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Agnosia for object orientation: Implications for theories of object recognition

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Abstract—Instances in which objects are copied accurately, but are dramatically rotated relative to the original, have been interpreted as evidence for viewpoint-independent accounts of the object recognition process. In two case reports, we demonstrate that patients who show rotation in copying also show difficulties in informing the examiner of the canonical orientation of known objects. In copying rotated versions of familiar objects, one subject showed a tendency to copy them in their canonical upright orientation, and both subjects copied non-representational line drawings with their principal axis vertically aligned, and with the irregular end pointing 'upwards'. Copyright © 1996 Elsevier Science Ltd.

Key Words: orientation; agnosia; rotation; recognition.

Introduction

Rotated drawing is an unusual neuropsychological phenomenon whereby an object is accurately copied, but rotated (usually by 90° or 180°) relative to the model from which the copy was made [19, 21, 26, 28]. In an earlier era of neuropsychology, there was great interest in errors of rotation during copying, with rotations being regarded as a reliable 'sign' of brain-injury (see [24] for review).

A more recent explanation for the rotated drawing phenomenon is based on the cognitive psychology literature on object recognition [28]. In normal cognition, there are multiple systems for the interpretation of visual information. Most visual systems, for example those involved in spatial cognition and in directing the process of action, would be expected to carry accurate information about an object's orientation [9, 11, 12, 16]. However, a system whose purpose is the recognition of an object need not carry such information, because object identity remains the same regardless of the object's orientation. For this reason, several accounts of the recognition process have suggested that recognition can be achieved by a system which is indifferent to the original orientation from which the object is observed, i.e. a system that is orientation-independent [4, 13, 14, 20] (at least for orientations in the picture-plane). The possibility of a system which is insensitive to object orientation offers a potential explanation for the rotated drawing phenomenon: that patients showing rotated drawing might have explicit access only to orientation-independent representations of the perceived object [28].

As predicted from such an explanation, it has been possible to demonstrate [28] that the phenomenon of rotated drawing was part of a more general loss of knowledge of the upright canonical orientation of objects: an agnosia for object orientation. Because it is the object recognition system that carries information without orientation information, this explanation implies that such patients would be in the surprising position of still being able to recognize the very objects that they fail to orient correctly. This finding has been explicitly demonstrated with one subject [28], confirming an earlier case report which suggested that the recognition abilities of a patient showing rotated drawing might be normal [26].

Several patients have been reported in which there is clear evidence of rotated drawing [19, 21, 24]. However, the paper by Turnbull *et al.* [28] (in which testing was unfortunately cut short by clinical considerations) remains the only reported case in which the central issues of recognition and orientation were tested with the same stimuli, and the only paper in which the nature of the phenomenon was further investigated. Given the fact that

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so few cases of this disorder have been reported in detail, and also that such patients offer an opportunity to examine several important theoretical issues relating to the mechanism of normal object recognition, we report two further patients who show clear features of rotated drawing, and investigate the phenomenon in more detail.

Case reports

Patient 1: NL

NL, a 67-year-old right-handed man, was admitted to a Neurological Unit on 28 December 1993, after suffering an ischaemic stroke that had produced a left hemiparesis. Computerized Tomography scan (13 January 1994) revealed an area of hypodensity in the right anterior parietal lobe (see Fig. 1). He was then admitted for a period of rehabilitation, at which stage he was cooperative, oriented for time and place, with fluent speech free of any aphasic features. He was able to recognize familiar faces. He remained hemiparetic. At that time, none of the hospital staff noticed any features typically seen in hemi-spatial neglect. NL accurately perceived stimuli in the left visual field, freely moved his right arm throughout peri-personal space, and had full awareness of his motor disability. However, he showed considerable problems in standing, positioning and moving his body, for example when attempting to sit down, he often placed his left leg too near his right leg, or actually placed the left leg over the right leg losing his balance. Further, his relatives reported an episode, suggestive of agnosia, in which he pointed to the handle of a car and asked his son what it was. They reported that he sometimes had difficulty perceiving sounds or voices on his left side, and made errors about the spatial relation of the hospital to his home. He was also depressed during this period. A second CT scan (22 March 1994) confirmed the previous findings (see Fig. 1). The neuropsychological examination of NL has been reported elsewhere [3]. His performance on the Mini Mental State Examination [15] was appropriate given his educational background (see Table 1). He showed no difficulty on tests of abstract reasoning [27], no acalculia, no deficits in short-term visuospatial memory [17, 27] or long-term verbal memory [18], and no constructional apraxia [2, 26]. Moreover, he showed no features of perceptual neglect, but did show a left visuospatial neglect specific to imagery.

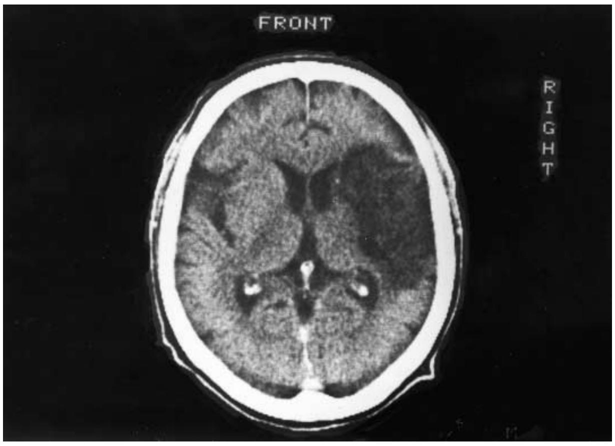

Fig. 1. CT scan of NL.

An unusual feature of NL's performance was a tendency to rotate figures in copying tasks. Examples of the Rey Figure, and the figure from the MMSE are shown in Fig. 2. Note that such rotations are invariably through 90°, and that the structural integrity of the figure is maintained. It is also of interest that the figures have a horizontal principal axis in the original, but that they are rotated to a position where the axis is vertically aligned. Remarkably, NL also preferred to hang the pictures in his room upside down.

Patient 2: SC

SC, a 58-year-old right-handed man, was admitted to a Neurological Unit on 1 October 1994, after an ischaemic stroke that resulted in a left hemiparesis. He was admitted to the unit of Somma Lombardo a month later for rehabilitation. At this stage, he remained hemiparetic. He was oriented for time and place, showing no aphasic deficit. A C.T. scan revealed a lesion in the right cerebral hemisphere, involving the temporal and anterior parietal lobes and extending sub-cortically (see Fig. 3). He showed a left-sided neglect, and was anosognosic for his hemiparetic limbs. SC performed well (see Table 1) on the Mini Mental State Examination [15], and on tests of abstract reasoning [27], calculation, short-term visuospatial memory [17, 27], long-term verbal memory [18], and constructional praxis [2, 27].

SC also rotated figures in copying tasks. For example, he copied the figure from the MMSE rotated by 90° (see Fig. 4), and copied a sailing boat with the sail pointing downwards.

Comment

SC shows the features of left visuospatial neglect commonly seen after right posterior brain injury. NL shows some of the features of neglect, although the neglect seems restricted to the imagery domain. Both patients are free of global intellectual decline, and perform well in tests in a number of cognitive domains (see Table 1). One highly unusual aspect of their clinical picture is the tendency of both patients to grossly rotate figures in copying. The features of the rotational phenomena in both of these patients are similar to those reported previously [19, 21, 26, 28], i.e. a tendency to rotate drawings through 90°, while maintaining the correct internal structure of the object. In order to further investigate and quantify NL

Table 1. Test performance of NL and SC

Test (range of possible scores)	NL's score (adjusted)	SC's score (adjusted)	Controls' median score	Controls' 5% cut-off
MMSE (0–30)	28.5	24.7	27.7	23.8
Verbal abstract reasoning (0–60)	60	56	49.3	32
Short-term memory, Corsi block tapping (0–10)	4.25	5	4.2	3.5
Long-term memory, paired associate learning (0–30)	18.5	19.5	15.0	7.5
Constructional apraxia (0–14)	10.75	9	12.2	7.75
Calculation test (0–21)	21	21	—	—

Scores are adjusted for age, education and, where appropriate, sex.
The range of possible scores is indicated in parentheses.

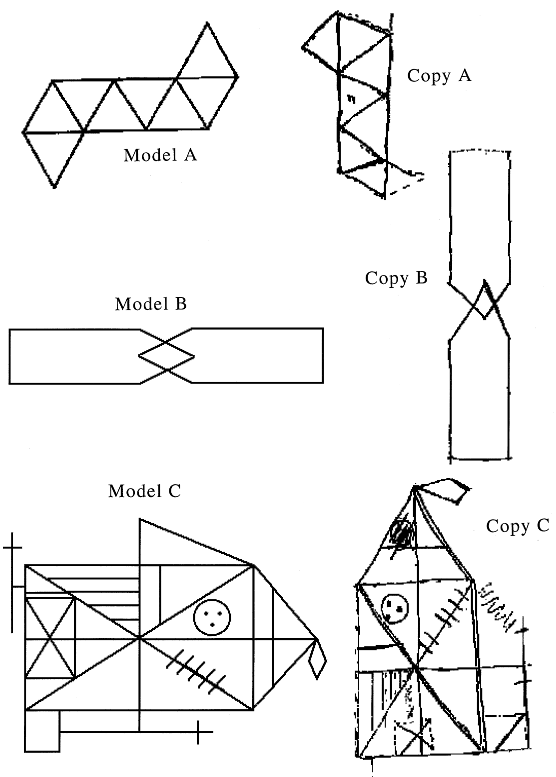

Fig. 2. Rotated drawings by NL.

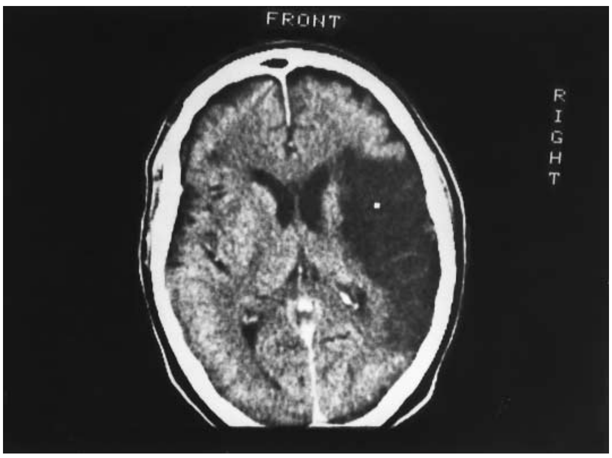

Fig. 3. CT scan of SC.

and SC's deficits, we administered a series of tasks to test their knowledge of the orientation of object drawings.

Experimental investigations

Task 1: Naming and orienting known objects

In a previous investigation [28], it was demonstrated that object recognition could be achieved, even in cases where the patient could not provide the correct canonical upright orientation for the object. The same task was given to NL and SC.

Stimuli

Thirty-two line drawings were selected (from [25], see Appendix). All of the stimuli had unambiguous upright orientations and were reproduced on square cards. Each drawing was individually placed in front of the subject, with the canonical upright in one of the four cardinal orientations. The patient was asked to name the object in that orientation. If it was named correctly, the examiner proceeded to test the subject's knowledge of the conventional upright for the object drawing "as you would see it in real life". On the subject's command, the examiner positioned and repositioned the drawing to each of the cardinal orientations, until the subject stated that

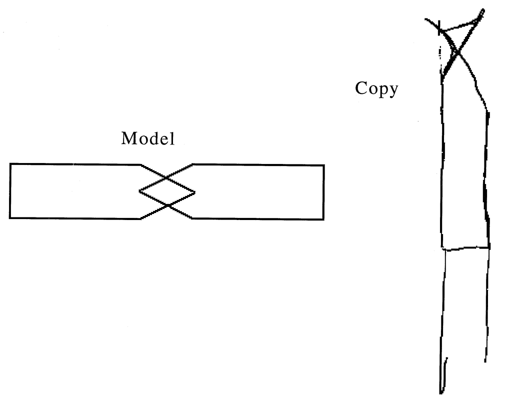

Fig. 4. Rotated drawings by SC.

he/she was confident that the drawing was in its canonical upright orientation.

Results

Both NL and SC named all 32 of the items correctly. However, NL had accurate knowledge of the canonical upright orientation of the object in only 15/32 cases and SC in 28/32 cases (see Appendix).

A group of 20 control subjects (mean age 60.5 years; all of whom had left school at the minimum leaving age) also performed the task. All of the subjects found the task easy to perform, and no subject scored less than 31/32 on either the naming or the orientation task. Data from this control group are reported in all of the later experiments of this paper.

In the case of NL and SC, the initial orientation of the object appeared to have some influence on the likelihood of the accuracy of the patients on this task. In the case of NL, he was correct on all of the eight trials when the object drawing was initially presented in its canonical upright orientation. However, he was correct on only 4/8 trials when the drawing was initially presented as inverted from its canonical upright orientation. There also appeared to be some effect of laterality on NL's accuracy, as he was correct on 7/8 trials when the object was initially presented with its canonical upright to the right, whereas he was correct on only 1/8 trials when the object was initially placed with its canonical upright to the left. There were only four instances of misorientation in the case of SC. However, these involved 4/8 of the trials when the drawing was initially presented as inverted from its canonical upright orientation.

Comment

These findings offer further evidence that both NL and SC were unable to establish the canonical orientation of objects with reliability, although they were able to accurately name these objects. This dissociation between knowledge of object identity and object orientation is analogous to that previously demonstrated [28]. Moreover, in this instance, neither patient showed any difficulty in object recognition, suggesting that the occasional naming errors in the previous report [28] might have been unrelated to the disorder of object orientation.

However, it is notable that both NL and SC appeared to have some knowledge of upright orientation, as they were far more accurate when asked to judge the orientation of some drawings—depending strongly on the initial orientation in which the object was presented. The fact that both subjects were far more accurate when the drawings were initially placed in their correct orientation is not particularly surprising. It might be that the initial presentation of the object served as a prompt for the later choice of orientation.

Of greater interest is the fact that there was also a clear difference in the importance of the lateral position of the drawings. NL was far more accurate when the object's initial canonical upright orientation was to the right. It might be tempting to suggest that his poor performance on items where the object was oriented to the left might be related to his neglect. However, this does not accord with the fact that NL showed neglect only in imagery tasks, whereas this task was perceptual. Perhaps it might be argued that the subject has to 'mentally rotate' an image of the object in the present task, in order to test whether other orientations would be more appropriate. However, it is notable that, on the items where NL made the most errors (i.e. those in which the object was oriented to the left) the structural component closest to the 'ground' (i.e. the base of the object, such as the legs) would have been on the side in which NL did not neglect (even in imagery). As cues such as 'legs' and 'wheels' are usually considered very useful in establishing object orientation, it might have been expected that such items would be easier for NL to correctly orient. At present, we can see no clear explanation for NL's lateral bias on this task.

Task 2: Copying misoriented drawings

This task was administered only to NL, because it was thought that SC's copying skills might not be adequate for this complex task. NL was asked to copy line drawings of known objects, to see whether the problem of orientation persisted even when he was offered a model against which to compare his performance.

Stimuli and procedure

NL was asked to copy 12 drawings from the set above. Each of these was oriented in one of the four cardinal orientations (see Fig. 5).

Results

NL copied all of the forms with reasonable accuracy, but rotated five of the 12 forms by 90° (Fig. 5). In all cases, the relative spatial position of the components of the object was not altered, but all were rotated so that they were in their canonical upright orientation. No errors of rotation were observed in any of the copies of the control subjects.

Comment

NL's performance on this task suggests that his rotational errors in copying occur for familiar objects, as well as for meaningless stimuli (c.f. Figure 2), and persist

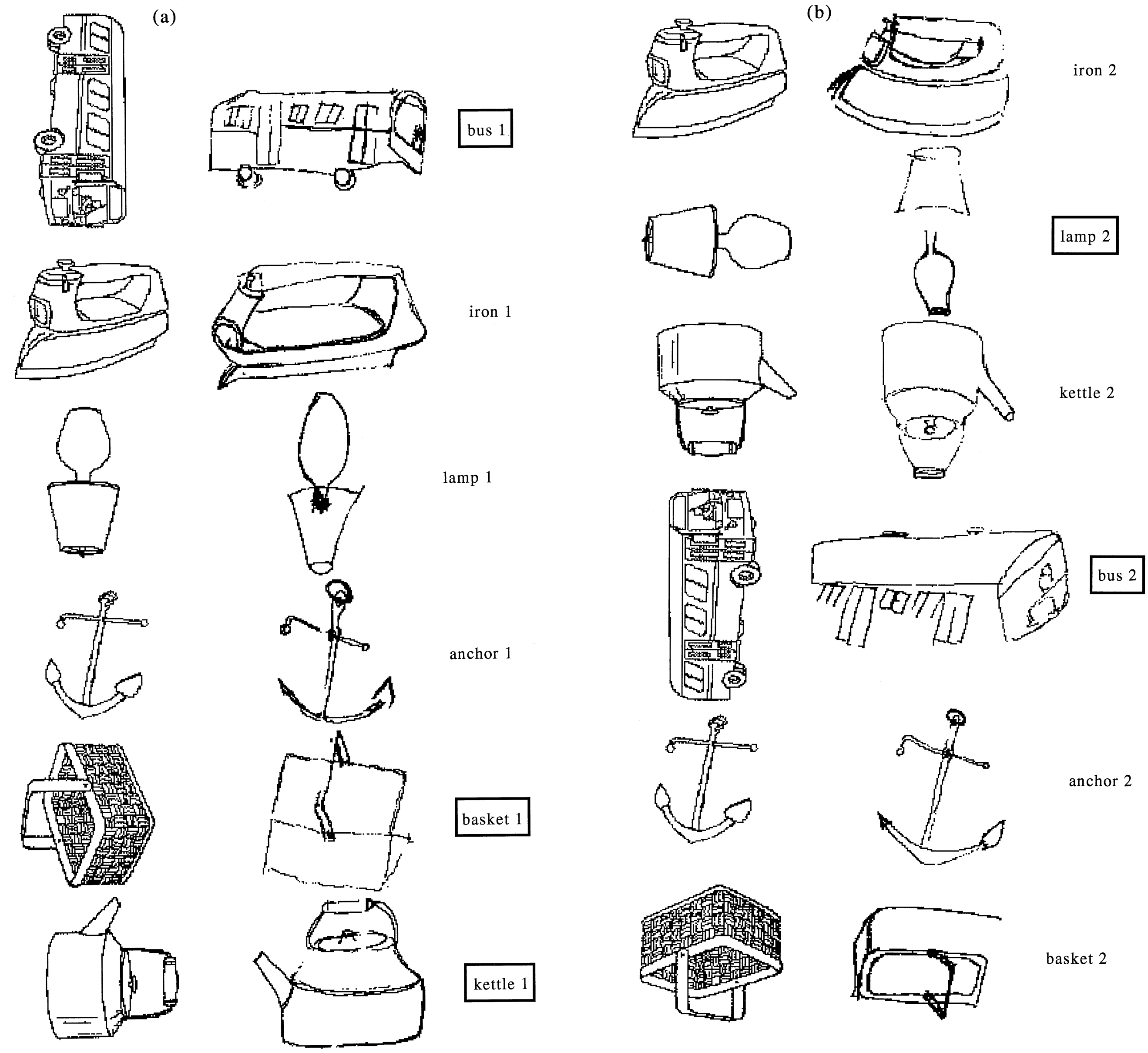

Fig. 5. (a and b) Copies of Snodgrass and Vanderwart [25] drawings by NL. Attempts that appear to be rotations of the model have been highlighted. All are rotations into a position in which the object is rotated to its canonical upright orientation.

even when he had a model from which to copy directly. The fact that most of the drawings were copied in 'correctly misoriented' orientations suggests that he understood the instructions to the task. However, the fact that all of those that were copied incorrectly were placed in their correct canonical upright orientation suggests that NL retained some knowledge of the appropriate orientation of the stimuli. This is a similar finding to that in Task 1, where NL's best performance was for items that were initially placed in an upright orientation.

Task 3: Discriminating object orientation

The tasks described thus far (i.e. copying line drawings and altering the orientation of an object to command) are influenced by the canonical orientation of an object, rather than merely involving knowledge of absolute object orientation. The role of the canonical upright orientation can be removed from the task by asking the subject to make a comparison of the relative orientation of objects. In this task, NL and SC had to judge which of three objects was misoriented relative to the other two.

Stimuli and procedure

Five items (camel, piano, shoe, motor cycle and bear) were used as stimuli. Three drawings of each object were presented to NL and SC across the desk, each printed on a separate square card. The stimuli could be either upright or inverted, with one of the three being misoriented rela-

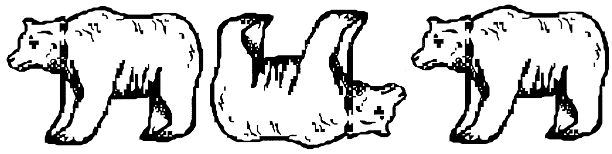

Fig. 6. 'Odd-one-out' stimuli with orientation changes.

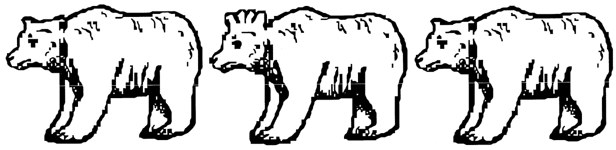

Fig. 7. 'Odd-one-out' stimuli with structural changes.

tive to the other two (see Fig. 6). The number of upright to inverted items was pseudorandomly varied from trial to trial, as was the relative position of the 'odd-one-out' (i.e. Trial 1: upright, upright, inverted; Trial 2: inverted, upright, inverted). The task was given in blocks of ten trials, for each of the five objects.

Results

Both subjects were able to name all of the objects. However, both found the orientation discrimination task difficult. NL was correct on only 17/50 items, and SC was correct on 29/50 items. There was no stimulus category on which either of the subjects scored less than 3/10 correct, and none on which there were more than 8/10 correct. No control subject scored less than 49/50 on the task.

Comment

These findings suggest that both NL and SC had difficulty in establishing object orientation, independent of any necessity to have knowledge of the canonical upright of the object. As in Task 3, these errors occurred, even when the subject had objects against which orientation could be directly compared.

Task 4: Critical feature discrimination

It might be that NL and SC had difficulty on the tasks described above because their visual skills were inadequate to gather sufficient detail of a visual object (although their ability to recognize the objects that they could not orient might argue against this). Thus, a control task, in which minor structural alterations were made to one object, was presented.

Stimuli and procedure

The stimuli were the same five object pictures used in Task 3. Some of the stimuli were the original drawing, and others had a small structural alteration (see Fig. 7, or [29] for details of the full set of altered drawings). In three cases, a component was added (extra ears on a bear, an extra leg on a camel, and longer laces on a shoe) and in two, a component was removed (spokes from the front wheel of a motor cycle, a leg from a piano). The number of original to altered items was pseudorandomly varied from trial to trial, as was the relative position of the 'odd-one-out' (i.e. Trial 1: original, altered, altered; Trial 2: original, altered, original). Other than this, the procedure followed the same 'odd-one-out' format as Task 4 above, involving blocks of ten trials, for each of the five objects.

Results

SC was correct on 50/50 of the items in this task, while NL was correct on 41/50 items. No control subject scored less than 47/50 on the task.

Comment

SC was able to accurately identify the 'odd-one-out' in this difficult discrimination task, in striking contrast to his poor performance on Task 3. NL's performance was also substantially better than his earlier (near chance) performances on the orientation task. The fact that he made a number of errors means that we cannot exclude the possibility of some form of low-level visual deficit as a contributory factor in his performance. However, it seems unlikely that an explanation based on low-level visual deficits would be able to explain the nature of the errors of rotation, together with the fact that he can accurately name objects, and copies drawings with great accuracy (although dramatically rotated).

Task 5: The importance of the orientation of the principal axis

Rotated drawing has previously been observed in a clinical setting when the Rey Complex Figure [22], one of the most commonly employed of such test stimuli, is copied by the patient. The most frequent position to which it is rotated is anti-clockwise by 90° (see Fig. 2; also [19, 21, 28]), so that it lies with its principal axis vertically aligned, and with the irregular end pointing upwards. The present experiment was devised to establish whether this error of vertical positioning was a result of the particular orientation of the Rey Figure, or the result of a more general tendency that is independent of the orientation in which the model is presented. Each subject was asked to copy a series of simplified versions of the Rey Figure, consisting of a generally rectangular form, bounded at one end by an irregular structure, and containing various geometrical components. Six forms were generated, and the subjects were asked to copy these forms in each of the four cardinal orientations (see Fig. 8).

Results

NL copied all of the forms with great accuracy, and applied himself diligently to the task. However, he rotated two of the figures by 90° (a1 and f1, see Fig. 8). He appeared to take even greater care in his copying of the items on which he made errors, to the point that he began to perspire as a result of the attentional demands. As regards the nature of the errors on these items, in both

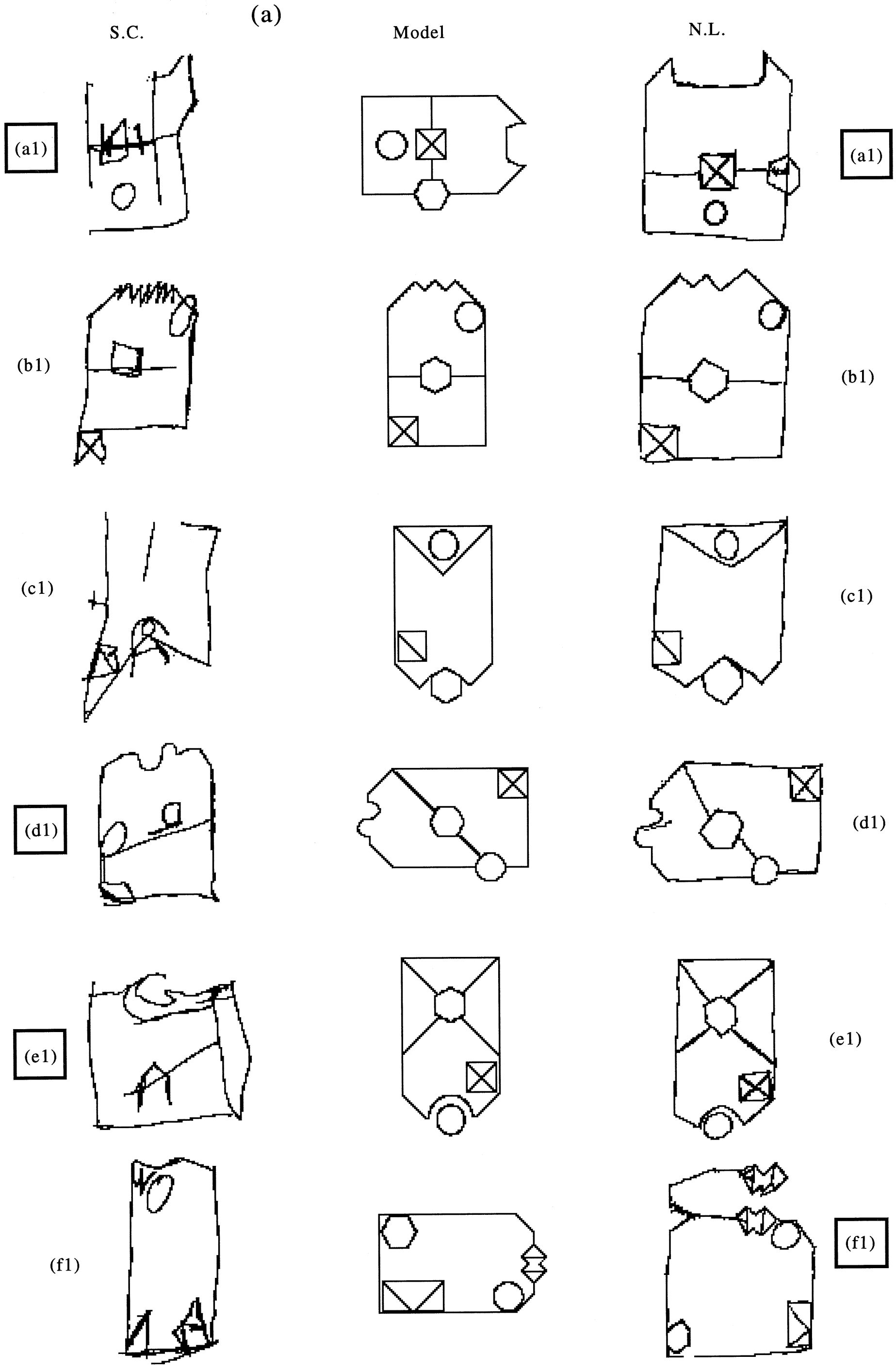

Fig. 8. (a and b) Copies of minature Rey Figures by NL and SC. Attempts that appear to be rotations of the model have been highlighted. All are rotations into a position in which the principal axis is vertical and the object is on a 'stable' base.

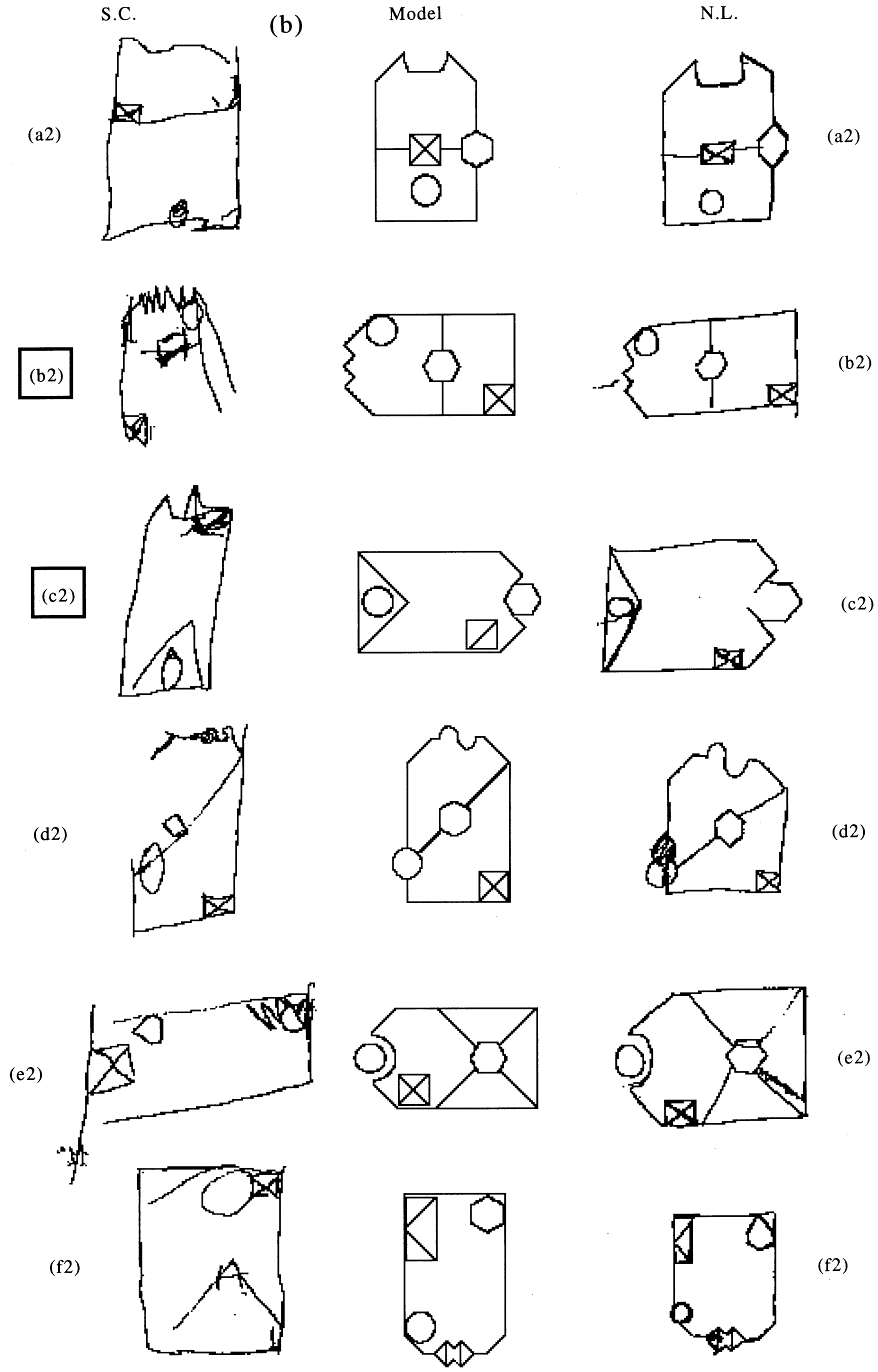

Fig. 8—*continued.*

cases, the relative spatial position of object components was not altered, with the exception of a minor duplication in one item (f1, see Fig. 8). Both of these rotational errors were from models where the principal axis was horizontal, and in both cases, the drawings were rotated to an upright position with the more irregular portion of the rectangle placed at the top of the form, so that it rested on a 'stable' base.

SC copied the forms with variable accuracy. In some instances, the quality of the copy made it difficult to be certain of orientation. However, SC appears to have rotated four of the 12 drawings by 90°, and a further one by 180° (see Fig. 8). In most cases, the relative spatial position of the components of the object was not altered, although this was often difficult to establish in the case of poor reproductions. As was the case with NL, in every case where the drawing was rotated, the principal axis was vertically aligned, and the more irregular portion of the rectangle was placed at the top of the form.

No errors of rotation were observed in any of the copies of the control subjects.

Comment

NL and SC's performance on this task suggests that their rotational errors are relatively frequent, although they did not occur on every item. However, when errors did occur, the pattern was highly specific: involving rotation to an orientation in which there is a vertically oriented principal axis, and where the irregular end of the object was pointed upwards. This might explain why the Rey Complex Figure has been the task on which rotated drawing has most frequently been reported [19, 21, 26, 28].

Task 6: Mirror-image discrimination of object drawings

The argument presented above to explain the deficit of NL and SC is that they represent instances of access to orientation-independent representations, in the absence of access to a more veridical, orientation-dependent (or viewer-centred), representation. However, an orientation-independent description would also lack the information necessary to discriminate between an object and its mirror-image [5, 10]. Support for the argument that representations free of mirror-image information might be found in the ventral visual system comes from findings in the animal neuropsychology literature. Animals with inferotemporal lesions can make mirror-image discriminations [7, 8], while this ability is impaired after parietal lesions [6] (see [30] for a review of this literature). Selective deficits in mirror-image discrimination have also been reported in human neuropsychology [23, 29], in which the interpretation of the deficit as a case of access to orientation-independent object descriptions was discussed. However, the fact that one patient (RJ [29]) had a profound deficit in mirror-image discrimination, but was able to discriminate objects on the basis of orientation, argues against a common factor underlying the tasks of mirror-image and orientation discrimination.

Stimuli and procedure

The same five stimuli were used as those in Experiment 2. Again, three items were individually presented on a square card. Two of the cards showed identical objects, and one was the mirror-image of the others. The subject was asked to name the object drawings, and then identify the 'odd-one-out' (see Fig. 9).

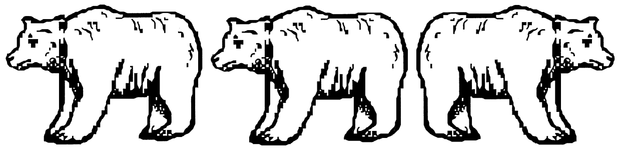

Fig. 9. 'Odd-one-out' stimuli with mirror-image changes.

Results

NL named each item correctly and without hesitation. However, he was correct on only 21/50 of the mirror-image discrimination items. In contrast, SC was correct on 50/50 of the items. No control subject scored less than 48/50 on the task.

Comment

The fact that SC shows a clear dissociation between a very poor performance on the orientation discrimination task (29/50), compared with an excellent performance on the mirror-image task (50/50), suggests that at least some aspects of the process of mirror-image and orientation discrimination are dissociable (see [30]).

Discussion

The findings presented above demonstrate that both NL and SC showed profound difficulties with their knowledge of the picture-plane orientation of object drawings. This deficit was evident in the copying of meaningless drawings (Figs 2, 4 and 8) and (in the case of NL) for familiar objects (Fig. 5). The deficit was also shown to be independent of any difficulty in object recognition (Experiment 1). Thus, NL and SC show the same striking dissociation between good knowledge of object identity, and loss of knowledge of object orientation, previously reported [28]. Indeed, this dissociation is clearer than in the previous case, as NL and SC performed at ceiling on object recognition tasks (cf. [28]).

It has been argued elsewhere [28] that such rotational errors, together with the fact that the subject can still achieve object recognition, represent instances of the achievement of object recognition by a mechanism that does not code orientation information. However, if such representations were truly independent of orientation (at least in the picture-plane), it might be anticipated that patients such as NL and SC would show no preference in the orientation of stimuli which they misoriented when copying, and on orientation-to-command tasks. Instead, these subjects appear to make systematic errors of orientation, such as placing the principal axis of the object in one of the cardinal orientations. One explanation for this might be that it is related to the preference for horizontal and vertical orientations (known as the 'oblique' effect) seen in many experimental situations, and observed throughout the animal kingdom [1]. One interpretation of the performance of these patients is that they have access to a system that does not code orientation information (perhaps orientation-independent representations). Nevertheless, the patient must choose some orientation in which to copy the drawing, and they tend to use the cardinal orientations as a default.

It is of further interest that, when tested using drawings of familiar objects, NL often rotated his copies of objects to their canonical upright, even when he was aware that he should be copying the drawing directly (as he was able to do on seven of the 12 items). Thus, he seemed to have some knowledge of the canonical upright of familiar objects, and this semantic information appeared to override any preference for copying the object in the same orientation in which it was presented.

There was a contrasting performance when NL and SC copied meaningless stimuli (the 'mini-Rey Figures' of Task 3). Here, the error of rotation in both NL and SC appeared to depend on the orientation of the principal axis (with both subjects preferring an upright orientation). The orientation of the copied object also depended on the presence of irregular features on the object boundary (with both preferring to orient the object with the irregular portion pointing vertically). The reason for this particular choice of orientation is not clear, but the general orientation of the axis may be related to the fact that a vertical orientation gives these stimuli greater symmetry than a horizontal placement of the axis. Within this constraint, the decision to have the irregular portion pointing vertically might be interpreted in relation to the fact that this orientation offers a more stable 'base' for an object than when the irregular portion points downwards.

The matter of the performance of NL and SC on the mirror-image discrimination items (Task 6) is a complicating issue. In providing the rationale for this task, we suggested that a mirror-image discrimination task might be failed by a patient who has access only to an orientation-independent representation. Indeed, NL did perform very poorly on the mirror-image task. However, SC's excellent performance on the task suggests that there is no necessary link between the skills required for mirror-image and orientation discrimination. Indeed, a patient has recently been reported who was at chance on tasks of mirror-image discrimination, but performed flawlessly on the orientation discrimination task [29]. This represents a complete, and classical, double dissociation with SC. This implies, at least on the currently accepted logic of cognitive neuropsychology, that the mirror-image and orientation deficits result from different cognitive deficits, and that the cognitive architecture required for mirror-image and orientation discrimination are (at least partially) non-overlapping.

It is also of interest that the cases of NL and SC are the first occasion in which the phenomenon of rotated drawing has been reported in patients with left visuospatial neglect. Indeed, since first noting this phenomenon in NL and SC, we have observed at least one instance of rotated drawing, involving misorientation of the drawing item from the MMSE, in seven of 22 patients with left visuospatial neglect. Given this possible association between rotated drawing and neglect, it is surprising that rotated drawing has not been reported more frequently, especially given the extensive interest in neglect in recent years. Certainly, the frequency with which we have observed rotated drawing in association with neglect suggests that the disorder may well be far less rare than was previously thought [26].

However, it is notable that several previously described patients showing rotated drawing have not shown neglect, and neither have they necessarily had lesions in the right posterior brain region usually associated with left neglect [19, 21, 26]. Excluding one case of Transient Global Amnesia [21], only one previous report of rotated drawing has implicated the right temporoparietal region (although without neglect [28]). Rotated drawing has also been reported after frontal lesions, either to the right hemisphere [19] or bilaterally [26] without any mention of neglect in any of these cases. This variability in the lesion site, seen in previous cases, argues against the reliability of rotated drawing as a localizing sign within one hemisphere. However, the presence of right-sided lesions in the cases of both NL and SC, as well as in the majority of previously reported cases of rotated drawing [19, 28] suggests some lateralizing significance for this neuropsychological sign.

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Appendix

Experiment 1: Naming and orientation

Drawings presented to NL and SC

Aeroplane, anchor, apple, basket, bicycle, bus, camel, chair, clock, coathanger, dustbin, frying pan, gun, helicopter, iron, kangaroo, kettle, lamp, oven, penguin, piano, pram, record player, roller skate, shirt, shoe, telephone, television, toaster, tree, vase, watering can.

Drawings misoriented but correctly named by NL

Basket, bicycle, bus, chair, coathanger, dustbin, gun, helicopter, iron, kettle, lamp, penguin, pram, roller skate, shirt, tree, watering can.

Drawings misoriented but correctly named by SC

Camel, record-player, roller-skate, telephone.