Perceptual learning and face recognition : Disruption of second order relational information reduces the face inversion effect.

Ciro Civile (cc413@exeter.ac.uk)
School of Psychology, College of Life and Environmental Sciences,
University of Exeter, UK.

R.P. McLaren (R.P.McLaren@exeter.ac.uk)
School of Psychology, College of Life and Environmental Sciences,
University of Exeter, UK.

I.P.L. McLaren (I.P.L.McLaren@exeter.ac.uk)
School of Psychology, College of Life and Environmental Sciences,
University of Exeter, UK.

Abstract

The face inversion effect is a reduction in recognition performance for inverted faces compared to upright faces that is greater than that typically observed with other stimulus types (e.g. houses; Yin, 1969). This study investigated the link between second-order relational structure and the face inversion effect suggested by Diamond and Carey (1986). The idea is that expertise gained as a consequence of a great deal of experience with exemplars derived from a familiar category, that possess what Diamond and Carey term second order relational structure, can produce an improved ability to distinguish between and recognise members of this category. Because facial features share the same basic spatial configuration, i.e. eyes are always above the nose and so on, and individual faces vary these spatial arrangements slightly, they have second order relational structure. The argument is that our experience with this structure underpins our ability to recognize faces, and this expertise with faces is lost on inversion because inversion disrupts the ability to exploit second order relational information. In this paper we report two experiments that confirm that we can obtain a strong face inversion effect, and that the magnitude of this effect can be reduced by disrupting the second order relational structure of the faces.

Keywords: Inversion effect; face recognition; Thatcher illusion; scrambled faces; expertise; perceptual learning.

Introduction

Recognition of objects that are usually seen in one orientation is sometimes strongly impaired when the same objects are turned upside down, showing how intrinsically difficult it is to identify them. This has been found to be particularly the case for faces, a phenomenon known as the face inversion effect. (Yin,1969). Thus, the fact that recognition of human faces is more impaired by inversion than is recognition for other stimuli has underlined how faces are, in some sense, special. Over the past two decades, however, more behavioural evidence has emerged that challenges the assumption that facial stimuli are special, not the least of which is the demonstration that the inversion effect on recognition memory can be as strong with dogs as with faces when the subjects are experts in the identification and assessment of specific dog breeds. Given that the only stimuli that result in a substantial inversion effect are the ones for which the subjects have the necessary expertise (Diamond & Carey, 1986), this suggests that the face inversion effect may not be due to the fact that facial stimuli are subject to special processing because they are facial in nature, but instead that there are other factors, such as expertise, which give rise to this effect. Diamond and Carey (1986) proposed that it is a special type of information "second order relational information" that we depend on with increasing expertise. Human faces all have the same group of features (eyebrows, eyes, nose, mouth, etc.). All faces tend to have in common the same basic disposition of components, such that the eyes are always above the nose and so on. Thus, "first order relational information" corresponds to the spatial relationship between these features of a face, and "second order relational information" corresponds to the small variations in these spatial relationships that individuate the faces. In one of their experiments on detecting grotesqueness, Searcy and Bartlett (1996) made faces grotesque by either changing local elements, such as blackening teeth, blurring the pupils, or by changing the facial configuration. When shown in an inverted orientation, faces that were distorted by means of configural changes seemed to be more similar to the normal version while the "locally distorted face" still looked grotesque. Thus, configural changes did not survive the inversion process as well as local ones. In another experiment, Leder and Bruce (1998) distorted faces so as to be more distinctive, either changing local features by giving them darker lips, bushier eye brows, etc. or by changing configural information to give a shorter mouth to nose spatial relation, etc. Distinctiveness impressions caused by distorted configural information disappeared when faces were presented in an inverted orientation compared to both upright faces and faces distorted in their local aspects. This sensitivity of configural distortions to inversion is also believed to be the basis of the "Thatcher illusion" (Thompson, 1980). Here, the illusion seems to depend on the inversion of mouth and eyes within the face being hard to detect (Thompson,1980) when the whole face is inverted. The explanation typically offered is that inversion reduces the use of configural information in the face, and promotes a more componential analysis of the features present. In isolation, the mouth and eyes do not look odd, and so cause no great reaction in the viewer. When the face is shown in its normal orientation, however, we revert to configural processing, and this makes the distortions present in the mouth and eyes stand out, resulting in a strong reaction to the face on the part of most percipients. These results all provide evidence for the powerful effect that second order relational information has in the processing of upright faces relative to inverted faces. One possible criticism of this position would be that the nature of the difficulty caused by disruption of configural information consequent on inversion is still to be explained. The suggestion from perceptual learning theories is that expertise for faces based on familiarity with them as a class might play a major role in this because this can act via configural information, and if the configural processing is disrupted by inversion, then this expertise is lost.

McLaren *et al.* (1989) proposed that having acquired expertise with a category represented by a prototype (by means of experience with it) will tend to lead to the unique discriminating elements of exemplars constructed from that category becoming more salient, more active, compared with the prototypical ones that tend to be common across exemplars. This is a consequence of latent inhibition accruing more to the prototypical component of the stimulus representation in the course of experience with the category. This model of associative learning makes predictions about the inversion effect which are consistent with McLaren's (1997) experiments. The first experiment demonstrated that the inversion effect is dependent both on the subject's familiarity with a category and on the category being defined by a prototype. Subjects were exposed to a set of chequerboards and were then asked to categorize them into two different categories. This was followed by a discrimination task which included two pairs of chequerboards (one pair in an upright and the other pair in an inverted orientation) from a familiar category plus two pairs of chequerboards from a novel category (again one pair upright the other inverted). The results showed that familiarity with a prototype-defined category possessing second order relational structure gave subjects an enhanced ability to discriminate between exemplars of that category in an upright orientation. This benefit was lost when the stimuli were inverted. Finally, in a second experiment this time using a delayed matching task in the test phase, it was shown that experience with a prototype-defined category once again resulted in a significant inversion effect. The importance of these results is that they imply that it should be possible to ensure that latent inhibition, produced by means of familiarity with a category possessing the requisite structure, will lead to perceptual learning that results in an inversion effect for exemplars of that category.

In the present study, we addressed the link between expertise and the face inversion effect made by perceptual learning theories. In Experiment 1, our goal was to obtain a strong inversion effect for normal face stimuli and we predicted a reduced inversion effect for Thatcherised face stimuli. These latter stimuli are well matched to normal faces in terms of complexity, but they suffer from disrupted second order-relational information even when upright, which should reduce some of the effect of expertise, and so inversion should have less of an effect on them. This theme is further developed in Experiment 2 where we investigated the inversion effect using a new set of faces (scrambled faces) that were characterized by complete disruption of both first and second-order relational structure whilst still maintaining all the local features typical of normal faces.

Experiment 1

Materials

The study used a set of 128 images in total. The faces were standardized to grey scale images on a black background using Adobe Photoshop. Only male faces were used. This was to enable the hair to be cropped on each image without cropping the ears (because males tend to have shorter hair with ears visible whereas females often have longer hair covering the ears). A programme called Gimp 2.6 was used to manipulate the 128 stimuli. Any given face stimulus was prepared in four different versions i.e. normal upright, normal inverted, Thatcherised upright and Thatcherised inverted which were used in a counterbalanced fashion across participants so that each face was equally often used in each condition of the experiment Thatcherised faces were produced by rotating the mouth and each of the eyes (individually) by 180 degrees. Examples of the stimuli used are given in Figure 1. The experiment was run using Superlab Version 4.0.7b. installed on an iMac computer.

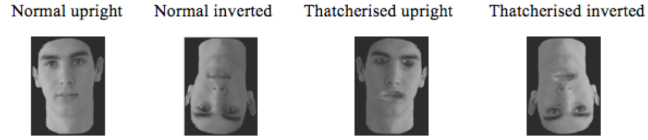

Figure 1; Examples of stimuli used in Experiment 1 showing the four different conditions. The dimensions of the stimuli were 5.63cm x 7.84cm. The stimuli were presented at a resolution of 1280 x 960 . Participants sat 1m away from the screen on which the images were presented.

Participants

The participants were 24 psychology undergraduates at the University of Exeter.

Procedure

The study consisted of a 'study phase' and a 'test phase'. In the study phase each participant was shown 4 types of faces with 16 photos for each face type (giving a total of 64 faces). These faces will be termed the "familiar" (designated as 1) faces for that participant. The face types were: 1-Normal Inverted faces (1NI); 2-Normal Upright faces (1NU); 3- Thatcherised Inverted faces (1TI) and 4-Thatcherised Upright faces (1TU). In the test phase another 64 novel faces (designated as 2) split into the same four face types were added to this set. Each facial stimulus had a unique identifying number, to make sure that individual faces never appeared in more than one face type at a time during the experiment. To simplify their use in the experiment, the facial stimuli available were divided into sets of 16 giving 8 sets of stimuli, and each participant group was shown a different combination of the 64 facial stimuli split over the 8 sets. Each participant saw the facial stimuli corresponding to their participant group in a different order. The first event that participants saw after the instructions consisted of a warning cue (a fixation cross in the centre of the screen) presented for 1 second. This was followed by a face that was presented for 3 seconds. Then the fixation cross was repeated and another face presented until all 64 facial stimuli had been seen. Once all 64 faces were shown, the programme moved to the beginning of the old/new recognition task. Participants were told that they were about to see more faces presented one at a time in random order. They were asked to press the '.' key If they recognised the face or to press 'x' if they did not. Each participant within each participant group was then shown (in random order) the 64 faces they had already seen intermixed with a further 64 unseen faces. These unseen faces were taken from the sets of facial stimuli not used during the study phase. Table 1 shows the combinations of faces presented to each participant group.

Face Type	Participant Group 1	Participant Group 2	Participant Group 3	Participant Group 4	Participant Group 5	Participant Group 6	Participant Group 7	Participant Group 8
1 (1NI)	Set 1	Set 4	Set 3	Set 2	Set 5	Set 8	Set 7	Set 6
2(1NU)	Set 2	Set 1	Set 4	Set 3	Set 6	Set 5	Set 8	Set 7
3(1TI)	Set 3	Set 2	Set 1	Set 4	Set 7	Set 6	Set 5	Set 8
4(1TU)	Set 4	Set 3	Set 2	Set 1	Set 8	Set 7	Set 6	Set 5
5(2NI)	Set 5	Set 8	Set 7	Set 6	Set 1	Set 4	Set 3	Set 2
6(2NU)	Set 6	Set 5	Set 8	Set 7	Set 2	Set 1	Set 4	Set 3
7(2TI)	Set 7	Set 6	Set 5	Set 8	Set 3	Set 2	Set 1	Set 4
8(2TU)	Set 8	Set 7	Set 6	Set 5	Set 4	Set 3	Set 2	Set 1

Table 1: Combinations of facial stimuli presented to each participant group.

The procedure for the old/new recognition task was that after the warning cue (1 second), a face was shown for 4 seconds and participants had to respond during this period. If participants pressed the wrong key (i.e. a key other than 'x' or '.') the feedback 'Wrong key' was shown for 2 seconds prior to the next face appearing on the screen. If participants were too slow in responding (i.e. took longer than 4 seconds), the message 'Too slow' appeared on the screen. Since in the old/new recognition task there were 128 faces to consider, three participant breaks were incorporated after every 32 faces. At the end of the experiment participants were thanked for participating.

Results

The data from all 24 participants contributed to the signal detection *d'* analysis. Figure 2 gives the results for the mean *d'* obtained for each face type. A planned comparison was used to examine whether or not there was a significant inversion effect for normal facial stimuli. This gave a highly significant advantage $F(1,23) = 22.24$, $p<.001$ one-tailed, for normal upright faces vs. normal inverted faces, and another planned comparison showed a similar (although not significant) trend for Thatcherised upright vs. Thatcherised inverted faces, $F(1,23) = 1.88$, $p=.09$ one-tailed. There was also a significant interaction between face type and orientation, $F(1,23) = 5.04$, $p<.02$. This reflected the fact that the inversion effect in the normal faces was significantly greater than that in the Thatcherised faces. To further investigate this result, the effect of face type on the recognition of upright faces was also analyzed. Normal upright faces were recognized significantly better than Thatcherised upright faces,$F(1,23) = 8.99$, $p<.003$, but there was no significant difference in the recognition of normal inverted faces and Thatcherised inverted faces. Thus, it would seem that the reduction in the inversion effect for Thatcherised faces is due to the impact that Thatcherisation has on the upright faces rather than the inverted ones.

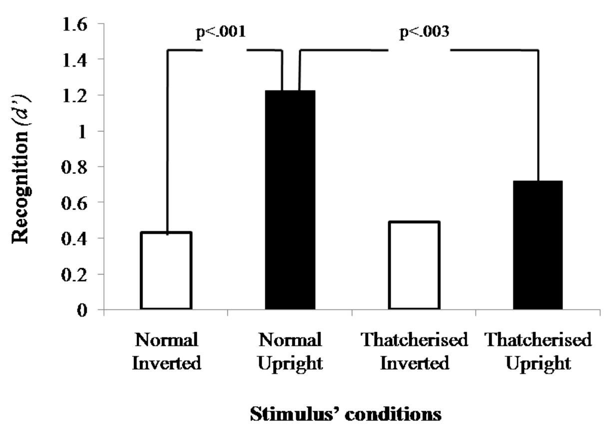

Figure 2: The X axis shows the four different stimulus conditions, whereas the Y axis shows the *d'* means for each of the four facial conditions in the test phase of Experiment 1.

Discussion

In agreement with the literature on face recognition, the results of this first experiment have shown a clear effect of inversion for normal faces. By way of contrast, there was no significant effect for Thatcherised faces (although there was a trend in this direction), and the effect for normal faces was significantly greater than for Thatcherised faces. This confirms that we can obtain a strong inversion effect, and the magnitude of this effect can be reduced by disrupting the second order relational structure of the faces (Diamond & Carey, 1986). Thatcherisation does not alter any of the local features, nor does it greatly change first order structure, but it does change the spatial relationship between features where the eyes or mouth are involved. The fact that this significantly reduced recognition performance to upright Thatcherised faces compared to normal upright faces is entirely consistent with our (and Diamond and Carey's, 1986) hypothesis, as is the fact that Thatcherisation had little impact on recognition performance to inverted faces. Nevertheless, Thatcherised faces clearly still have some unaltered second order relational information, and according to our hypothesis it is this that will enable them to benefit from our life experience with faces and so produce a trend towards an inversion effect. The logical next step is to construct a set of stimuli with all the features of a normal face, but with no second order relational information at all. Thus, we devised Experiment 2, in which we used the same experimental procedures as in Experiment 1 but this time rather than Thatcherised faces we created a set of scrambled faces. By simply re-arranging the local features of a face we hoped to control for stimulus complexity compared to normal faces, but completely eradicate the familiar first and second order relational information.

Experiment 2

Materials

Six facial features were used for scrambling i.e. the mouth, nose, two ears and the two eyes (including eyebrows). Scrambling was done by selecting at random one feature of the face and moving it to the forehead (chosen because this is the widest space inside the face and so can accommodate any feature). Following this, a second feature was selected and moved to the space left empty by the first feature, and so on until all the 6 facial features had been moved.

Figure 3: Examples showing the four different conditions.

Participants

24 psychology undergraduates at the University of Exeter took part in the experiment. The study was counterbalanced, as in Experiment 1, by splitting the participants into 8 groups.

Procedure

The procedure was exactly the same as that used in Experiment 1. Firstly, in the study phase, participants were asked to look at a set of faces shown on the computer screen one at a time in random order. Following this first phase of the experiment, the participants were presented with an old/new recognition task. The participants were told to press "." on the computer keyboard if they had seen the face before in the study phase, or "x" if they had not seen it before.We predicted that we would obtain a strong inversion effect for normal faces and no inversion effect for scrambled faces.

Results

The data from all 24 participants were used in the signal detection *d'* analysis. Figure 4 gives the results for the mean *d'* for each face type. Once again planned comparisons revealed a significant inversion effect for normal faces, $F(1,23) = 20.00$, $p < .001$, none for scrambled faces, $F < 1$, and a significant interaction between face type and orientation, $F(1,23) = 7.78$, $p < .01$. Performance in recognizing normal upright faces was also significantly better than recognition for scrambled upright faces, $F(1,23) = 26.62$, $p < .001$, but this time there was also a significant difference in the recognition of normal inverted faces and scrambled inverted faces, $F(1,23) = 3.37$, $p < .05$. Finally normal inverted faces were recognized numerically better than scrambled upright faces but not significantly so $F(1,23) = 2.75$, $p = .06$.

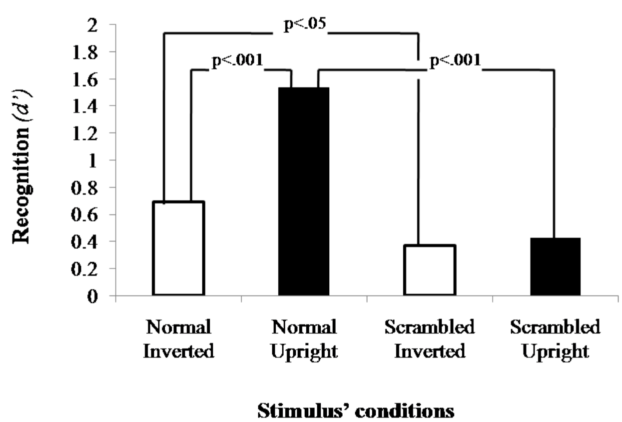

Figure 4; The X axis shows the four different stimulus conditions, whereas the Y axis shows the *d'* means for each of the four facial conditions in the recognition phase of Experiment 2.

Discussion

In agreement with our predictions there is a strong inversion effect for normal faces (upright better than inverted) whereas there is no inversion effect at all for scrambled faces. This is consistent with our hypothesis that participants when presented with scrambled faces in an upright orientation, which are affected by the complete disruption of the usual second-order relational information, would not have any expertise for those upright faces. Thus, when the same scrambled faces are presented in an inverted orientation participants would not suffer any loss of expertise, as there was none to start with. Hence, we do not observe any inversion effect. The new finding here is the significant difference between normal inverted faces and scrambled faces, with participants actually performing better in recognizing inverted normal faces than scrambled faces in both orientations (though only significantly better than scrambled faces that have been inverted). We return to this finding in the general discussion.

General Discussion

The two experiments reported here provide clear evidence that second order relational information is indeed critical in driving the substantial inversion effect for faces. When we disrupted the second order relational information of our set of faces by inverting (rotating by 180^0) the eyes and the mouth, producing Thatcherised faces, the intention was to disrupt exactly the information that Diamond and Carey identified as the basis of our expertise with faces whilst leaving other types of information (first order, local) relatively intact. Our Thatcherised faces are themselves defined in terms of a prototype (if you averaged the Thatcherised faces you'd get a prototypical Thatcherised face as a result), and so in some sense possess second order relational structure. But it is not structure that our participant's would be familiar with when entering the experiment, and so any effect of expertise would be confined to those aspects of the second order structure that had not changed (the spatial relationship between the nose and the ears for example). We have hypothesized that it is the combination of second order relational structure and experience with it that leads to expertise – and this is the basis of the interaction between Face Type and Orientation that we have repeatedly demonstrated in this paper. Our conclusion is that the inversion effect observed with normal faces is driven by our ability to exploit second order relational structure in categories of stimuli that both possess the necessary structure and that are sufficiently familiar. If this structure is disrupted, then so is the inversion effect. If it is eliminated entirely then so is the inversion effect. So far, so good; we will now subject this account to greater scrutiny in the context of our results and the theory of perceptual learning first put forward by McLaren, Kaye and Mackintosh (1989) and subsequently developed in McLaren and Mackintosh (2000, 2002).

The case for Thatcherised faces seems quite straightforward and has already been given in the discussion of Experiment 1. By rotating the eyes and mouth we do not alter the first order or local feature information to any great extent, but we do change the second order structure involving those features. If this is important for recognition, then we should see an effect on upright Thatcherised faces, and we do, as they are recognised significantly worse than normal upright faces. If inversion removes our ability to make use of this information, then the fact that it has been disrupted should not matter, and indeed, inverted Thatcherised faces do not seem to suffer in comparison with inverted normal faces. The results of Experiment 1, then, are entirely consistent with our version of Diamond and Carey's (1986) hypothesis with respect to face recognition.

Experiment 2 is superficially somewhat similar in its results, but actually reflects the consequences of a quite different manipulation. True, the local features are unchanged for the scrambled faces relative to the normal ones, but now both first and second order information are no longer in their familiar form, and the variation from scrambled face to scrambled face means that, in some real sense, there is no way to develop expertise with any second or first order relational information as a result of experience with the stimulus set. The effect of this is, in part, the expected one in that any inversion effect for the scrambled faces disappears. But the overall performance to scrambled faces, whether in an upright or inverted orientation, is now below not only that for upright normal faces (which would be expected) but also below that obtained for inverted normal faces, significantly so in the case of the inverted scrambled faces. This is a challenging result which stands in stark contrast to the finding that recognition performance for inverted Thatcherised faces is no different to that for inverted normal faces. If it was the case that we had simply eradicated second order relational information in the scrambled faces, and that this information was the source of the inversion effect in normal faces, then we might have expected scrambling to produce faces that (in any orientation) supported the same level of recognition performance as inverted normal faces. The finding that these faces are now recognized significantly worse than inverted normal faces indicates that something more is involved.

One possible explanation for this effect starts by suggesting that inverted normal faces may still be benefiting from some effects of expertise. After all, they contain standard facial features that have not been themselves changed apart from rotation as a configuration so they are recognizable as faces. Clearly it would be unwise to assume that all effects of expertise disappear under inversion, perhaps the use of second order relational information is only attenuated in these circumstances. If this is so, however, then some explanation of why the inverted Thatcherised faces are not worse recognized than inverted normal faces is needed. It would be tempting at this point to note that, because of the 180º rotation of the eyes and mouth used to Thatcherise the faces, when a Thatcherised face is inverted the eyes and mouth are now in their normal orientation – could this offset what otherwise would be a disadvantage for Thatcherised faces compared to their normal inverted counterparts? One problem with this explanation is that the upright scrambled faces (for which no local features are inverted) are also worse recognised ($p=.06$) than inverted normal faces, and not distinguishably different from inverted scrambled faces, which suggests that having features in their correct orientation is not, in itself, enough to confer much of an advantage.

Another possible explanation appeals to the fact that by using scrambled faces we have disrupted both first and second order relational structure. To make the point with somewhat greater force, with normal faces it is clear that one is dealing with a face whether it is upright or inverted. The same applies to Thatcherised faces, there is something odd about them in an upright orientation but there is no doubt that, upright or inverted, they are faces. This cannot so easily be said of scrambled faces, even though they possess all the local features of a face, the loss of first order structure makes it relatively hard to describe these stimuli as "face like" in either orientation. Perhaps this is the key then, to the poor performance with these faces, poor performance which is paradoxical in the sense that these faces, by virtue of the variation in the spatial arrangement of their features actually differ more from one another objectively than normal or Thatcherised faces. This should make them easier to discriminate and recognise, and the fact that it does not we would argue is testament to the strong influence of expertise on face recognition, though we note that it is also consistent with the notion of a specialised processing mechanism for faces. In the next section we consider one theory that offers an explanation for the development of expertise with faces that might be able to accommodate our results.

The MKM theory of perceptual learning (McLaren, Kaye and Mackintosh, 1989; see also McLaren and Mackintosh, 2000, 2002) suggests that features that are associatively predicted by other features are less salient than relatively unpredicted features. The associations that make the predictions are built up in the course of experience with the stimuli, but can only come about if there is a reliable relationship between features for these associations to exploit. Upright faces possess this quality, the first order structure is highly predictable, the second order structure less so. Thus the first order structure becomes relatively less salient with experience, and the second order structure can then be more easily used to individuate faces. On this theory, then, the scrambled faces should be the baseline for performance where all benefits of experience with the first order structure of faces is lost making them much less discriminable from one another. The theory would also have it that it is this benefit that is responsible for inversion effects, which fits well with the lack of a difference between upright and inverted scrambled faces. But what of Thatcherised faces? The theory predicts that, in the case of upright Thatcherised faces, the rotated eyes and mouth will have changed such that the predictions made for them (by other features in the face) will no longer match with the reality. This mismatch makes these features look salient and enhances their "oddness". Unfortunately, many of these salient features will tend to be those typical of Thatcherisation, and so will be common across Thatcherised faces, and will not help discrimination and recognition, making upright Thatcherised faces worse than upright normal faces in the experiments of the type reported here. Now consider an inverted Thatcherised face. We know that it does not look very different to its normal inverted equivalent, and performance to both in our experiments is roughly the same. The conclusion we draw is that features are predicted to be in certain spatial locations (because we know this is an inverted face), but that this happens without making second order structure relatively salient. The (somewhat speculative) claim being made here is that inversion of a stimulus that is recogniseable as a face has the effect of disrupting our expertise for second order structure, whilst maintaining (at least in part) some reduction in the salience of first order structure. Thus, inverted faces benefit from this loss of salience of features that would otherwise be common to all inverted faces (their basic spatial arrangement) whilst losing the sensitivity to second order structure that makes us so good at dealing with upright faces, and which is the basis of the inversion effect. Eliminating familiar first order structure by scrambling a face reveals the advantage that this confers even for inverted faces.

Further research will be needed to evaluate this account of our results, but our data clearly suggest that there is a role for both first and second order structure in face recognition, that we argue can be understood in terms of experience-based expertise.

References

Diamond, R. & Carey, S. (1986). Why faces are and are not special: An effect of expertise. *Journal of Experimental Psychology*: *General*, 115, 107-117.

Leder, H. & Bruce, V. (1998) Local and relational aspects of face distinctiveness'. *The Quarterly Journal of Experimental Psychology* A, 51, 449 – 473.

McLaren, I.P.L. (1997). Categorization and perceptual learning: An analogue of the face inversion effect. *The Quarterly Journal of Experimental Psychology* 50A (2), 257-273.

McLaren, I.P.L., Kaye, H. & Mackintosh, N.J. (1989). An associative theory of the representation of stimuli: Applications to perceptual learning and latent inhibition. Oxford university press.

McLaren, I.P.L., & Mackintosh.(2000). An elemental model of associative learning: latent inhibition and perceptual learning. *Animal Learning & Behavior, 28 (3), 211-246.*

McLaren, I. P. L. & Mackintosh, N. J. (2002). Associative learning and elemental representation: II. Generalization and discrimination. *Animal Learning & Behavior*, 30,3,177-200.

Searcy, J. H., Bartlett, J. C. (1996) Inversion and processing of component and spatial-relational information in faces. *Journal of Experimental Psychology: Human Perception and performance* 22 904 – 915.

Valentine, T., & Bruce, V. (1988). *Mental rotation of faces. Memory & Cognition, 16, 556-566*

Yin, R. K. (1969). Looking at upside-down faces. *Journal of Experimental Psychology*, 81, 141-145.