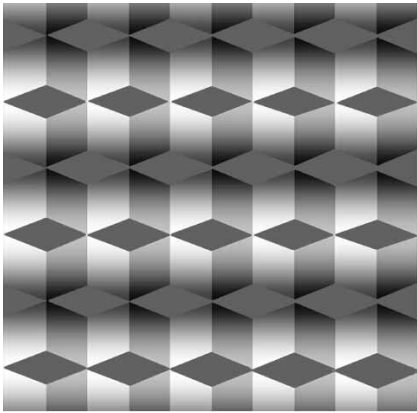


Figure 2. Bressan's 'impossible-lighting wall of blocks' (after Bressan 2001).

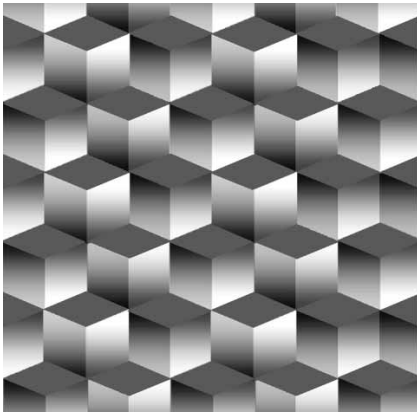


Figure 3. A wall of blocks with a shadow-incompatible luminance gradient.

an experimental session. In one presentation of figures 1 and 4 the observers were asked to make a Munsell match for the diamonds in 'light' rows, in the other in 'dark' rows. Respectively, in each single presentation of figures 3, 5, and 6 the observers were asked to make a Munsell match for just one of two kinds of diamonds in these figures: the diamonds which are the top side of two kinds of the cubes (with gradient upwards and downwards). Five sessions (one session a day) were held for all the observers. Therefore, altogether 100 measurements were made for each of the four types of the diamonds.

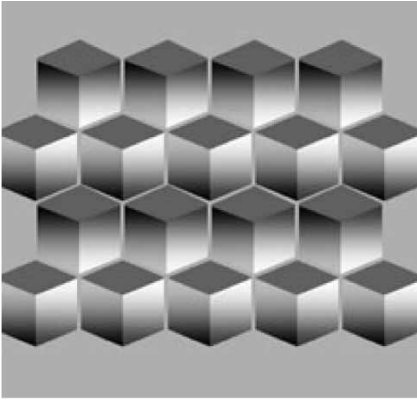


Figure 4. The shadow-compatible wall of blocks with separated cubes.

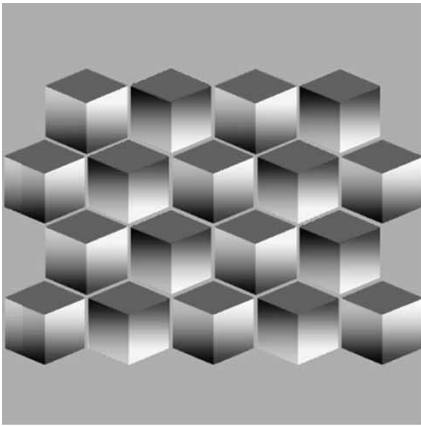


Figure 5. The shadow-incompatible wall of blocks with separated cubes against a light background.

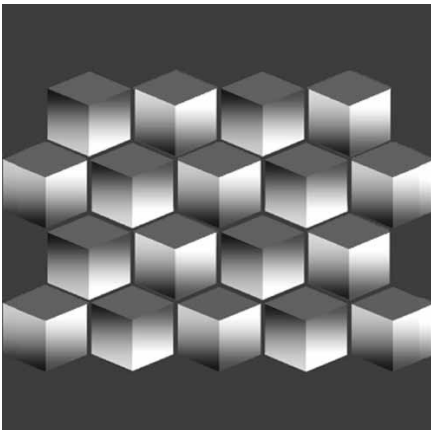


Figure 6. The shadow-incompatible wall of blocks with separated cubes against a dark background.

The median Munsell match (for all 100 measurements) for the diamonds in 'light' rows in figure 1 is 4.75, and that for the diamonds in 'dark' rows is 8.00. The median lightness difference between the diamonds in the 'light' and 'dark' rows was taken as a measure of the simultaneous lightness contrast. It was equal to 3.50 Munsell units.⁽¹⁾ The median Munsell match for the diamonds belonging to the cubes with

⁽¹⁾Note that the median difference is not equal to the difference of the medians. We believe that the former is a more appropriate index of the lightness shift between the 'light' and 'dark' rows than the latter since the inter-individual variability may mask this shift, especially when it is relatively small.

the luminance increasing upwards in figure 3 is 5.25. The median Munsell match for the diamonds belonging to the cubes with the luminance increasing downwards in figure 3 is 5.75. The median difference between lightness of these two types of the diamonds is 0.5. Although the lightness shift (ie simultaneous lightness contrast) was statistically significant (Wilcoxon signed rank test) for both figures (p values were less than 0.001), it is considerably reduced for figure 3.

Separating the diamonds from each other does not make an essential difference for both pictures (figures 4 and 5). The median Munsell match for the diamonds in 'light' rows in figure 4 is 4.75, and that for the diamonds in 'dark' rows is 6.75, the median lightness difference being 1.75. The median Munsell match for the diamonds belonging to the cubes with the luminance increasing upwards in figure 5 is 5.75. The median Munsell match for the diamonds belonging to the cubes with the luminance increasing downwards in figure 5 is 6.00. The median lightness difference for figure 5 was 0.25.

It follows that it is not the local luminance contrast at the diamonds' border that brings about the difference between simultaneous lightness contrast in figures 1 and 3. Really, the local luminance contrast at the diamonds' border is the same in figures 4 and 5; however, the simultaneous lightness contrast effect in figure 4 is seven times that in figure 5; and this difference (between figures 4 and 5) is highly significant according to the Wilcoxon signed rank test ($p < 0.001$).⁽²⁾

Furthermore, as follows from figure 6, reversing the sign of the contrast does not make any difference. In figure 6 an array of the same cubes as in figure 5 is presented against a black background. The median Munsell match for the diamonds belonging to the cubes with the luminance increasing upwards in figure 6 is 5.75. The median Munsell match for the diamonds belonging to the cubes with the luminance increasing downwards in figure 6 is 6.00. The median lightness difference between the diamonds in different rows is the same as for figure 5, viz 0.25 Munsell units. This implies that the background in figures 5 and 6 plays a minor role, if any. Hence, the difference between the illusion in figures 11a and 11b in Logvinenko (1999) is unlikely to be accounted for by the difference in the surround as suggested by Bressan (2001, page 1035).

Thus, when a pattern with a luminance gradient is shadow-compatible, as in figures 1 and 4, it produces a strong simultaneous lightness contrast effect. On the contrary, when the same (local) luminance gradient is arranged so that the pattern is not shadow-compatible, as in figures 3, 5, and 6, the simultaneous lightness contrast effect, if found, is very weak.

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⁽²⁾For further evidence against the argument that luminance contrast around the diamonds' border contributes to the illusion in figure 1, see Logvinenko (1999), and Logvinenko et al (2002).

Comment by Paola Bressan

In his interesting paper, Logvinenko makes a number of points, none of which I agree with in the slightest; except the first, which is merely imprecise. The first point is that my ‘impossible-lighting wall-of-blocks’ (Bressan 2001) is shadow-compatible. This is inexact: if the display is seen as a wall of blocks, then the illumination *is* incoherent. What Logvinenko is correct in remarking is that, under one of its possible interpretations, the display becomes shadow-compatible. In that case, it is *not* a wall-of-blocks, but a corrugated surface. The diamonds are not the tops of the blocks seen in perspective, but actual diamonds, suspended in front of the corrugated surface. In other words, the impossible-lighting wall-of-blocks might be seen as a possible-lighting corrugated-surface-with-pendants.

Now to point two. Logvinenko produces a display (figure 3) that is truly shadow-incompatible, and shows that, here, lightness contrast is considerably reduced, although still highly significant ($p < 0.001$). He appears to take this as evidence for the shadow-compatibility idea. However, he has just explained the lightness illusion in figures 1 and 2 as the result of “discounting the wave of illumination”. How does he then propose to explain the significant lightness illusion in figure 3, where there is no wave of illumination to discount? One has to concede that the illusion is caused either by something *other* than discounting the wave of illumination, or, if one is totally unable to part with the idea, by something *more* than discounting the wave of illumination.

Forward to point three. Logvinenko takes the two main displays and separates very slightly the cubes from each other, creating figure 4 from figure 1, and figures 5 and 6 from figure 3. He observes a decrease in the illusion when separating the cubes of figure 1 (from 3.50 to 1.75 Munsell units), and a decrease in the illusion when separating the cubes of figure 3 (from 0.50 to 0.25 Munsell units). This finding seems to have quite diverse effects on Logvinenko and on myself. To Logvinenko, it indicates that “separating the diamonds from each other does not make an essential difference for both pictures”. To me, it indicates that each illusion is reduced by half.

Let the numbers arbitrate. What they tell is that when, on two sides, the diamonds are disconnected (even by millimetres) from the nearby gradients, the lightness illusion diminishes significantly. Contrary to Logvinenko’s claim, this finding supports, rather than contradicts, the explanation I have given (see figures 3a and 3b in Bressan 2001) of the difference between two of Logvinenko’s displays (figures 11a and 11b in Logvinenko 1999). In one of them (yielding strong lightness induction), the gradients surround the diamonds on all four sides; in the other (yielding weak lightness induction), the gradients are missing altogether on two sides. Referring to the latter, I have written: “any gradient-induced effect will be reduced by half for these blocks” (Bressan 2001, page 1035). Not too astoundingly, this is the precise amount of effect reduction now reported by Logvinenko for the displays where the diamonds are removed from two of the four gradients. Inasmuch as two is half of four, this seems to accord very nicely with the idea of local or semi-local operations.

Going now back to point two, and then rapidly towards the exit: the notion that figure 3 is less effective than figure 1 because of its shadow-incompatibility does not sit well with me. My disbelief stems not from prejudice, but from consideration of several pieces of evidence, where objects apparently in the shade, or under a dark veil, fail to lighten. See, by way of example, the two ‘articulated anti-snakes’ (Bressan 2001) at the bottom of figure A. Do I have, then, an alternative answer why the illusion in Logvinenko’s figure 3 is so much fainter than in his figure 1? I do: in figure 1, each diamond is surrounded by four gradients with identical polarities, one on each side. In figure 3, each diamond is surrounded by three gradients with identical polarities, plus one gradient whose polarity is reversed. Hence, other conditions are not equal.

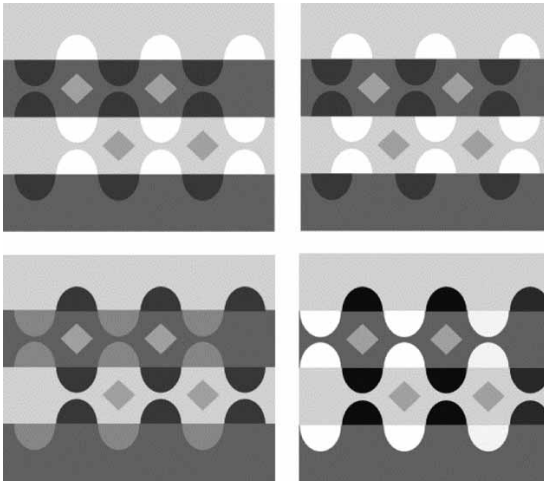


Figure A. All the grey diamonds in these displays are identical. Top-left display: the snake illusion (redrawn after Adelson 2000). The two diamonds that appear to sit in the shadow, or under a dark filter, look lighter than the other two. Is this a product of shadow discounting? None of the other displays is consistent with this idea. In the chopped-and-shifted snake (Bressan 2001), top-right, the X-junctions that are supposed to mediate the impression of illumination or transparency have gone, but the illusion has abated only slightly. In the ‘articulated anti-snakes’ (Bressan 2001), bottom, the bulk of the illusion has vanished, although in each display two of the four diamonds appear to sit in the shadow, or under a dark filter.

A clever test, but not a fair one: in figure 3, we expect a weaker contrast effect from *any* theoretical stance, and *whether or not illumination matters*. The true ‘fair test’ would be the one where shadow-compatibility changes, but nothing else in the stimulus does; least of all, local surrounds. Given the way shadow-compatibility is defined, such a test is impossible.

In figure B, I present a demonstration where the objects of our dispute are stripped to their barest bones. The two diamonds on the left are placed at the light ends (top) and at the dark ends (bottom) of four coherent gradients. These are the bricks from which the wall-of-blocks of figure 1 is made. The two displays in the middle are identical to their left-side neighbours, except that, in each, one of the four gradients has been reversed. These are the components of the wall-of-blocks of figure 3. Reversing another gradient generates the displays on the right: each contains two light–dark and two

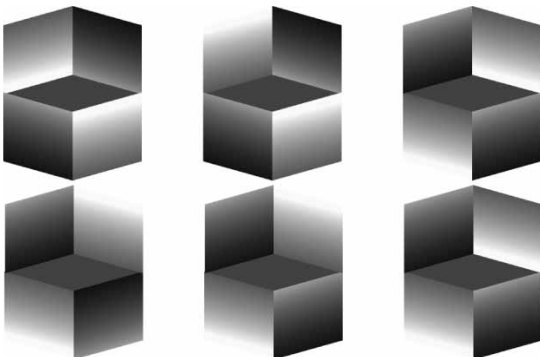


Figure B. Each diamond is surrounded by four light–dark (top) or dark–light (bottom) gradients, in the left pair; three light–dark (top) or dark–light (bottom) gradients, plus a reversed gradient, in the middle pair; two light–dark (top) or dark–light (bottom) gradients, plus two reversed gradients, in the right pair. The apparent difference between the top diamonds and the corresponding bottom diamonds declines gradually.

dark–light ramps. The reader will agree that the simultaneous contrast illusion, prominent for the pair on the left, subsides in the middle pair, and dissolves entirely in the rightmost one. I conclude that it is the different gradient layout, not the impossible lighting, that spoils simultaneous lightness contrast in figure 3.

Of course, one may speculate that gradient coherence works exactly inasmuch as it signals the presence of regions of light and shadow. But none of Logvinenko's figures is direct evidence for this. If they are evidence for anything, it is for the opposite: in figure B, shadow-compatibility exits the scene abruptly in the passage from the left to the middle pair, yet part of the illusion lingers. The middle and right pairs are both shadow-incompatible, but the former shows some contrast, while the latter shows none. Again, whichever meaning we wish to give to 'local' and however much we loathe the word, the 'local-computation' bell rings much earlier, and louder, than the 'shadow-compatibility' one.

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Reply to Bressan's comment

My "fair test of the effect of a shadow-incompatible luminance gradient on the simultaneous lightness contrast" is criticised by Bressan on the following grounds.

First, she claims that the definition of shadow-compatibility was imprecise and the test was inexact because the same picture (Bressan 2001; my figure 2) could be interpreted as shadow-compatible for one sort of illumination and as shadow-incompatible for the other. Such a conclusion, however, is apparently based on a misunderstanding of my definition of shadow-compatibility. It states that a luminance pattern is shadow-compatible if there is at least one pattern of illumination that can produce the luminance pattern in question.⁽³⁾ I have pointed out an illumination pattern which *can* produce the picture in question, thus having proved its shadow-compatibility according to my definition.

Second, Bressan believes that the residual simultaneous lightness contrast effect observed in my shadow-incompatible picture (my figure 3) undermines shadow-compatibility as an explanatory principle. This implies that shadow-compatibility is the only explanatory principle. While I long for a monistic theory of lightness perception too, I must admit that such a dream is unlikely to come true. Indeed, it looks as if what we loosely call simultaneous lightness contrast is, in fact, a whole variety of different phenomena requiring different explanations. More specifically, apart from Helmholtzian type of simultaneous lightness contrast (eg lightness illusions produced by shadow-compatible luminance patterns) there is Hering's type of simultaneous lightness contrast (eg grating induction, Hermann grid, etc), which is quite different (Logvinenko and Ross 2002). Furthermore, it was shown recently that there is at least one more type of simultaneous lightness contrast which is, actually, a particular case of a more general

⁽³⁾ It should be kept in mind that shadow-compatibility is a characteristic of a luminance pattern from the human visual system point of view. Every luminance pattern can, generally speaking, be produced by adjusting an illumination. Therefore, by saying that a particular pattern is not shadow-compatible, we mean that the human visual system "does not believe" that the pattern has been produced by the illumination.

psychophysical phenomenon called the anchoring effect (Logvinenko 2002). Although it is far beyond the scope of the present note to find out the causes of the residual simultaneous lightness contrast effect in question, note that making the luminance gradient shadow-incompatible reduces the illusion to the level of a classical simultaneous contrast effect—0.5 Munsell units.

Third, Bressan interprets the 50% reduction of the illusion caused by insulating cubes (my figures 4 and 5) as evidence against the explanation based on shadow-compatibility, claiming that it can be accounted for in terms of local contrast. As to the role of local contrast, there is abundant evidence against it (eg Adelson 1993; Logvinenko 1999; Logvinenko et al 2002). For example, the local contrast around the diamonds' borders in the picture with a shadow-compatible luminance gradient (my figure 1) is the same as that in the 3-D model of the original Adelson's tile pattern⁽⁴⁾ (Logvinenko et al 2002). Nevertheless, we found no illusion at all for this 3-D model. Moreover, in my figures 4 and 5 exactly the same cubes are presented. The only difference between these pictures is in the spatial layout. The same cubes as in figure 4 are rearranged in figure 5. Hence, any explanation based on the local contrast has to predict the same effect for both pictures. However, figure 4 was found to produce seven times as great an illusion as figure 5.

As to an account of the reducing effect of insulation, this can be easily done within the theoretical framework resting on the shadow-compatibility idea. Remember that the picture with a shadow-compatible luminance gradient (my figure 1) creates a perceptual conflict of cues for illumination. A luminance gradient, and other pictorial cues, indicates the sinusoidal wave of illumination, whereas cues for the real illumination testify against it. What we see in this picture is a result of a compromise between these two conflicting sources of information of illumination. Separating cubes from each other weakens the weight of the luminance gradient as a cue for pictorial illumination, thus resulting in a decrease of the illusory effect.

Fourth, Bressan suggests that only shadow-incompatible patterns with the same local contrast around the test area could be a 'fair test' of the shadow-compatibility hypothesis. Such patterns are presented in figure I. Being physically the same, the central disks have the same local contrast around their borders as the corresponding

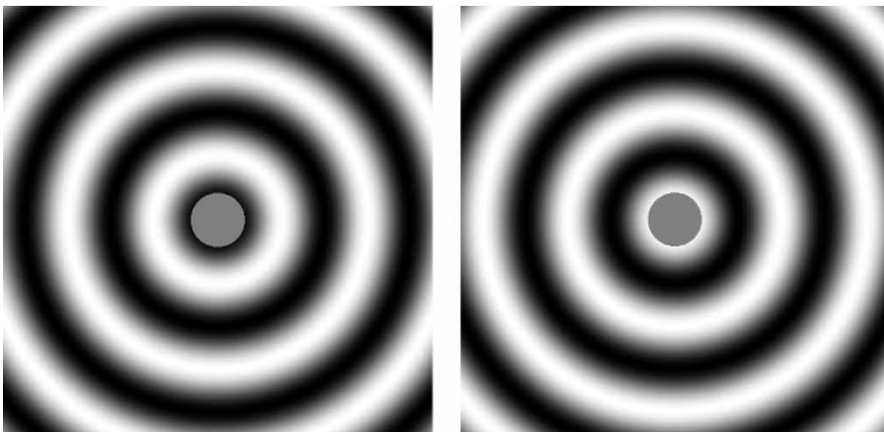


Figure I. When shaped as a circular pattern, a luminance sinusoidal gradient elicits no more than the classical simultaneous lightness effect.

⁽⁴⁾Note that the picture with a shadow-compatible luminance gradient was made from the original Adelson's tile pattern (Adelson 1993) by blurring the border between the horizontal strips, leaving the local contrast unchanged.

diamonds in the picture with a shadow-compatible luminance gradient (my figure 1). However, they look pretty much the same. Furthermore, the lightness illusion produced by such patterns was found to be even weaker than the classical simultaneous lightness contrast effect (Zaidi et al 1992; Peromaa and Laurinen 2002). Therefore, the luminance gradient itself is not enough to produce a lightness illusion. It is important how it is shaped. A rectilinear sinusoidal gradient brings about a very strong lightness effect of the Helmholtzian type (Logvinenko 1999; this paper). On the contrary, a circular sinusoidal gradient produces almost no effect at all. I believe that this is because a circular sinusoidal grating is a shadow-incompatible luminance pattern. The lack of the illusion in figure I corroborates Adelson's finding that a curvilinear luminance border is unlikely to be interpreted by the human visual system as an illumination border (Adelson and Somers 2000).

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Reply to Logvinenko's reply

Logvinenko's replies fall into two separate categories. The first contains replies to comments I have made. The second contains replies to comments I have not made.

I will deal with these categories in turn, starting with the first, which contains one item.

"As to an account of the reducing effect of the insulation, it can be easily done within the theoretical framework resting on the shadow-compatibility idea. (...) Separating the cubes from each other weakens the weight of the luminance gradient as a cue for pictorial illumination, thus resulting in a decrease of the illusory effect."

We all agree that separating the cubes from each other weakens the weight of the luminance gradient (we have the evidence, that is the reduced effect). But does it do it inasmuch as gradients are a cue for pictorial illumination, as Logvinenko suggests? This we do not know, and for the good reason that we do not have the palest evidence either for or against. Separating the recipient of lightness induction from its inducer obviously reduces the amount of induction, whether the inducer is a luminance gradient, as here, or a piece of white paper, as in Newson (1958). I cannot bring myself to believe that, when two pieces of paper are moved apart, induction subsides because the visual system changes its inferences about the scene illumination. We need to be persuaded

that whatever modulates induction here cannot modulate induction in the gradient case, before we forgo a common explanation.

Let's now move to the second category of Logvinenko's replies (replies to comments I have not made), which contains five items. All five are examples of straw man fallacy. In a dialectical contest, this is the process of misrepresenting an opponent's position, making it implausible and more easily refutable, then tearing it apart, and concluding that the original version of the argument has been demolished. The arguer sets up a man of straw, knocks it down, and proclaims victory. I shall now dissect each of the five straw men, in the same sequence as they appear in Logvinenko's piece.

First straw man

Setting it up:

"She claims that the definition of shadow-compatibility was imprecise and the test was inexact because the same picture could be interpreted as shadow-compatible for one sort of illumination and as shadow-incompatible for the other."

Knocking it down:

She did not understand the definition.

My real position:

Nowhere have I claimed that the definition of shadow-compatibility is imprecise. (Although, reading Logvinenko's footnote 3 where a pattern is defined as "not shadow-compatible" "when the human visual system 'does not believe' that the pattern has been produced by the illumination", I am tempted.) But for the moment, my dissatisfaction here is minor and only applies to imprecise picture labelling. I had called this pattern "impossible-lighting wall-of-blocks" (Bressan 2001). The lighting is indeed impossible if we see this pattern as a wall of blocks. Now, I agree that under a different interpretation the pattern is shadow-compatible (and, thus, shadow-compatible *tout court*): let's just give it a name different from "wall-of-blocks", since in its shadow-compatible guise it no longer looks like a bunch of blocks.

Second straw man

Setting it up:

"Bressan believes that the residual simultaneous lightness contrast effect observed in my shadow-incompatible picture (...) undermines shadow-compatibility as an explanatory principle. This implies that shadow-compatibility is the only explanatory principle. While I long for a monistic theory of lightness perception too ..."

Knocking it down:

There are many different sorts of simultaneous lightness contrast requiring different explanations [including a 'special' type recently described by Logvinenko himself (2002) and named "anchoring effect"], hence shadow-compatibility cannot possibly be the only explanatory principle.

My real position:

My actual words were: "One has to concede that the illusion is caused either by something *other* than discounting the wave of illumination, or, if one is totally unable to part with the idea, by something *more* than discounting the wave of illumination". In other words, if shadow-compatibility works at all, it cannot possibly be the only explanatory principle. This is exactly the argument with which Logvinenko claims he is contradicting me.

Incidentally, the "anchoring effect" that Logvinenko mentions as a case of lightness illusion demanding an explanation different from the traditional lightness illusion (Logvinenko 2002) is perfectly predicted by the double-anchoring model of lightness (Bressan, submitted), where it is the outcome of the very same mechanisms (highest-luminance anchoring and surround anchoring) that produce the traditional lightness illusions. As a matter of fact, Logvinenko's (2002) 'anchoring effect' is exactly the same

as Bressan's (2001) 'dungeon illusion', the only difference being that Logvinenko used fewer elements, thus obtaining a weaker effect. (In the dungeon illusion, white remote elements darken grey target elements; black remote elements lighten grey target elements.)

I should add that the effects enumerated by Logvinenko as "requiring different explanations" (SLC versus grating induction versus the Hermann grid) are for example accounted for, all in one go, by models based on multiscale spatial filtering, such as that of Blakeslee and McCourt (1997, 1999). I recently learned that the dungeon illusion (and consequently the 'anchoring effect', too) is also predicted by such models. So, it seems that there are, after all, fewer types of lightness illusion than Logvinenko has reason to believe.

Third straw man

Setting it up:

"Bressan interprets the 50% reduction of the illusion caused by insulating the cubes as evidence against the explanation based on shadow-compatibility, claiming that it can be accounted for in terms of local contrast."

Knocking it down:

There is abundant evidence against the role of local contrast.

My real position:

Two unrelated straw men in a single sentence. First, I do *not* interpret the 50% reduction of the illusion as evidence against the shadow-compatibility idea. What I said instead was: "this finding supports, rather than contradicts, the explanation I have given (...) of the difference between two of Logvinenko's displays (...)". In plain words, the 50% reduction of the illusion now reported by Logvinenko was indeed predicted by my explanation, which is alternative to an explanation based on shadow compatibility. In the presence of two explanations, B and L, which are not mutually exclusive, showing that something is consistent with explanation B is not the same as saying that it is evidence against explanation L. What raises my spirits is that this finding resulted from an experiment concocted in order to dismantle explanation B.

Second, I do *not* claim that this finding can be accounted for in terms of local contrast. We all know that local contrast is just a small part of the lightness-computation picture. Evidence is everywhere, so much of it that profusion has made it stale. What I said instead was: "this seems to accord very nicely with the idea of local or semi-local operations". By "local or semi-local operations" I most certainly do not mean local contrast! Local and semi-local anchoring would be more like it (Gilchrist et al 1999; Bressan, submitted). And in that passage I made no mention of 'global' operations not because I only believe in local events (I do not), but simply because global processes are not required to explain the 50%-reduction finding.

Fourth straw man

Setting it up:

"Moreover, in my figures 4 and 5 exactly the same cubes are presented. (...) The same cubes as in figure 4 are rearranged in figure 5. Hence, any explanation based on the local contrast has to predict the same effect for both pictures."

Knocking it down:

On the contrary, figure 4 produces an illusion considerably larger than figure 5.

My real position:

First, the line of reasoning followed here has no bearing on my position, or anyone else's, since I am not advocating that local contrast explains lightness illusions, and I would actually be amazed if anyone currently working in the field were, either. Second, the finding that identical local contrasts in these two pictures yield different effects fails to surprise me, and poses no problem whatsoever in a double-anchoring approach, where the lightness of any given diamond is a weighted average of its lightness values

within each of the frameworks (perceptual groups) to which it belongs. The framework that links each diamond to the uniform background is just one of these; here, conditions are equal in the two pictures, and all diamonds receive the same lightness value. The framework that links each diamond to the two adjacent gradients underneath is another one; here, conditions are also equal in the two pictures. Being the highest luminance, the diamonds adjacent to the dark end of the gradients are computed as white, hence receive a lighter value than the diamonds adjacent to the light end of the gradients (making for some illusion in both pictures).

In the framework that links each diamond to the two non-adjacent gradients above, however, conditions are *not* equal. In figure 4, each diamond is roofed by two gradients with identical polarities: two dark ends for some diamonds, two light ends for others. In this framework, the former diamonds are the highest luminance and are, once again, computed as white. In figure 5, however, each diamond is roofed by two gradients of opposite polarities. In this framework, no diamond is computed as white, and all diamonds are equal. An essentially symmetrical reasoning goes for the diamonds surrounded by four *light* gradients in figure 4, and the corresponding diamonds in figure 5. Relative to the former, the latter lighten, owing to the replacement of a light gradient with a dark one. The double-anchoring model thus predicts that the illusion will be much larger in figure 4 than in figure 5; that the diamonds surrounded by dark gradients will look lighter in figure 4 than in figure 5; and that the diamonds surrounded by light gradients will look darker in figure 4 than in figure 5. This is precisely what Logvinenko found—no need to invoke shadow compatibility or the perception of illumination.

Fifth straw man

Setting it up:

“Bressan suggests that only shadow-incompatible patterns with the same local contrast around the test area could be a ‘fair test’ of the shadow-compatibility hypothesis. Such patterns are presented in figure I.

Knocking it down:

“Being physically the same, the central disks have the same local contrast around their borders as the corresponding diamonds in the picture with a shadow-compatible luminance gradient. However, they look pretty much the same.”

My real position:

Again, this is not what I said. My words were: “The true ‘fair test’ would be the one where shadow compatibility changes, but nothing else in the stimulus does”. The test should consist of comparing two stimuli which are *identical* in all respects, *except* shadow compatibility. This is an impossible experiment, given the way shadow compatibility is defined (“a luminance pattern is shadow-compatible if there is at least one pattern of illumination that can produce the luminance pattern in question”. Thus, simply changing the interpretation will not do.) Unfortunately, the two concentric patterns presented by Logvinenko are different from the wall-of-blocks in most respects, and therefore irrelevant to the point we are discussing here.

But since we are at it, I would like to remark that the failure of these patterns to produce a strong lightness contrast is to be expected, and that Logvinenko’s explanation that this happens because the luminance pattern is a “circular sinusoidal grating”, hence “shadow-incompatible”, cannot be correct. Let’s see what an anchoring perspective would predict in this case. The lightness of the two grey disks is a weighted average of the lightness values obtained by the disks within each of the frameworks to which they belong. It is a weighted average in the sense that values computed within stronger frameworks weigh more than values computed within less strong ones. The ‘strength’ of a framework is a direct (though not proportional) function of its area (see Gilchrist et al 1999; Bressan, submitted).

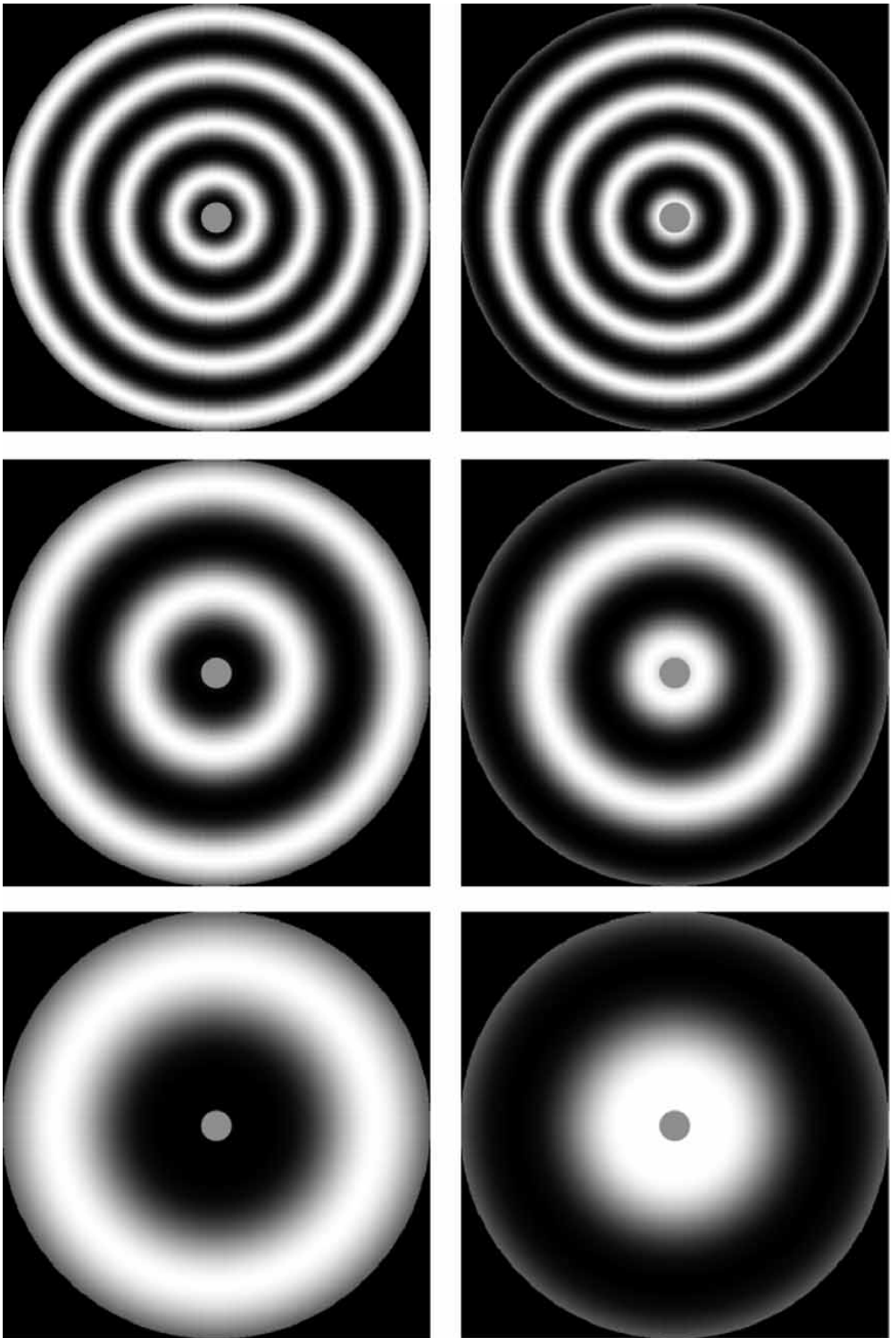


Figure C. The small grey disks in these displays are identical. Top display: the disk on the left looks lighter than the disk on the right, but the effect is extremely weak. Is this due to the circular shape of the gradient, as suggested by Logvinenko? This appears unlikely: the effect is quite obvious in the middle display, and even more in the bottom display, although the gradients are still circular.

The frameworks where all the action takes place are those where the disks group with the closest end of the gradients on which they sit: black for the disk on the left, white for the disk on the right. In this display, however, the two grey disks become anchored to a local framework (the adjacent gradient) whose visible area is quite small. To be sure, the incremental disk on the left *is* computed as locally white, but this value weighs little in the final average, yielding a feeble simultaneous contrast effect (see figure C, top). Increasing the area of the adjacent gradient augments the relative contribution of the ‘white’ local value in the final average, and with it the resulting contrast effect (see figure C, middle and bottom). I conclude that the vanishingly small effect seen in Logvinenko’s figure is not due to the grating being circular, but more mundanely to the target disk covering up most of the gradient on which it sits.

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