Chapter 4

Rehabilitation of unilateral neglect

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4.1 Unilateral spatial neglect

Acquired brain damage to structures of the right hemisphere can lead to the phenomenon of unilateral spatial neglect. Neglect can be characterized as a failure, difficulty or slowness in reporting, interacting with or moving towards objects, sounds or representations as a consequence of their spatial position, most frequently on the left. Although both left and right hemisphere stroke patients are equally likely to suffer from neglect in the acute phase (De Kort, 1996), chronic neglect is almost exclusively caused by right hemisphere lesions (Bisiach & Vallar, 1988; Vallar, 1993). And even though its more florid manifestations usually remit in the very large number of patients who show acute neglect following right hemisphere stroke, it has long-lasting, severe effects on other domains such as motor function (Gialanella & Mattioli, 1992).

The fact that symptoms associated with neglect can be observed in all sensory modalities (i.e. visual, tactile, auditory, olfactory and gustatory) indicates that neglect cannot be explained by a deficit of primary sensory or motor functions, but rather consists of a range of phenomena related to the high level representation of, and attention to, space. Neglect may represent a ‘gradient’ of attentional bias from left to right, such that there is a continually increasing probability of detecting stimuli the further to the right of external space these stimuli occur. Neglect may not be a unitary disorder. Given that the brain’s representation of space is not itself unitary, then it should not be surprising to find that neglect may occur separately for semi-independent spatial areas, each defined with respect to their proximity to the body (Rizzolatti & Berti, 1990; Rizzolatti & Berti, 1993). Three distinct regions of space can be distinguished: personal space (which is delimited by the body itself), peripersonal space (also referred to as reaching space), and extrapersonal space (which is beyond the reach of the arms). Neglect thus, may be a variable and multimodal pattern of dysfunction affecting spatial representation at many different levels in the brain.

What is striking about neglect is the range of brain lesions that appear to be implicated in the disorder (for a recent overview, (Vallar, 2001)). In most literature reviews, neglect is associated with large right hemisphere lesions including the temporoparietal-occipital junction. Within this region the inferior parietal lobule (IPL) appears to be highly correlated with chronic neglect (Vallar & Perani, 1986).
Some studies, however, indicate that the IPL does not play an exclusive role in chronic neglect. Using neuro-imaging techniques, Samuelsson and co-workers found that neglect was highly associated with middle temporal lobe and/or the temporo-parietal paraventricular white matter (Samuelsson et al., 1997). Karnath et al. showed that for neglect patients without hemianopia (which frequently coincides with neglect), the neuro-anatomical correlate of neglect lies mainly in the superior temporal cortex (Karnath et al., 2001). There is also evidence that unilateral neglect can be caused by a lesion of subcortical regions in the brain such as the thalamus (Watson & Heilman, 1979) and the basal ganglia (Damasio et al., 1980).

These lesion studies suggest that unilateral neglect cannot be linked to a discrete anatomical structure. It is far more likely that neglect is merely the result of a disruption of a large network of anatomically distinct yet functionally connected cortical and subcortical structures which are all (partially) involved in attention and spatial cognition. Apart from neglect, right hemisphere brain damage may also cause non-lateralized (i.e. non-spatial) attentional deficits such as impaired arousal (Heilman et al., 1978) and impaired sustained attention (Robertson et al., 1997a; Wilkins et al., 1987). As we will discuss later on in this chapter, these deficits may also interact with chronic neglect.

### 4.2 Rehabilitation of Neglect

Unilateral neglect is a particularly appropriate disorder when attempting to develop rehabilitation strategies closely tied to theoretical models derived from cognitive neuroscience. This is in part because of the extensive body of theoretical work that has been devoted to this condition. On the other hand, lesion studies have provided an important basis for models of spatial attention in humans. Finding adequate rehabilitation methods for unilateral neglect is of great importance for at least two reasons. Firstly, neglect is a predictor of poor ADL function even after the most conspicuous symptoms (such as head and eye deviation towards the ipsilateral side and the failure to orient to highly salient stimuli on the contralateral side) have disappeared. Secondly, both temporary and long-term interventions can provide insight into the mechanisms that underlie human spatial attention in general and neglect in particular.
In some cases, it has been shown that neglect can be temporarily or permanently overcome - both in animals and humans. Sprague (Sprague, 1966) for instance demonstrated that a strong spatial bias in cats caused by a large unilateral posterior lesion could be ameliorated by destroying the superior colliculus on the side opposite to initial visual input. There are also examples of this phenomenon in humans: for instance, following a right hemisphere stroke, one patient showed severe left-sided spatial neglect which then disappeared abruptly following a second stroke in the left frontal region (Vuilleumier et al., 1996). A possible interpretation of these data is that the persistence of the neglect was due to inhibition by the intact left hemisphere of the attentional networks in the damaged right hemisphere. When the second lesion in the left hemisphere occurred, this may have reduced the competitive inhibition, thus allowing the impaired attentional circuits in the originally lesioned right hemisphere circuit to function at a more normal level. Whatever the actual underlying mechanism, these data show that latent function persisted in the damaged hemisphere but could only be unlocked by an alteration of the dynamic architecture of the brain's attentional or orientational systems. A second lesion to the opposite hemisphere is, however, a rather unethical if not impractical approach to rehabilitation. Nevertheless, these studies show that there is a latent function to be unlocked, and that rehabilitation therapists must strive to find methods to do so. They can only do so by iterative interactions with the models of normal cognitive function that cognitive neuroscience has developed.

4.2.1 Clinically evaluated methods

4.2.1.1 Scanning Training

The only treatment procedure for unilateral neglect to have been submitted to clinical trials with evaluation of long-term effects under controlled conditions consists of scanning training (Antonucci et al., 1995; Weinberg et al., 1977). Scanning training is a behavioural strategy that trains patients to compensate visually for impaired scanning of the neglected left side. It was developed by Weinberg, Diller and colleagues of the Institute of Rehabilitation in New York. Weinberg et al. compared a group that received a standard rehabilitation programme (occupational therapy) with a group that received twenty hours of scanning training over a period of about a month in addition to the standard rehabilitation programme. Scanning training consisted of
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several elements, such as a number of modified cancellation tasks, a graded practice in reading and a scanning machine. In the first stages of the reading practice, patients could use a vertical line on the left of the text as an anchoring point in addition to numbers at the beginning and end of each line. These cues were withdrawn as training progressed. First the line numbering on the right was removed, followed by the numbers on the left and ultimately the anchoring line was removed. The scanning machine consisted of a board on which light-stimuli could appear in different positions. Patients were required to track targets that moved from one side of the board towards the other side and to search for lights that appeared in different positions on the board.

Patients who received both conventional training and scanning training benefited significantly compared to the group that received conventional therapy only. The improvements were found mainly on a number of tasks relating to academic performance, such as reading and writing, but did not generalize to tasks such as line bisection or location of the body midline.

However, a large randomized group study by Robertson and colleagues comparing a group that received computer-based scanning training (using techniques similar to those of Weinberg et al.) with a group that received recreational computing, found no significant difference between the two groups (Robertson et al., 1990).

Pizzamiglio and co-workers in the Clinica Santa Lucia in Rome (Pizzamiglio et al., 1992) evaluated the effects of a systematized and extended version of the visual scanning training developed by Diller and Weinberg (1977). Thirteen patients with extensive lesions in the right hemisphere who showed symptoms of both neglect and left visual field deficits due to hemianopia or quadrantopia each received forty sessions of intensive scanning training (five times a week over a period of eight consecutive weeks). Each training session lasted approximately ninety minutes and consisted of four different procedures:

1. Visual scanning training, in which the patients had to detect digits appearing in different sequences on a large screen (2.20 x 1.50 m). The task was to name the digit presented and to press a button as quickly as possible afterwards.

2. Reading and copying training, in which sentences and titles of increasing complexity were presented. In order to encourage complete scanning of the stimuli, a flashing bar was presented on the left side of the paper and the
patients were given both spatial (e.g., “look carefully on your left”) and semantic (e.g., “who has done…?”) cues. As training progressed, the flashing bar and the cues were left out.

3. Copying line drawings on a dot matrix. Patients were presented with a matrix of dots on their left. Some of the dots in the matrix were connected by lines. Patients had to copy these lines in a matrix presented on their right.

4. Figure description, in which patients were shown drawings of simple, realistic scenes. They were cued verbally to describe in detail all elements depicted in the drawings.

In general, patients improved specifically on tasks that required spatial scanning (e.g., letter cancellation), but not on other tasks requiring visuo-spatial functions (e.g., judgment of stimuli orientation). This indicates that although patients were able to apply the learned behavioural strategy to compensate effectively for their deficit in spatial attention in a limited number of tasks, their spatial deficit itself did not change as a result of the training.

In a series of more recent studies, the potential effectiveness of this extremely intensive scanning training combined with optokinetic stimulation was demonstrated by the same group led by Pizzamiglio (Pizzamiglio et al., 1998). Optokinetic stimulation was used to induce a so-called nystagmus reflex in neglect patients. Patients were required to perform a visual scanning task that was presented in the foreground on a large projection screen while the background was moving slowly towards the left thus inducing a slow wave eye-movement from right to left. It is possible that in addition to teaching patients a behavioural strategy to compensate for their spatial deficits, this method also facilitates changes in the attentional system. However, the effects of scanning training on functions such as contralesional motor impairment still remain to be tested.

Though the effectiveness of scanning training in improving visual neglect has been demonstrated, doubts about generalization to other spatial functions were raised by subsequent studies (Gouvier et al., 1987). Indeed, most improvements after scanning training tend to be limited to the same type of task as was used for the training itself.
4.2.1.2 Limb Activation Training

Limb Activation Training (LAT) is a distinctive approach to the rehabilitation of neglect. LAT was developed from a series of experiments based partly on Rizzolatti’s premotor model of neglect (Berti & Rizzolatti, 1992; Rizzolatti & Berti, 1993). As mentioned earlier, multiple representations of space can be distinguished in the brain, namely personal, peripersonal and extrapersonal space. According to Rizzolatti, these systems interact to produce a coherent spatial reference system against which purposeful motor movements are calibrated and organized. As the parallel activity of these different perceptuo-motor neural maps produces the normal representation of space, it is the breakdown of one or more of these systems in neglect that creates a distorted representation of space.

In a series of experiments (Robertson & North, 1992; Robertson & North, 1993), a number of conditions were compared to determine the effects of finger movements. In the first condition patients were required to make finger movements with their left hand while performing a visual scanning task. In the second condition patients had to perform the same task but were now required to scan the left side visually the same number of times that they made finger movements in the first condition (i.e. subjects received a general instruction to “find the left arm” prior to each trial). Making finger movements significantly reduced neglect. Visuo-perceptual anchoring did not reduce neglect.

A second comparison was made between movements of the fingers of the left hand that were made ‘out of sight’, in left and right hemispace. Only left hemispace ‘blind’ finger movements significantly reduced neglect compared to the standard condition. Thirdly, blind movements of the fingers of the left hand in left hemispace were compared with passive visual cueing (reading a changing number), and again it was found that only the finger movements reduced neglect. Finally, movements of the fingers of the right and left hands in left hemispace were compared. Only the latter reduced neglect. These findings have been replicated in a large group study (Ladavas et al., 1997).

These results suggest that this potent effect of moving the hemiplegic side results from actually making movements with the left limb in left hemispace and is not simply because the result of cueing attention to the neglected side. Interpreting these data in terms of Rizzolatti’s model, one could argue that by inducing the subject to make voluntary movements with the left hand in left hemispace, activity in the left
half of the somatosensory personal space was activated or enhanced. The integrated nature of the somatosensory and peripersonal spatial systems resulted in enhanced activation of the impaired half of peripersonal space. But why did left-hand movements in right hemispace not similarly activate the left side of peripersonal space? Even though left hemispace may not have been activated, the left side of the body was activated. One possibility is that reciprocal activation of more than one corresponding spatial sector of closely linked neuronal maps in the brain must occur in order to overcome the deficit in representing the left side of space. In other words, cueing or recruitment of the hemispatial system was inadequate on its own. The same applies for the hemi-corporeal (‘personal’) system. Only when both systems were activated simultaneously did some improvement of spatial perception of the left occur, possibly by reciprocal activation across related neuronal systems.

The above studies led to a series of treatment evaluations (Robertson et al., 1992; Robertson et al., 1998a) which involved making minimal movements of left limbs by using a Limb Activation Device (LAD). The LAD emitted random sounds, which the patient had to prevent or terminate by pressing a switch with some movement of a left limb. The results of this training were positive and daily ratings of mobility difficulties arising from the neglect showed improvements beginning with the onset of treatment. These ratings improved as the training commenced, and patients also showed improvements on standardized tests. The effectiveness of LAT has also been demonstrated in several controlled single-case-experimental design studies (Robertson & Hawkins, 1999; Samuel et al., 2000; Wilson et al., 2000).

LAT has also been subjected to a randomized-controlled trial (Kalra et al., 1997), though without use of the Limb Activation Device (LAD). In this last study, the neglect patients given LAT and standard inpatient rehabilitation had higher Barthel scores at twelve weeks (14 versus 12.5) and a significant reduction in median length of hospital stay (42 versus 66 days) compared to control patients receiving standard rehabilitation.

Recently, LAT has been subjected to a single-blind randomized controlled trial (Robertson, McMillan, Macleod, Edgeworth & Brock, submitted). Thirty-nine patients, who showed left unilateral neglect as a result of right hemisphere brain damage following CVA were randomly allocated to perceptual training plus LAT or to perceptual training alone. Both groups received twelve 45-minute training sessions over a twelve-week period. Thirty-six of the 39 patients were successfully followed
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up blind at three months, a total of 32 were followed up blind at six months and 26 at 18-24 months. Outcome was assessed using a variety of standardized functional outcome and neuropsychological measures. LAT treatment was associated with significantly reduced unilateral neglect at three months post-treatment, and with significantly improved left-sided motor function at three, six and 18-24 months. The LAD can be used in the context of existing therapy with no increase in therapy time. This study shows that LAT can produce enduring improvements in unilateral neglect and in left-sided motor impairment in CVA patients suffering left unilateral neglect.

4.2.2 Other approaches to rehabilitation of neglect

4.2.2.1 Use of Prisms in neglect
French researchers (Rossetti et al., 1998) studied the effects of prism adaptation on patients with neglect. Distorting prisms over the eyes created an optical shift of ten degrees to the right for all visual input. Subjects had to point to stimuli in front of them, and received natural feedback through the mislocation movements they made. Over fifty such trials, they gradually learned to remap their motor responses to the new, distorted visual array. After removal of the goggles, they showed a significantly reduced neglect. This improvement lasted two hours, suggesting that the sensory-motor remappings produced by the prisms were not transient. In other words, the experience of having to recalibrate motor responses to a shifted visual array may have created relatively long-term plastic changes in synaptic connectivity in the impaired perceptuo-motor system of the lesioned hemisphere. This raises the possibility that the effects of the other types of rehabilitation described above may also rest at least in part on such plastic changes in the brain. Hence the observed therapeutic effects of rehabilitation may be based both on manipulation of activation in inhibited attentional networks, as well on plastic reorganization of the lesioned networks.

4.2.2.2 Interaction between the dorsal and ventral routes in neglect
The interaction of the brain's perceptual and motor systems is a topic of considerable current interest, particularly in the light of evidence that some visual information may have privileged access to the control of motor responses, yet not be available to awareness. The notion that the so-called dorsal stream may provide visual information for the motor system that is not available to awareness has received strong support
from a series of experiments by Milner and Goodale (1995). They have shown how cortically damaged patients who are incapable of consciously discriminating perceptual features (e.g. orientation) may nevertheless be able to make motoric responses that are sensitive to these features.

In the light of these results, Robertson and colleagues (Robertson et al., 1995a; Robertson et al., 1997b) predicted that the manifestation of unilateral neglect could be altered by changing the purpose of a reaching response. In their first experiment, ten neglect patients were tested in two conditions. In the first condition, patients were asked to point to the centre of a metal rod, while in the second condition they were asked to reach for the metal rod with a pincer grip of forefinger and thumb as if to pick it up so that it was balanced. The perceived middle was significantly further to the right in the pointing condition than in the reaching condition. In a second experiment, thirteen neglect patients pointed to the centre of a rectangular box with a lid that could swivel. They were then asked to place a coin at the centre of the lid, in a position sufficiently central to prevent the lid tilting and the coin falling into the box (in fact, unknown to the patients, the lid was fixed). In this experiment, patients showed less neglect when placing the coin in the perceived middle of the lid than when pointing to the perceived middle.

The result of these two experiments suggest that prehension movements towards objects allow ‘leakage’ of information about their spatial extent, via an apparently unaffected stream of information available for motor-manipulative responses. These findings have subsequently been replicated by Edwards and Humphreys (1999). This finding is compatible with data showing that while a conscious, ‘ventral’ representation of a stimulus can contaminate or override the short-lived motor representation, no such reciprocal influence seems to occur (Rossetti, 1998). In other words, this latter finding is compatible with data showing that activation of the dorsal stream appears to have effects on the ventral stream, a finding which was supported in a subsequent quasi-rehabilitation study (Robertson et al., 1997b).

In this study, people suffering from unilateral left neglect were actually encouraged to pick up rods so they would remain balanced. This activity not only facilitates the putative 'crosstalk' between the dorsal and ventral systems repeatedly, but also induces perceptual conflict in neglect patients: even though reaching to grip reduced neglect, their grip was still biased to the right of centre. Hence when they
picked up the rod at the point which visually seemed to them to be the centre, they would experience contradictory feedback from both the proprioceptive and visual modalities showing that this was not in fact the case. Robertson et al. therefore predicted short-term improvements in neglect as a result of a brief number of such exposures. Indeed, significant short-term improvements were found on neglect tasks after subjects experienced proprioceptive and other feedback discrepant from the judgments they made on the basis of visual information alone. Robertson and colleagues are currently studying whether extended training of this type produces more enduring improvements in neglect.

4.2.2.3 Manipulating egocentric space
The rightward spatial bias in neglect patients has also been explained in terms of a disturbance of the central transformation process that converts peripheral sensory input into an egocentric, body-centred co-ordinate system (Karnath et al., 1991; Karnath et al., 1993; Karnath, 1994; Karnath, 1995). Karnath and co-workers suggested that in neglect patients a systematic error in this co-ordinate transformation system results in deviation of the spatial reference frame to the ipsilateral side. Some rehabilitation methods have been homing in on manipulating the subjective body midline position in order to reduce neglect symptoms.

Karnath et al. (1993) showed that manipulating proprioceptive input by vibrating the posterior neck muscles or by turning the trunk 15° to the left reduced neglect symptoms compared to vibrating the left-hand muscles, which had no effect on neglect. These data were interpreted as showing that incoming proprioceptive information from the left neck muscles produced a leftward shift in the patients’ subjective position of the sagittal midplane thus reducing neglect symptoms.

Another method that can temporarily reduce the rightward bias in neglect patients is caloric stimulation. A subjective sensation of displacement can be achieved by pouring iced water into the left ear canal or warm water in the right ear canal. In many cases this leads to a temporary improvement of unilateral neglect, which in most cases lasts 15-20 minutes. Studies of caloric stimulation have shown short-lasting facilitation of eye- and head turning towards the contralateral side (Cappa et al., 1987; Rubens, 1985). Although the effects of this technique are very limited in duration and may result in long lasting diminished responsiveness to repeated
stimulation, it may provide a useful tool in rehabilitation of neglect by facilitating attention to stimuli in the neglected side of space during training.

A third way to improve awareness of contralateral space by modulating patients’ subjective body orientation is transcutaneous electrical nerve stimulation (TENS). TENS consists of electrical impulses delivered by surface stimulation electrodes that generate a tingling sensation. In an experiment by Vallar et al. (1995), neglect patients received TENS applied to the neck. While stimulation of the left side of the neck improved performance on a letter cancellation task in thirteen out of fourteen patients, right neck stimulation worsened performance in nine patients. In a following experiment using TENS, stimulation of both the left hand and the left neck had comparable effects on neglect in six patients. A number of studies have shown that TENS can (transiently) improve symptoms associated with neglect (Guariglia et al., 1998; Guariglia et al., 2000a; Guariglia et al., 2000b; Karnath, 1995; Vallar et al., 1996).

There are several ways to interpret these results. One possible interpretation attributes the effects of TENS to the correction of the systematic error in the coordinate transformation system in neglect patients (Karnath, 1995). However, there is also data suggesting that TENS produces a non-specific activation of the right hemisphere by increasing arousal (Vallar et al., 1995). The relationship between arousal and neglect will be discussed in the following paragraph.

4.2.2.4 Arousal and neglect

Our analysis of the cognitive architecture of spatial attention has so far suggested two types of rehabilitative process - joint activation of mutually facilitatory networks and reduction of inhibitory competition. Another example of the mutual facilitation process draws on evidence for the lawful interaction of two apparently very different types of cognitive process - the arousal/sustained attention systems of the brain on one hand, and the spatial attention system on the other. Heilman and colleagues showed the predominance of the right hemisphere in mediating this generalized enhanced responsivity/activation to stimuli (Heilman et al., 1978; Heilman & Van den Abell, 1979). Patients with right hemisphere lesions were hypoaroused relative to left hemisphere lesioned patients. For example, absent galvanic skin response (GSR) to pictures of emotionally arousing scenes (such as of mutilated hands and battles) was almost absent.
As we mentioned before, sufferers from both left- and right-sided stroke are equally likely to suffer distortions of spatial attention in the immediate post-stroke period (De Kort, 1996). Quite rapidly however, the pattern becomes unbalanced with right hemisphere patients forming the overwhelming majority of those who show chronic spatial deficits. There is considerable evidence now to suggest that the persistence of unilateral spatial neglect is very strongly determined by deficits in a non-spatial, partly right-hemisphere-based system for maintaining arousal in the brain. In support of this view, researchers found that non-lateralized attentional deficits are extremely powerful predictors of persisting unilateral neglect (Robertson et al., 1997a), and that the most powerful anatomical predictor of persisting neglect is a lesion to the paraventricular white matter in the right temporal lobe, the likely location of fibres projecting up to the parietal and frontal lobes from the midbrain arousal systems (Samuelsson et al., 1997; Samuelsson et al., 1998).

Robertson et al. (Robertson et al., 1998b) put these correlational links between arousal and neglect to experimental test. They predicted that phasically increasing the patients’ alertness should transiently ameliorate the spatial bias in perceptual awareness, and indeed the results provided the first direct confirmation of this prediction. The task required right-hemisphere neglect patients to judge whether a left visual event preceded a comparable right event, or vice-versa. On average, neglect patients became aware of left events half a second later than right events. This dramatic spatial imbalance in the timecourse of visual awareness could be reversed if a warning sound alerted the patients phasically. Even a sound on the right dramatically accelerated the perception of left visual events. A non-spatial alerting intervention can thus overcome disabling spatial biases in perceptual awareness after brain injury.

In a clinical-experimental corollary of the above study, Robertson and colleagues attempted directly to rehabilitate sustained attention in eight patients with unilateral left neglect following right hemisphere lesions (Robertson et al., 1995b). Patients received training in the context of a number of tasks: sorting coins, sorting cards, or sorting shapes of different colours, sizes, and shapes. These tasks did not emphasize lateralized scanning. The patients’ attention was repeatedly drawn to the task by combining a loud noise with an instruction to attend. They were then gradually taught to ‘take over’ this alerting procedure in order to improve their
internal, or endogenous, control of attention by ‘talking themselves through the task’. The training had a fixed series of stages:

1. The patient carried out one of the tasks. His/her errors were pointed out.
2. The nature of problems with sustained attention and alertness and the rationale for the training strategy were explained to the patient in colloquial terms, namely, that it is possible to use undamaged parts of the brain (i.e. the language system) to modulate and activate the impaired parts of the brain – namely the sustained centres of the right hemisphere.
3. The patient had to carry out the task again, but now the trainer knocked loudly and unpredictably on the desk on average every 20-30 s and said “Attend!” in a loud voice.
4. After several repetitions of step 3, the patient said “Attend!” when the trainer knocked on the desk, and the trainer said nothing.
5. After several repetitions of step 4, the patient was cued rap the desk at approximately the same frequency as the trainer had. The patient was required to say “Attend!” out loud at the same time.
6. The patient now rapped the desk and said “Attend!” subvocally.
7. The patient now simply signalled whenever he/she was ‘mentally’ rapping the desk and telling him/herself to “pay attention”. If this was not done, he or she was cued by the trainer to implement the strategy.
8. Finally, the patients were told about the desirability of trying to apply this strategy habitually in everyday life situations, so that they could monitor their attention to any particular task.

Not only were there improvements in sustained attention among this group of eight patients, there were also very significant improvements on spatial neglect over and above those expected from natural recovery. This study shows that the spatial bias in unilateral neglect can be briefly reduced using exogenous alerting stimuli, but that it may also be possible to reduce this bias endogenously, using self-initiated alerting mechanisms.
4.3 Concluding remarks

The fact that symptoms of neglect vary from patient to patient and may even be subject to change over time within each patient can make it very hard for rehabilitation therapists to decide which method should be applied to an individual patient, let alone to formulate a single superior modus operandi applicable to all patients. Furthermore, in clinical practice rehabilitation of neglect is often hampered by patients’ lack of awareness with regard to their symptoms. Anosodiaphoria (an inappropriate lack of concern about impairments) and anosognosia (a complete denial of symptoms) are commonly found in association with personal and peripersonal neglect. Making a patient aware of his / her deficit is often the key to successful rehabilitation.

In the past decades numerous behavioural strategies and more theory-driven methods have been developed to rehabilitate neglect. When comparing these methods some considerations should be taken into account. Firstly, some interventions are aimed mainly at overcoming specific symptoms of neglect and are limited to a specific domain. In general, the effects of these methods are also task-specific and do not generalize over the entire domain of ADL functioning, let alone change the underlying mechanisms of neglect. On the other hand, methods aiming to improve the wider spectrum of neglect are much harder to evaluate, since both training and effect are not limited to specific tasks or tests. Secondly, some methods appear to be effective only when training is very intensive. In practice, only a restricted number of patients may benefit from these methods since both therapy resources and the patient’s condition may not allow such a level of intensity. Thirdly, it appears that some of the most potent rehabilitation effects are also the most transient. Behavioural changes lasting for periods of hours are not in themselves clinically useful, unless they can be demonstrated to endure over much longer periods of time. Nevertheless, careful experimental investigations of short-term changes, particularly if they are tied into strong theoretical models of underlying cognitive function, are of considerable value in the development of theoretically based, yet clinically-important, rehabilitation methods.

It is also important to note that not all improvements in neglect produced by the different manipulations we described may be based on experience-dependent structural changes in brain circuits. Where such effects are long lasting, however,
there is a much greater chance that the observed differences are attributable to such mechanisms. Pizzamiglio and colleagues have carried out one of the very few PET studies of brain reorganization following rehabilitation. In three patients with unilateral neglect following primarily subcortical lesions, they found that recovery was mainly associated with cerebral activation in right hemisphere cortical regions similar to those observed in normal subjects (Pizzamiglio et al., 1998). While there have been too few studies carried out on the cerebral effects of rehabilitation to compare with studies on natural recovery, this latter study suggests that under certain circumstances, the mechanisms of natural recovery and of ‘guided’, rehabilitated recovery may be quite similar.
References


