Belief and awareness: reflections on a case of persistent anosognosia

Annalena Venneri a,∗, Michael F. Shanks b
a Cognitive Neuroimaging Research Unit, Department of Psychology, University of Aberdeen, King’s College, Aberdeen AB24 2UB, UK
b Department of Psychiatry, University of Auckland, Auckland, New Zealand
Received 2 January 2003; received in revised form 15 May 2003; accepted 24 June 2003

Abstract
Persisting anosognosia after acute lesions is relatively rare, and no case studies to date have reported functional scanning investigation of this disorder. This is a case report of an 85-year-old right-handed Scottish woman, EN, who showed persistent anosognosia for hemiplegia following a haemorrhagic stroke. Extensive damage in the right hemisphere caused left upper and lower limb flaccid hemiplegia and severe left-sided neglect. Lack of awareness for her deficits was still present 2 years after the stroke, when neurological, neuropsychological, and SPECT examinations were performed. Testing revealed severe left unilateral neglect and poor performance on verbal fluency tasks. EN had age normal memory performance, and her object recognition and praxic abilities were preserved. She showed no global reasoning or language problems apart from her abnormal beliefs. EN believed that she was able to walk and carry out several activities, in a context of other disorders of belief. SPECT scan showed marked hypoperfusion in the right parietotemporal cortex and this extended to the associative cortex in the right frontal regions.

The persistence of anosognosia in this patient cannot be explained by memory impairments or global cognitive decline. A possible account might be that alteration in awareness was maintained by contingent right frontal and/or parietal dysfunction causing a suspension or change in the ability to monitor and check the ‘real’ and especially to assess the veracity of mental contents.

© 2003 Elsevier Ltd. All rights reserved.

Keywords: Anosognosia; Hemiplegia; Neglect; SPECT; Persistent; Chronic; Reality monitoring; Delusions

1. Introduction
A failure of awareness of deficit or anosognosia is frequently reported following right hemisphere damage and can also be seen in patients who have global cognitive impairment from degenerative causes like Alzheimer’s disease (AD). Lack of awareness of functional decline in AD, when this symptom makes its appearance, is persistent and its severity increases with disease progression. When anosognosia appears following an acute lesion it is usually shortlived, in most cases involves unawareness of hemiplegia, and when the acute or post-acute state is over patients usually gain awareness of their condition. Persisting anosognosia after acute lesions is less frequent, although a few cases have been described (e.g. Berti, Ladavas, & Della Corte, 1996; Berti, Ladavas, Stracciat, Giannarelli, & Osoda, 1998; Cocchini, Beschin, & Della Sala, 2002; Marcel, Tegnér, & Nimmo-Smith, in press). In the context of global cognitive impairments anosognosia can be seen as an inevitable consequence of multiple and increasingly severe cognitive failures, but the need for a theoretical explanation seems both more necessary and potentially achievable where this symptom appears in the absence of global deficits. Several such theoretical accounts have been put forward. These can be fairly divided into psychodynamic or motivational theories (Weinstein & Kahn, 1955) and cognitive theories (Bisiach, Meregalli, & Berti, 1990; McGlynn & Schacter, 1989). Pure psychodynamic theories, involving for example denial or depression, are challenged to some degree as comprehensive explanations of disturbances in awareness by the more frequent link between anosognosia and right hemisphere dysfunction. It is also perhaps hard to understand how mechanisms of denial might be specific to individual aspects of awareness when these disturbances are dissociated in individual patients (Berti et al., 1996).

Motivational explanations are also less convincing given the usual parallel resolution of the symptom and the acute phase of brain damage, although it is conceivable that certain forms of brain damage might allow the appearance of otherwise suppressed defence mechanisms.

The existing cognitive theories are numerous and must attempt to account for the various syndromes of
anosognosia, and the different observed patterns of neu-
rological and cognitive disturbance. No theory appears to
account for the phenomenon in all its forms, its association
with the right hemisphere, and the appearance of anosog-
nosia as both a transient and occasionally as a persistent
symptom.

This paper reports a case of persisting anosognosia for
hemiplegia and left-sided neglect in the absence of global
mental deterioration. It is suggested that the associated
phenomena of false beliefs and misidentifications may
be integral components of persistent anosognosia in this
case. Similar mechanisms may be of importance, albeit
transiently, in association with more acute disturbances of
awareness. It is important for our argument, and not avail-
able in other published material, that functional as well as
structural imaging is available for analysis in this case.

2. Case report

EN is an 85-year-old right-handed Scottish lady with a
history of hypertension, atrial fibrillation and asthma. She
was taking aspirin. In February and March 1999 she had
two transient ischemic attacks. In the first, she reported
mild and shortlived speech disturbance, while in the sec-
ond, she had left upper limb paresthesia which resolved
spontaneously after 1 h. During the second episode, her
case notes record that she felt that her arm was weakened
and difficult to move. By the time she was neurologically
examined, however, there were no focal signs. Warfarin
was prescribed after the first episode. In June 2000 she was
admitted to general medical care following a haemorrhagic
stroke, with extensive damage in the right hemisphere. The
MRI images, 3 days after the stroke, showed a hemor-
rhage measuring 2 cm × 3 cm × 3 cm involving the right
posterior temporal and parietal regions. The lesion was
surrounded by a rim of cerebral oedema, and there was
some effacement of the posterior horn of the right lateral
ventricle. Routine neurological examination indicated a
left-sided flaccid paralysis of the upper and lower limb.
There was a mild paresis of the left lower facial muscles,
which quickly resolved. She also had some difficulty swal-
lowing with impaired tongue movements. She was mildly
dysarthric with severe left visuospatial neglect and profound
anosognosia for her hemiplegia and unilateral neglect. No
visual field defect was elicited. No specialist neurological
or neuropsychological assessments were carried out at this
time.

The patient had physical rehabilitation but remained un-
able to walk and was mobilised only with a wheelchair. She
was discharged after 4 weeks to permanent nursing home
care.

2.1. Neuropsychiatric assessment

In November 2001, 17 months after the stroke, she was
referred for psychiatric assessment because of behavioural
problems. The nursing home staff reported her spontaneous
claims following admission that she was able to stand and
walk, and to look after herself. She accused staff of being
cruel, torturing and poisoning her and leaving her out in the
rain. At times she had requested that her mother be informed
of her whereabouts. She had discussed sexual matters with
her son in an inappropriate and disinhibited way.

EN presented as an alert and emotionally serene lady who
smiled readily and showed no language disorder. There was
no evidence of subacute confusion or alteration in the level
of consciousness at any point during the examinations. She
claimed that she lived in a new house in the city, although
she was presently visiting another city where her sister lived.
She had frequent visitors at home and was perfectly able to
travel by train between her present residence and that of her
sister. She continued to hold the belief that her left side was
fully functional and that she was physically independent.
At different times the staff reported she had said that either
her left hand or both of her hands had disappeared. Neu-
ropsychiatric inventory was completed and the retrospective
assessment showed that she had frequent delusions, persis-
tent apathy interspersed with frequent episodes of aggres-
sive behaviour, all of moderate severity. There was evidence
of left-sided neglect and inattention. She was referred for
functional and structural brain scan and neuropsychological
assessment, because of concerns about more global cogni-
tive decline due to progressive degenerative brain disease
together with a requirement to counsel and fully inform her
family and nursing staff about her symptoms. Risperidone
0.5 mg daily was prescribed with benefit for the hostility
and aggressive behaviours associated with paranoid beliefs.

2.2. Neuropsychological assessment

EN was tested in December 2001 and August 2002. On
both occasions comprehensive testing as detailed below was
carried out, including assessment of the persistent anosog-
nosia. There were only minor differences in psychomet-
ric test scores and no changes in her behaviour or mental
state between examinations. Mini Mental State Examination
(Folstein, Folstein, & McHugh, 1975) showed that EN was
partially oriented in time and place. She knew the month
and the year, and the city and country where she lived. She
could readily understand and follow test instructions and
was very cooperative. She had no oral or written compre-
hension deficits nor grammatical comprehension deficits nor
expressive language problems. Her spontaneous speech was
well organised with good intonational contour, grammatic-
al and logical structure and rich in information content. On
confrontation naming she showed no naming difficulties, al-
though on two occasions she produced visual paraphasias
(e.g. thermometer → pen, compasses → stepladder). There
were no object recognition deficits, but her performance was affected by poor eyesight.

Her short term memory was intact and she achieved repetition of seven digits forward and four digits backward. Long term verbal memory was tested with a paired associate word task and she achieved a total score of 11/12, a performance within the range of that achieved by a group of normal Scottish individuals comparable to EN for age and education. Her verbal long term memory was also tested using a prose memory task on which she scored 15/25, a score within the normal range for her age. She was also given a structured questionnaire which assessed susceptibility to provoked confabulations (Cooper, Shanks, Venneri, unpublished). Her performance on this task was within local norms for the memory components, but was within the pathological range for verbal invention. She was able to report personal events, the occupation of family members and their whereabouts. She could identify and name them as well as indicate their relation to her when shown their photographs. She achieved scores well below those of age and education matched controls both on semantic (17 items) and phonemic (8 items) fluency tasks. Reasoning abilities were tested with the similarities subtest of the WAIS III (Wechsler, 1997). She scored 19/28 on this task, a score within the range of age and education matched controls. Her ability to make plausibility judgments was informally evaluated during assessment. EN showed no difficulties in this respect.

2.3. Assessment of neglect

She showed severe left-sided neglect while copying simple geometrical figures with omission of the left side of the figures. Spontaneous drawing was also hampered by severe spatial neglect. She drew only the right part of a daisy and crammed all numbers in the top right quadrant of a clock face (see Fig. 1a and b). She was able to name the objects represented in simple line drawings, but her copying of these drawings was also affected by the presence of neglect (Fig. 1c).

Both in spontaneous drawing and when requested to write a sentence or her name, EN used only the far right side of the sheet which had been positioned in front of her aligned to her trunk midline.

The severity of her left-sided spatial neglect was tested formally using the Albert test (Albert, 1973), the Bells test (Gauthier, Dehaut, & Joanette, 1989), a letter cancellation task and a line bisection task. On the Albert test she made 10 omissions in total, eight of which were in the left half and only two were in the right half. She identified only six target items, all on the far right side, on the Bells test. She also marked two distractors placed in the same spatial region; she was, however, aware of making these errors. Similar findings were obtained on the letter cancellation task where she omitted 38 out of 52 target letters in the right half and 52 out of 52 target letters on the left half. Most of the identified target letters were placed in the bottom part of the right half of the page. Severe neglect was also detected on the line bisection task. She placed the mid point of different lines on the right of the true midpoint and her error was greater with longer lines. Her reading abilities were tested with single words from 4 to 10 letters long. She read all words correctly but one (photograph → monograph).

Left-sided spatial neglect was observable on both testing occasions. She also showed a marked bias to the right in both her trunk posture and face orientation. There were signs of personal neglect for the left upper limb. A cushion had been positioned by the nurses to support her left arm, which had a severe flaccid paralysis. However, her left arm would
often slip from its original position and she would leave it dangling, with no attempt to make it resume its original position, no matter what activity she was engaged in and no matter how awkward her position was.

2.4. Assessment of sensation and extinction

Visual, auditory and tactile extinction was tested. Extinction in the visual modality was severe, and only mild in the auditory modality. During the assessment of tactile extinction it became apparent that EN had severe sensory deficits in both her left upper and lower limbs. Sensory assessment by routine neurological examination showed that she was insensitive for touch over the upper and lower left limbs although she was able to feel pinprick, and she spontaneously complained of discomfort in her left foot.

2.5. Assessment of anosognosia

EN showed severe anosognosia for her hemiplegia on both occasions, confirming the observation and reports by staff in the nursing home. Hemiplegia was assessed by routine neurological examination of the limbs. When asked to lift her hands, she only lifted her right hand. When asked if she could move her left arm she replied ‘Yes, I can move my arm, but it is better if it is rested’. The doctor told me to rest it’. Similar behaviour was observed when asked whether she could walk. She claimed she could walk. When challenged by the examiner to go to the door to greet her visitors, she replied ‘Yes, I could get up to meet them, but the doctor says it would be better if I rested’. A formal questionnaire (adapted from Feinberg, Roane, & Ali, 2000) was then used to explore her awareness of her hemiplegia for the left upper and lower limbs separately. This instrument allows a qualitative assessment of anosognosic symptomatology, rather than a quantitative estimate. When asked whether she had any weakness in her arms she acknowledged that her left arm was weak but denied that it was causing any problems, except when she had to be put in a hoist. Asked why she had to be put in hoist, she replied that this was to avoid tiring the staff when they were helping her. When challenged, she acknowledged that she could not use her left arm as well as before and that she was fearful about losing her ability to use her arm properly. She claimed that sensation in her left arm was normal. She acknowledged that her left arm had been paralysed and when her left arm was lifted she agreed that the limb appeared to be rather weak.

A similar interview was completed in reference to her left lower limb. If asked about weakness in her legs, she claimed that there was none. EN maintained that her left leg was not causing her any trouble. She claimed that sensation in her left leg was normal and that the leg felt normal. She acknowledged that she could not use it as well as before and she was fearful that something might prevent her from using it properly in the future. When asked whether her doctor’s account of her leg being paralysed was correct, she denied paralysis and asserted that only the functions of her left wrist had been impaired. When her left leg was lifted and she was invited to look at the limb and to see that she had no control over it, she acknowledged this fact but could not explain why she had lost control. Her ability to use both unimanual as well as bimanual objects was also investigated. She was requested to lift and open a book. She took it with her right hand by its spine, holding the book as if her left hand might contribute to the action, but then failed to complete the task. She said that she was unable to act as requested. Asked why, she could not say. Similar behaviour was observed for all actions requiring bimanual involvement (harmonica, stethoscope, etc.). Even when repeatedly asked, she would insist that she did not know why she was unable to execute the requested action. She completed all unimanual activities successfully with her right hand.

2.6. Neuroimaging investigation

Three-dimensional MRI scan and SPECT scan were acquired in August 2002. The MRI images showed the right parietotemporal lesion demonstrated in the acute phase post-stroke with resolution of oedema, and no extension of the stroke. T2-weighted MRI images showed hyperintensities in deep and periventricular white matter in both hemispheres (Fig. 2).

Functional brain scanning with 99Tc HMPAO SPECT showed that a large area of hyperperfusion in the right hemisphere involved not only the overtly damaged right parieto temporal structures, but also a significant part of the right frontal lobe. In detail, the dorsolateral and ventral right frontal cortex showed a marked reduction in blood flow affecting the primary motor cortex and the posterior part of the middle and inferior frontal gyri (Fig. 3). These investigations were carried out while EN still showed anosognosia and this symptom still persisted in December 2002 when the patient’s carers were last contacted.

In summary, the case description shows that EN remained anosognosic for left hemiplegia and hemianaesthesia 26 months after a right sided haemorrhagic stroke in the territory of the middle cerebral artery. Her neuropsychological profile demonstrated a preservation of language, short term and long term episodic memory, abstract reasoning, praxis and object recognition. Semantic and autobiographical aspects of memory were also spared, as was face recognition. She had no visuoconstructive deficits, although her actual performance showed the influence of left unilateral visuospatial neglect. EN had reduced verbal fluency with more pronounced impairment in the phonemic task. Her reading and writing abilities were affected by mild neglect dyslexia and dysgraphia. There was visual and auditory left extinction. Motor and sensory functions of the left upper and lower limbs were lost.

The disturbances of awareness were to a degree dissociated in that she was unaware of her motor disability and how
this affected her performance on spatial and motor tasks, but she was aware of poor performance in some areas of cognitive functioning. For example, she was not aware of the neglect component in any graphic or lexical production but recognised her lack of artistic ability and poor handwriting. She was also fully aware of poor performance on the fluency tasks. There was no awareness of the profound anaesthesia in the upper and lower limbs, but she sometimes showed awareness of the left arm paresis. This deficit was acknowledged in response to specific questions, but in practice and during object use she was anosognosic for upper limb function. Her avoidance of certain actions with a rationalisation and her attempts to perform certain actions with her right hand rather than left hand, however, raise the possibility that EN might have had some implicit awareness of her inability although she resisted full explicit acknowledgment.

These neuropsychological deficits were associated with equally striking and persistent neuropsychiatric symptoms. EN confabulated extensively on themes of active excursions and bizarre acts of persecution. Some of these themes were relatively stable including a conviction that her mother was alive and concerned about the alleged transgressions against her daughter by the staff. An equally stable belief was that her surroundings were “home”, and she seemed able to entertain apparently conflicting versions of her current reality as both persecuting institution and her familiar former home.

3. Discussion

To what extent do the existing theoretical models for anosognosia offer a plausible explanation for EN’s lack of awareness and the persistence of this symptom? What significance, if any, should be attached to the other abnormalities in her mental state? Any explanation should try to account for transient and persistent loss of awareness, the prevalence of right hemisphere lesions and the patterns of dissociated awareness described in the literature.

EN’s emotional reactivity without evidence of clinical depression, her alertness and the absence of global cognitive decline sufficiently refute any argument for reduced awareness based on disturbance of these elements in her mental state. There are formulations of anosognosic symptoms which point to the probability of profound sensory deficits.
and sensory inattention leading to lack of central feedback and therefore an inability to experience the paretic limbs (Heilman, Barrett, & Adair, 1998). While this might contribute to explanation in some cases, EN indicated discomfort from a tight-fitting shoe on her left foot while engaged in a drawing task. Neurological examination demonstrated a lack of acknowledged epicritic skin sensation in the left limbs, but she was sensitive to pinprick and so there may have been sparing of elements of the protopathic sensory pathways related to the perception of pain or discomfort. There are no published case studies bearing on the incidence of such sensory dissociations in cases of anosognosia. In a wider sense, the argument from impaired sensory feedback finds difficulty in accounting for lack of awareness in other cognitive domains of, for example, memory or reasoning.

EN’s persistent anosognosia was associated with concurrent phenomena of lifestyle as well as examination triggered confabulations and with other reality dysfunctions. These included delusions based on autobiographical memory failures, place misidentification with double orientation and persecutory delusional beliefs about staff members and their intentions. Similar neuropsychiatric symptoms have been argued, on the basis of case and cohort studies in AD, to arise from regional neuropsychological failures in a context of disturbances in reality monitoring due to right hemisphere dysfunction (Feinberg & Shapiro, 1989; Förstl, Almeida, Owen, Burns, & Howard, 1991; Mizukami, Yamakawa, Yokoyama,
Shiraishi, & Kobayashi, 1999; Shanks & Venneri, 2002; Staff et al., 1999). Such symptoms are seen with highest frequency in patients with right frontoparietal dysfunction. EN did demonstrate some of the other behavioural changes which have been associated with frontal lobe dysfunction including occasional disinhibition and socially inappropriate behaviours together with apathy and loss of realistic motivation. Reduced verbal fluency was also recorded, but no other components of a formal dysexecutive syndrome.

SPECT examination showed an area of hypoperfusion in the right frontal lobe extending beyond the precentral cortex into lateral and orbital associative cortex. It is difficult of course to be certain in someone of this age whether the extended regional deficit demonstrated by rCBF measure- ment is wholly related to the stroke event. There is always the possibility that asymptomatic microvascular and/or degenerative brain disease (even developmental deficits) might contribute to the functional impairments following stroke. Her MRI also showed high grade white matter hyperintensities in both hemispheres. These white matter changes might have contributed, speculatively, to an overall reduction in cerebral reserve, but there was no indication of global cognitive decline, as might be expected if diffuse vascular brain disease were an important aetiological factor. Brain ageing may well be a contributory factor in this patient, but instances of confabulation and somatoparaphrenia can also be observed in younger populations.

When these neuropsychological, neuropsychiatric and neuroimaging findings are taken into account, it is reasonable to consider whether existing cognitive theories or modifications of them might offer some explanatory hypothesis accounting for this patient’s symptoms. Most cognitive theories invoke higher order systems whose damage might lead to anosognosia. These conjectured systems might either be integral with the functional domain for which awareness has been lost (i.e. modular Bisiach et al., 1990) or superordinate with the functional domain for which awareness to anosognosia. These conjectured systems might either be partial disconnection cannot account for the clinical observation of patients with loss of awareness for some symptoms but not for others. Neither modular nor centralised hypothesises seem to explain why the greatest proportion of left hemiplegic patients do not show anosognosia.

An attempted hypothesis at this level of cognitive functioning might be informed by theories of self-monitoring and reality monitoring. The argument would likely find support from findings made in studies assessing the role of the right frontal lobe in the retrieval and monitoring of self-related memories, as well as those evaluating the function of the right hemisphere in verifying the truthfulness of recollections (Craik et al., 1999; Fletcher, Shallice, Frith, Frackowiak, & Dolan, 1991; Metcalfe, Funnell, & Gazzzanga, 1995; Schacter, Curran, Galluccio, Milberg, & Bates, 1996; Shanks & Venneri, 2002; Venneri, Shanks, Staff, & Della Sala, 2000). It is worth considering in the first place, therefore, whether cognitive disturbances suggesting a wider dysfunction of frontal lobe functions are observed either transiently or chronically in association with neurologically defined lack of awareness. Similarly, it may be relevant if the brain damage and dysfunction identified in cases of anosognosia might in some instances extend beyond the lesion in the motor cortex to compromise frontal lobe function and contribute to related disturbances of normal consciousness, particularly when the disorder of awareness is persistent.

The most straightforward point to make is that in all cases of anosognosia for hemiplegia there will be direct or indirect damage to the motor cortex in the frontal lobe. This must, from neurological reasoning, involve a significant part of the precentral gyrus and/or its subcortical connections and associated subcortical structures that even if structurally spared must be functionally damaged. In the acute phase following stroke, there is likely to be, at the least, a more anterior and ventral region of oedema and parenchymal reaction encroaching on the associative cortex of the frontal lobe. This raises the possibility that in transient cases of anosognosia for hemiplegia, there might be a more extensive or regionally significant frontal dysfunction dependent on individual variation in the local consequences of acute brain lesion either directly or via disconnection. The extent of any frontal lobe dysfunction has rarely been assessed in acute stroke patients. There is likely to be, at the least, a more anterior and ventral region of oedema and parenchymal reaction encroaching on the associative cortex of the frontal lobe. This raises the possibility that in transient cases of anosognosia for hemiplegia, there might be a more extensive or regionally significant frontal dysfunction dependent on individual variation in the local consequences of acute brain lesion either directly or via disconnection.

The association between loss of awareness of hemiplegia and right hemisphere dysfunction has also been examined using the Wada technique. Some authors have found that unawareness of hemiplegia is preferentially associated with anaesthesia of the right hemisphere while others claim that anosognosia can be observed with induced dysfunction of either hemisphere (see Heilman et al. (1998) for a
whose content is then determined by emotional and motivational factors as well as by specific regional dysfunctions (Shanks & Venneri, 2002; Venneri et al., 2000).

In this case at least, therefore, there may be a barrier to the natural awareness of hemiparesis as part of a wider syndrome of reality monitoring failures which also have allowed the development of other abnormal beliefs. The content of these false beliefs often seems psychogenically driven and either gainful for the patients or explicative in terms of their changed appreciation of their environment. The neuropsychiatric symptoms may be viewed, therefore, as integral with whatever mechanisms are promoting persistent anosognosia, and this approach might have heuristic value for the interpretation of other similar cases and for future research. This hypothesis could be tested by studies of reality assessment and susceptibility to provoked confabulation in acute or subacute stroke patients with and without lack of awareness. Cases of hemiparesis with anosognosia might show a more extensive or subregionally relevant disorder of frontal lobe function, and this also could be assessed by functional brain imaging. Detailed evaluation of the idea that frontal dysfunction may be an embedded factor in the genesis and maintenance of lost awareness after stroke will, therefore, require data from the study of both transient and persistent cases with or without demonstrable frontal involvement. The present case, however, offers evidence that a functional lesion extending into the associative cortex of the right frontal lobe, as shown by the rCBF pattern, can lead to distinctive neuropsychological and phenomenological changes in chronic anosognosia. These features suggest the probable contribution of such regional dysfunction (either transient or persistent) in the genesis and endurance of anosognosia.

Acknowledgements

The authors thank Alison D Murray and Howard G Gemmell for making the MRI and SPECT images available. They also thank Anthony Marcel for his careful review of this paper and his valuable comments, many of which have significantly improved the content and argument presented.

References


