While definitions of unilateral neglect still emphasise a patient’s failure to respond or orient to stimuli in the contralesional hemispace, a plethora of research studies over the last decade have greatly enriched our understanding of the complex mechanisms underlying this behaviour. Earlier attentional and representational accounts of neglect (see McCarthy, 1996 for review) proved too parsimonious to have much explanatory power in accounting for such a heterogeneous symptomology. Findings such as those of Marshall and Halligan (1988) and Berti and Rizzolatti (1992) also illustrated that so-called ‘neglected’ information could still influence behavioural responses even in the absence of any explicit awareness. Furthermore, a growing number of studies illustrated differential patterns of neglect performance across multiple reference frames. Current explanations, now consider neglect to result from a breakdown in the interaction between the cognitive systems responsible for the selection of information for further perceptual processing in different sectors of space. This current commentary reviews some of the key papers that have addressed dissociated performance profiles within the neglected hemispace and considers the contribution that Laeng et al. (2002, this issue) make to this interesting area of enquiry.

The spatial co-ordinates responsible for the representation of left and right in the damaged hemispace pose an interesting challenge for neglect research. Over the last decade, a number of studies have recognised the importance of the relationship between the frame of reference relevant to the representation of 3D space and the clinical manifestation of neglect. In accordance with accounts borrowed from spatial cognition (see Bryant, 1993), objects in one’s environment can be perceived with respect to an egocentric frame of reference (i.e. coded from the observer’s perspective with respect to three body axes: head/feet; front/back; or left/right) or an allocentric reference frame (i.e. the constituent parts of objects are coded independently of the observer’s perspective or indeed the spatial location of the stimulus). Awareness of the importance of this relationship led to a number of studies which illustrated that neglect performance could be modulated when egocentric and allocentric co-ordinates were not aligned. Calvanio et al. (1987) illustrated that neglect patients reclined on a chair, neglected objects both on the left side of their body and the left side of the stimulus array, independently of their body position. Similarly Ladavas (1987) reported that when patients with neglect were asked to tilt their heads to
the left or right such that both stimuli fell within one or other visual field, neglect was manifest according to allocentric co-ordinates. Findings such as these inspired a host of studies, which further highlighted distinctions between space-based neglect (where all stimuli in a particular region of space are affected), and object–based neglect (where the left side of a stimulus is neglected irrespective of its location within space), both of which operate with respect to egocentric coordinates (see Umiltà, 2001, for review).

An elegant illustration of object-based neglect was presented by Marshall and Halligan (1993). They reported the performance of a patient who failed to copy the left side of two independent flower drawings but subsequently neglected to copy the single flower drawing depicted in the contralateral side when both flower drawings were conjoined (potted) to form a single object. The theoretical implications of these findings suggest that both spaced-based and object-based mechanisms of attention co-exist to define ‘left’ and ‘right’ in the contralesional hemispace. Indeed, there is even some evidence that the neural substrates responsible for their mediation may be hemispherically differentiated, with the left hemisphere operating on object-based attentional mechanisms and the right hemisphere more specialised for space-based mechanisms of attention (Egly et al., 1994).

In recent times, a controversy has arisen in the literature regarding the criteria for establishing a true expression of object-centred neglect. According to Umiltà (2001) the object-centred reference frame is viewpoint invariant (operates according allocentric coordinates) and ‘left’ and ‘right’ are specifically defined with respect to the intrinsic symmetry of the object (see also Behrmann and Moskovitch, 1994). In this form of neglect, one side of the object is affected irrespective of the location or orientation of the object within space and is defined according to allocentric coordinates. One of the most frequently cited cases of object-centred neglect is the right-sided neglect patient NG, who following left hemisphere damage made reading errors on the right, end part of words, independently of whether they were presented horizontally, vertically or mirror-reversed (Caramazza and Hillis, 1990). That is, NG neglected the right endings of words even when they were presented in the left intact side of space (as in the mirror-reversed position). Other clinical support of object-centred attentional mechanisms was reported by Driver and Halligan (1991) who noted the performance profile of a left neglect patient PP. They asked PP to make same/different judgements about the presentation of two vertically elongated nonsense shapes presented in 45° rotated (clockwise and anticlockwise) positions. Their findings confirmed the presence of object-centred neglect since PP’s impaired performance was defined with respect to objects’ principal axes (differences between shapes on the left side were undetected even when they were presented on PP’s egocentrically defined right/intact side).

In a series of elegant experiments, Behrmann and Tipper (1994), required subjects to detect the presence or absence of a target presented in one of two circles each located in the right and left hemispace (the static condition) which were joined by a solid horizontal line to form a barbell (or single object). In the moving condition, participants watched the barbell rotate 180° around its midpoint, so that the side of the barbell and the side of space previously
occupied by the barbell in the static condition were now incongruent. More specifically, the original left side of the object (the barbell) now occupied the ipsilateral or intact side of space. The findings confirmed that detection times were inhibited in the right hemispace and facilitated in the left hemispace in the moving condition relative to the static (or baseline) condition. Moreover, this effect persisted even when overt eye-movements were systematically controlled (Tipper and Behrmann, 1996). In a later study, Tipper and Behrmann disconnected the two circles by removing the conjoint bar. In this sense, the barbell no longer represented a single object with an inherent left and right side but instead represented two independent circles or objects. The findings once again confirmed the contralateral facilitation and ipsilateral inhibition in the moving relative to the static conditions, which was not present when the two circles were disconnected (i.e. neglect remained in the left side of space and therefore defined by spatial co-ordinates). Closer inspection of the individual profiles failed to confirm a direct flipping over of neglect behaviour (from contralateral to ipsilateral) in all patients. Tipper and Behrmann argued that neglect for the contralateral side can be defined according location or object-centred co-ordinates and that both of these representations can co-exist. The current evidence from neglect research suggests at least that while the space or location based co-ordinate system might have priority at any one time, the magnitude of neglect behaviour can be modulated such that an object’s reference frames can co-exist and interact with other reference frames to define left and right.

More recently, Cubelli and Speri (2001) have argued that some normalisation process of rotated stimuli to their upright canonical positions, might, alternatively explain all previous evidence of object-centred neglect (specifically Driver and Halligan’s case PP described above) where stimuli other than those of an orthographic form were employed. Their argument rests on Jolicouer’s (1985) theory that some compensatory re-orientation of planar rotated objects to their original canonical position precedes identification. Cubelli and Speri argue that if participants presented with misorientated stimuli engaged in this normalisation process, neglect could therefore reflect a space or object-based interpretation (egocentrically defined) and not an object-centred impairment (allocentrically defined) as proposed.

In their own study, Cubelli and Speri (2001) presented eight left neglect patients with chimerical configurations of objects and animals (both halves being dissimilar semantically and perceptually, but all of which had a typical upright canonical orientation) in four different orientations: standard upright, rotated 180° (inverted), rotated 90° to the right and rotated 90° to the left. The mirrored reflection of all stimuli in all orientations was also presented. According to Cubelli and Speri’s argument, a true object-centred interpretation would result in the left part of stimuli being neglected irrespective of their orientation (allocentrically defined) while failure to name the left part of upright stimuli and right part of inverted stimuli would fit more comfortably with a space or object-based account of neglect (egocentrically defined). While a main effect for spatial side in favour of all left-sided parts of the stimuli in all orientations (especially the inverted condition) failed to support a pure object-centred neglect, Cubelli
and Speri (2001) argue that their results were not entirely consistent with a space or object-based interpretation. Rather curiously, they found that stimuli rotated clockwise to the right resulted in no difference between reports of right and left component parts but anti-clockwise rotations resulted in significantly more left-part than right-part components being omitted. This effect is consistent with conventional accounts of object-centred neglect, but Cubelli and Speri (2001) argue that the effect might also be elicited if patients normalised stimuli to the original canonical position and neglected the left side of the stimulus, defined once again by egocentric coordinates. In explaining why a similar account was not applicable to stimuli rotated to the right, they argued that qualitatively different amounts of information were differentially available with clockwise and anti-clockwise rotations and that no re-orientation of clockwise rotated stimuli was necessary for identification. Their argument is both convincing and very plausible.

However, in accepting it, one also accepts that normalisation is implicit for identification of rotated stimuli and this itself is contentious. Jolicoeur’s (1985) own account rests on a host of consistent findings that have observed an increase in naming latencies for rotated stimuli as orientation moves away from the upright or canonical position. Furthermore and critically important is that these orientation effects are sensitive to stimulus quantity since the presentation of a stimulus at one orientation reduces response times to the same stimulus presented at subsequent orientations (Jolicoeur and Milliken, 1989). This suggests that repeated exposure to rotated stimuli results in more efficient processing independent of orientation. Jolicoeur (1990) later argues these reduced recognition latencies observed with repeated exposures reflect a shift in strategy from the initial normalisation process to a more efficient feature-based system of recognition which maps unique object features to stored representation (see also Corballis (1988) for verification hypothesis as an alternative). In any case, the main point here is that normalisation does not necessarily precede the identification of misoriented stimuli. There is also corroborative neuropsychological evidence to suggest that object recognition can be dissociated from mental rotation ability (Farah and Hammond, 1988; Turnbull et al., 1995, 1997). Even more recently, De Caro and Reeves (2000) suggested that normalisation occurred to determine orientation rather than identification. While Cubelli and Speri present very interesting data, the recent findings of Vannucci and Viggiano (2000), who argued that differential processes are involved in the recognition of misoriented objects as a function of object category, and those by Hamm and McMullen (1998), who reported differences in orientation effects as a function of naming level (i.e. basic, superordinate and subordinate level naming) merit consideration in interpreting their own findings, particularly given the nature of the stimuli and task used.

In any case, Cubelli and Speri (2001) argue for a revised definition of object-centred neglect to take account of a specific form of neglect (now object-based) which is manifest when attention follows a rotating object or when stimuli are mentally rotated in some way. Using this definition, Cubelli and Speri argue that all previous accounts of object-centred neglect (with the exception of studies which used orthographic stimuli) could be re-interpreted as a form of stimulus-
centred neglect. Interestingly, Driver and Pouget (1999) provide a different rationale but similarly argue that many previous accounts of object-centred neglect could be explained by egocentric co-ordinates.

The data reported by Laeng et al. (2002, this issue) are particularly timely in light of these revised interpretations of object-centred neglect. Using a novel paradigm, Laeng et al. report on the differential pattern of naming latencies observed for cube colour naming by a left-sided neglect patient AE. The critical finding in their study relevant to the current discussion, was that naming latencies for cubes located in the experimenter’s left hand, were longer than comparable naming latencies for cubes held by the right hand, in equivalent hemispaces (the direct comparison being allowed by manipulations of body orientation and the use of a mirror). Laeng et al. interpret the increased naming latencies for cubes held in the experimenter’s left hand as tentative support for the assumption that the severity of AE’s neglect was exacerbated when the reference frame centred on the experimenter (the object-centred reference frame) defined ‘left’ and ‘right’.

This pattern of data is interesting for many reasons, not least of which is that the presence of the object (the human figure) was irrelevant to the execution of the task. Still, it clearly interacted with the task and modulated the overall expression of AE’s neglect behaviour. In some ways the uniqueness of the paradigm (i.e. the use of the human figure as the object) makes it more difficult to directly compare the findings with previous illustrations of object-centred neglect.

However, if object-centred neglect is defined as neglect of the left side of the object, independent of the orientation or location of the object, then the findings of Laeng et al. do not provide a straightforward expression of this form of neglect. Indeed the consistent, significant main effect for hemispace reported, suggests that in all cases, a reference frame defined according to egocentric coordinates (space-based) was contributing to the expression of AE’s neglect. Of course, this interpretation still fails to explain why a significant difference between left-handed and right-handed stimuli was observed in all trials, with the exception of those presented in the right hemispace of the mirror reflection conditions. Here, no significant differences between naming latencies for stimuli held in the left and right hand and presented in the right hemispace were observed. While one cannot be absolutely sure, it is possible that a multiplicity of reference frames (space and object-based, e.g. the reflection of the human figure and perhaps even the mirror itself) may have contributed to the overall profile of impairment observed. Indeed the profile observed here could in fact be explained as reflecting the interaction of multiple reference frames, all of which could operate according to egocentric coordinates. More specifically, the reference frame centred on the experimenter could be object-based (egocentrically defined) and not object-centred (defined according to allocentric coordinates) as argued by Laeng and colleagues. In fact, even Cubelli and Speri’s (2001) re-coined stimulus-centred neglect would not be applicable to AE’s profile since AE did not follow the object as it changed orientation. In my view, the veracity of the effect rests on how convinced one is that rotating a human figure actually dissociates the reference frame centred on the patient from the one centred on the experimenter as argued by Laeng et al. Additionally, one also needs to feel convinced that the composition of the response latencies...
reported, represents a true index of neglect severity and that increased latencies solely represent a more severe form of neglect. Of some concern, is that a host of other cognitive activities may have been engaged while searching for the stimulus held in the left hand, particularly if cubes in the left hand were always named secondary to the right hand-held stimuli. A pure expression of object centred neglect in this study might therefore have expected response latencies for left hand-held stimuli to have greater parity across conditions, irrespective of the orientation or hemispace of presentation.

An alternative, but tentative interpretation, based on empirical findings from the hemisphericity literature, might explain the profile of impairment reported by Laeng et al. to reflect a straightforward space-based neglect with differences in naming latencies in the left and right hand-held stimuli accounted for by one’s biological predisposition to inspect the right hand of human figures. In this account, significant differences in naming latencies might simply reflect a right hand advantage. Of course, this is rather difficult to prove but the argument is not entirely implausible especially since no constraints on order of report were imposed, and response latencies were so long that it is difficult to be specific about what strategies AE may have employed in orienting attention between stimuli (Beaumont, personal communication).

In summary, the data reported by Laeng et al. fail to provide a pure expression of object-centred neglect. However, their data does support a host of empirical studies with normal participants, that the mechanisms of selective attention can operate simultaneously on both object- and location-based references frames and that metaphors of attention as a spotlight (Posner, 1980) or zoom lens (Eriksen and Schultz, 1979) are not readily accommodated by these findings (see Egeth and Yantis, 1997 for review, or Driver 1998 for discussion in relation to neglect). In essence, the critical point is that the mechanisms of spatial attention can access multiple representations simultaneously, and that qualitative differences in the clinical expression of neglect may depend not just on the site and severity of the lesion but also on the reference frame which is accessed. Furthermore, there is now evidence to suggest that the extent of neglect manifested can be further modulated by the contingencies of the task (Humphreys and Riddoch, 1995). Rather counterintuitive is the finding that greater activity within a particular frame can give rise to a more severe presentation of neglect, owing possibly to what Behrmann and Tipper (1999), call “greater levels of reactive inhibition” (p. 99). Conversely, Hillis et al. (1999) report a case where the patient’s neglect improved when the expectation about a stimulus’ location became more unpredictable. Collating these findings might therefore result in view of normal spatial attention as a dynamic and adaptable system, capable of switching between reference frames in response to task demands, but without spatial bias.

Somewhat tangential to the previous discussion, though no less important, is whether distinct anatomical areas or indeed discrete neural mechanisms are responsible for the allocation of attention to different sectors of visual space. Rizzolatti et al. (1983) first provided anatomical support for a distinction between impairments of near and far space, following surgical ablations of the postarcuate cortex or frontal eye-fields in macaque monkeys. Furthermore,
Previc (1990) argued that the visual system might be organised such that lower and upper visual fields are differentially specialised in the processing of near and far stimuli respectively. There is also some clinical support for this proposal (Heilman et al., 1990; Shelton et al., 1990). More recent evidence using PET, confirmed that both frontal and parietal areas are implicated in different aspects of spatial selection (see Corbetta and Shulman, 1999 for review). Clinical evidence for a double dissociation between neglect in near and far space (Halligan and Marshall, 1991; Cowey et al., 1994; Vuilleumier et al., 1998) has confirmed that impaired coding in one sector of space can co-occur with intact coding in another sector. It follows that functionally dissociated neural sub-systems are responsible for the perception of and response to stimuli in near and far space. Variations in the execution of line bisection in both clinical and normative cohorts, have refined our understanding of the mechanisms underpinning the selection of stimuli for further perceptual processing in different sectors of space. For example, modulation of neglect performance in line bisection has been demonstrated to be a function of stimulus properties (Halligan and Marshall, 1988; McCourt and Jewell, 1999), the orientation or location of lines (Halligan and Marshall, 1993; Heilman and Valenstein, 1979), the effects of lateralised cueing or scanning direction (Chokron and Imbert, 1993; Varanva et al., 2002), individual differences (Manning et al., 1990), motor components (Harvey et al., 1994; Scarisbrick et al., 1987), viewing distance (Varanva et al., 2002), and one of the most curious of all, line length (Halligan and Marshall, 1988; Marshall and Halligan, 1989; Corbetta et al., 1993; Chatterjee 1995; Anderson, 1997; Tegner et al., 1991; Tegner and Levander, 1991). The evidence suggests that some neglect patients show leftward bisection errors with shorter lines compared to the rightward bisection errors typically reported with assessments using standard line lengths. Similar bisection biases have been reported with normal participants (Laeng et al., 1996; McCourt and Jewell, 1999; McCourt et al., 1997; Werth and Poppel 1988), although this effect is not consistently present (Jewell and McCourt, 2000).

While there remains some ambiguity in the collective findings here, many of these studies argue against a simple right-left dichotomy in the relationship between each hemisphere and the contralateral spatial representation of each hemispace. Furthermore, the evidence is generally in favour of a distinction between the neural mechanisms responsible for the mediation of spatial attention in different sectors of visual space although behavioural illustrations of this distinction appear fragile. In a clinical study with neglect patients, Cowey et al. (1999) failed to detect any sudden change in mechanisms dealing with stimuli at different distances. Equally, Varnava et al. (2002) assessed the direction of attentional bias in near and far space with normal adults and failed to detect any abrupt shift from a left to rightward bias as distance was increased. However, as Cowey et al. (1999) argued, this failure to detect a sudden shift does not necessarily preclude the involvement of discrete neural mechanisms dealing with stimuli at different spatial distances since there is still potential for compensatory effects from neighbouring cortical areas.

More recently, Berti and Frassinetti (2000) have argued that the coding of near and far space is not fixed with respect to the egocentric reference frame.
They examined whether external space was coded according to stimuli which fell within reachable distance (near/peripersonal) or beyond manual reaching distance (far/extrapersonal). Their patient illustrated a clear dissociation between near and far space, with neglect more pronounced in near space. However, when bisection performance in far space was conducted with a stick instead of a projection-light pen (which served as an extension of the patient’s body and clearly allowed the line to be reached) neglect was as severe in far space as it previously was in near space using the light pen. Berti and Frassinetti interpret this finding as evidence that far space was re-mapped as near space when the task to be performed falls within a reachable distance. In a later study, Berti et al. (2001) addressed whether activation of near and far representations were computed purely on the bases of distance (i.e. near map representations are activated when a stimulus is reachable and far map representations are computed for objects outside reaching distance) or whether computation of respective maps might also be contingent upon the action to be performed in that spatial sector. They asked three neglect patients with more severe neglect for far space than near space to either bisect a line at three different distances using a projection light pen or to bisect a doorway by walking through it. In the locomotion task, patients’ bisection errors to the right of the objective midpoint were more pronounced when the starting position was in far space. Unlike the previous study, where far space was re-mapped as near space by use of a tool, there was no evidence in the current study of space re-mapping in the locomotion task. Taken together, Berti et al. interpret this as evidence that spatial maps are computed in advance of an action being executed and that the re-mapping of far space as near space in the previous study was possible as the spatial map was re-coded (by use of a tool) prior to the action being initiated. Their findings support a hypothesis that different action based systems might sub-serve the mediation of attention to different spatial sectors. A recent neurophysiological investigation using PET lends partial support for this suggestion since dorsal visuo-motor areas were more active in near space processing and ventral visuo-perceptual areas were more active during far space processing even though the actions to be performed in both spaces were identical (Weiss et al., 2000).

Laeng and colleagues make a valuable and interesting contribution to this area of neglect research. Using a mirror, they isolated the effects of visual/perceptual processing by dissociating ‘physical’ near and far space from ‘visually scanned’ near and far space. Their patient, AE, responded more slowly to far space presentations than near space presentations and this effect was more pronounced for stimuli presented in the left hemispace than the right hemispace (although it is unclear why AE should be slower to respond to far space presentations in the intact right hemispace). Laeng et al. observed that AE was slower to name colour cubes located near his body but viewed distantly (far space representation) than when cubes were located near his body. This is an interesting finding since AE’s neglect was more pronounced for far space than near space even when the physical location of stimuli was unknown.

Their findings extend those of Berti and Frassinetti (2000) that modulating the perception of near and far space can alter the magnitude of neglect.
manifested. Their finding is particularly timely in light of recent neurophysiological evidence. Weiss et al. (2000) points to the need to inspect more closely dissociations between near and far space when the perceptual and attentional components of the task demands are examined in isolation of tasks with explicit motor involvement. Laeng et al. advance a hypothesis which proposes that different action based attentional systems might contribute to dissociations observed between near and far space. Specifically, they speculate that the exploration of eyes/gaze may be more closely linked to far space processing while action based mechanisms of attention more specialised in the control of limb/arm movements may be more specifically linked to near space processing. This suggestion supports the view of Berti et al. (2001) that modulations of neglect performance in near and far space might, to some degree, be action-specific. Furthermore, the findings give rise to a view of the mechanisms of spatial attention being sensitive not just to the spatial sector in which the stimulus is present but also to the nature of the action behaviour that is to be performed there. The suggestion is also compatible with a view of normal attention that is directed away from the body when executing tasks which involve eye/visual exploration of space (Rizzolatti and Gallese, 1988) but directed towards the body when the task involves some element of tactile engagement (see Ward, 1999 for discussion). While neuroanatomically, one might expect far space neglect to result from more frontal localised lesions (unlike AE whose lesion was in the right parietal and occipital regions), the richly interconnected pathways between the anterior and posterior attentional systems proposed by Posner and Petersen (1990) would accommodate this possibility.

To summarise, it appears that a multiplicity of spatially selective mechanisms of attention can be differentially disrupted in neglect. Both normative and clinical evidence highlight that there are asymmetrical differences in the representation of contralateral hemispace, that attention and neglect thereof can coexist in multiple reference frames and that the extent of neglect can be modulated by the contingencies of the task. Neuroanatomical, neurophysiological and now neuropsychological findings provide convincing evidence that discrete neural mechanisms contribute to the clinical dissociations observed in near and far space. Furthermore, in support of others, Laeng et al. now provide new evidence that different action based mechanisms of attention may flavour the presentation of neglect, at least in near and far space. These findings collectively lead to a view of normal attention which is sufficiently dynamic to be able to access multiple spatial representations simultaneously while still maintaining sufficient flexibility to be able to respond to changes in task contingencies.

Three final points bring this commentary to an end. Firstly, in light of these findings it is difficult to overlook continuously, the contribution that visual field loss might make to the modulation of neglect performance, particularly in near and far space where the selection of stimuli for further processing seems inextricably linked to visual processing (Weiss et al., 2000). In general, the neglect literature has been rather complacent in accounting for the role of visual field loss in neglect performance. The general consensus is that sensory impairment is simply insufficient to explain neglect. This argument is
strengthened by the common double dissociation between neglect and visual field loss; neglect can be present without any impairment of the visual fields and patients with visual field deficits rarely show neglect (Driver, 1998). While this is entirely correct, it is categorically different from the point that the presence of a visual field deficit does little to alter or modulate neglect performance in any way when both are present. Many patients with neglect also present with visual field deficits and while differentially diagnosing between the two is of little concern (patients with visual field deficits will spontaneously turn to the unattended hemispace unlike neglect patient where there is a deficit in the spontaneous exploration of the neglected hemispace) few studies systematically evaluated the contribution of a patient’s visual field deficits to their neglect performance. While this has not been of any specific relevance up until now, the findings reported in this current discussion highlight the inextricable interaction between selective mechanisms of attention and visual processing and this might be considered sufficient grounds for at least consideration of the presence or absence of visual field deficits to the clinical presentation of neglect. While some might argue that there is simply no evidence to suggest that visual field deficits modulate neglect in any surreptitious way, my view is that there is similarly no convincing evidence to the contrary.

Secondly, one might be forgiven from thinking that neglect must constitute a unique dysfunction of visuo-spatial processing, since all of the research discussed in the current commentary relates specifically to aspects of selective processing in visual space. On the contrary, dissociations between visual and auditory neglect have been reported (Barbieri and De Renzi, 1989; Beaton and McCarthy 1993; 1995) as well as evidence of cross modal extinction (Heilman et al., 1990; Inhoff et al., 1992). In essence, these findings suggest that functionally autonomous types of spatial attention (modality specific) may also contribute to selective processing in the damaged hemispace. The veracity of this proposal rests on whether the representation of space and the selection of stimuli in it are computed with respect to an overall supramodal or modality specific attentional system. While a considerable number of studies have recently examined cross modal links in spatial attention in normal subjects (see Driver and Spence, 1999 for review), the issue is underexploited in neglect research.

Finally, while many of the studies cited in this commentary have contributed immeasurably to our theoretical understanding of the complex mechanisms underlying this condition, they nevertheless remain unprescriptive about how current clinical measures of neglect or rehabilitative techniques to ameliorate the disabling consequences of the condition, should progress. To this end, Laeng and colleagues contribute two-fold: they present a paradigm suitable for the clinical assessment of neglect in multiple reference frames; their data clarify further, how the interaction of multiple reference frames can modulate the expression of spatial neglect.

Acknowledgements. Thanks to my colleagues, Mr. Niall Pender and Prof. Graham Beaumont at the Royal Hospital for Neurodisability, London, for helpful comments and discussions.
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