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BEHAVIOR (H. S. KIRSHNER, SECTION EDITOR)

Delusional Misidentification of the Mirror Image

David M. Roane[1] · Todd E. Feinberg[2] · Taylor A. Liberta[3]

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Abstract

Purpose of Review Delusional misidentification syndromes (DMS) include conditions in which a false belief about the identity of a person, place, or object occurs in the context of psychiatric or neurological disorders. One form of DMS involves the delusion that the patient's mirror image is a separate individual. This review of reported cases characterizes the psychiatric, neuropathological, and neuropsychological aspects of DMS for the mirror image. An individual case presentation highlights the patient's subjective experience. Finally, the impact of this syndrome on the sense of self is considered.

Recent Findings Mirror DMS is a persistent delusion that occurs in the context of neurological illness. It is associated with right hemisphere impairment and a variety of neuropsychological and neuroimaging abnormalities. This phenomenon contributes to our understanding of a range of neurobehavioral syndromes that can be classified as *neuropathologies of the self* (NPS).

Summary DMS for the mirror image is a neurobehavioral syndrome in which the inability to recognize oneself in the mirror entails neurological, neuropsychological, as well as psychiatric aspects of the sense of self.

Keywords Mirror sign · Delusional misidentification · Neuropathology of the self

Introduction

Delusional misidentification refers to a condition in which there is a fixed, false belief about the identity of a person, place, or object. The term has been applied to a variety of clinical syndromes. In the Capgras syndrome, the patient believes that a close relation, such as a spouse, has been replaced by an imposter [1, 2]. By contrast, in the Fregoli syndrome, the patient claims that a familiar individual is masquerading as a stranger [3, 4].

Delusional misidentification syndromes (DMS) occur in both psychiatric conditions, especially schizophrenia, and in neurological conditions, including stroke, dementia, and traumatic brain injury [5, 6]. Early explanations for the occurrence of the DMS for the Capgras syndrome emphasized psychiatric factors such as marked ambivalence toward the misidentified person [7]. However, with the increased recognition of the prevalence of DMS in association with brain disease, recent discussions have focused on neurocognitive factors such as visual perceptual impairment and right hemisphere dysfunction [8].

One particularly intriguing form of DMS is called the mirror sign or mirror delusional misidentification where the patient treats the mirror image as a separate individual [8, 9]. Although the mirror sign is most commonly seen as part of a dementia [9–11], some patients have only mild cognitive impairment yet despite this they display mirror misidentification that is highly delusional and strictly confined to the patient's own mirror image [8]. In these cases, the patient can successfully identify other individuals when the mirror is tilted to display them and thus they do not have a general impairment in recognizing familiar faces, as is seen in prosopagnosia [12]. Additionally, this syndrome is distinct from mirror agnosia [13] where patients cannot distinguish between actual objects and their mirror images and will attempt to grasp objects through the mirror. Mirror DMS is also separate from mirror ataxia [14] where patients recognize that an image is in a

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✉ David M. Roane
droane@northwell.edu

[1] Department of Psychiatry, Lenox Hill Hospital, Donald and Barbara Zucker School of Medicine at Hofstra University, 111 E. 77th Street, New York, NY 10075, USA

[2] Yarmon Neurobehavior and Alzheimer's Disease Center, Icahn School of Medicine at Mount Sinai, Mount Sinai Beth, Israel

[3] Adelphi University, South Ave, Garden City, NY 11530, USA

mirror but cannot use the mirror to guide movements. The latter two conditions are both strongly associated with lesions limited to the parietal lobes [14].

Several investigators have found a relationship between DMS, including the mirror sign, and right hemisphere dysfunction [6, 8, 11, 15, 16] and efforts have been made to associate the mirror sign with particular cognitive or perceptual deficits related to right hemisphere pathology, including deficits in face recognition [17]. Ellis and Young explained the Capgras syndrome on the basis of distinct neural pathways for facial recognition [12, 18, 19]. These included an overt pathway that is presumably disrupted in patients with prosopagnosia and results in a failure of explicit visual identification of any face but leaves emotional recognition intact and a covert pathway that provides the appropriate emotional response to a familiar face that could be disrupted in the Capgras syndrome. The latter would result in intact explicit recognition of faces without the appropriate emotional response, resulting in a delusion of identity.

Breen and colleagues [20, 21] have also proposed that mirror DMS could be linked to particular deficits in face processing. They reported two patients with early dementia who developed persistent mirror sign. Their analysis showed that facial processing defects could be present or absent in patients with the mirror sign, suggesting that such deficits might not be necessary or sufficient to create the condition. They concluded that the mirror sign may require "a perceptual deficit, a disturbed affective response, and a deficit in reasoning" [20]. This proposal is consistent with the observation that Capgras syndrome often presents in the context of paranoia [6, 16, 22].

In this paper, we review case reports from the literature to characterize the demographic, psychiatric, neuropathological, and neuropsychological features of DMS for the mirror image. Then, we present an individual case to focus on the patient's subjective experience. Finally, we will discuss how this syndrome can impact the patient's sense of self, considering that the psychological meaning of the misidentification can vary from person to person.

Literature Review

We used PubMed standard search to collect cases for the present study. For DMS for the mirror image, we searched the database for all studies published through 2018 using the keywords "mirror" combined with "misidentification" or "delusion."

We found 19 articles that described 24 cases of mirror sign [8, 20, 22–38] (Table 1). Patients ranged in age from 53 to 90 years old. The ratio of female to male was 16:8. Twenty-four had evidence for neurological disease, including 18 with dementia. Of the dementia patients, 10 were diagnosed with Alzheimer's disease, 2 with Lewy body dementia, 1 with vascular dementia, and 5 were unspecified. Nine patients had evidence for right hemisphere abnormalities including patients with and without dementia. Areas of right brain involvement included the following: parietal cortex, temporoparietal cortex, occipito-temporal cortex, dorsolateral frontal cortex, basal ganglia, and thalamus. Fifteen of 24 had paranoid responses to the mirror image. These included beliefs that the 'other' was stealing, staring or spying, insulting, threatening, and living at the patient's expense. Six others considered the misidentified person to be a friend. In one instance, the "stranger" began as a friend and then became "aggressive." In only 2 cases was the patient's response considered neutral.

Of the 24 cases described, 15 reported duration of symptoms. These delusions were reported to persist for several days (1), weeks (1), months (6), and years (7). Therefore, mirror DMS presents a significant enduring clinical problem.

Of the 24 cases, 19 patients were reported to have received formal neuropsychological testing. Cognitive deficits were reported in 22 of the 24 cases described. On a measure of overall cognitive functioning, 14 patients scored below the cutoff for impairment. Disorientation was reported in 11 patients. Memory deficits were reported in 18 cases, including 3 patients who were described as increasingly forgetful, 5 patients with poor memory, and 10 patients with memory deficits/impairment. Visuospatial deficits were reported in 13 cases, including 10 patients with visuoconstructional impairment (e.g., on a block design task, when copying simple stimuli, when copying a complex figure, and on a clock drawing task), 3 patients with visuoperceptual impairment (e.g., on a line orientation task), 4 patients with visuomotor sequencing/tracking impairment, and 2 patients with unspecified visuospatial impairment. Executive functioning deficits were reported in 11 cases, including patients with impairments in planning (1), sequencing (3), abstract reasoning (3), calculations (5), set-shifting (1), and response inhibition (1), as well as 3 patients with unspecified executive dysfunction. Notably, little reference to abnormalities in attention and working memory/concentration was reported (3). Language deficits were reported in 10 cases, including impairments in confrontation naming (3), verbal initiation/fluency (5), word-finding (3), comprehension (e.g., difficulty following complex commands; 5), and semantic fluency (2), as well as 1 patient with unspecified language dysfunction.

Imaging was reported in 20 cases. CT findings (7) revealed ventricular dilation and widening of cortical sulci (1) and periventricular white matter changes (2; one study specified that changes occurred in the parietal and occipital regions); 4 CT findings were reportedly within normal limits. MRI findings (18) showed mild generalized atrophy (13) as well as atrophy in specific regions (right parietal 3, right temporal parietal 2, bilateral occipital 1, bilateral parietal 1, bilateral temporal 1), infarcts in the right basal ganglia (1) and right frontal (2) regions, and white matter hyperintensities (5).

Table 1 Patients with mirror sign

Patient	Diagnosis/etiology	Subjective experience of the mirror image	Areas of cognitive impairment	Treatment
61F[23]	Probable dementia	Persecutor: image mocked and insulted her	Orientation (time) Memory	Husband refused to hospitalize her against medical advice
64F[24]	Degenerative dementia	Persecutor: image followed her and stole from her	Orientation (time, place) Memory Language (confrontation naming, comprehension) Executive functions (abstract reasoning, calculation) Visuospatial (visuoconstruction) MMSE = 9	Admitted to a nursing home; DMS diminished after several months
77F[8]	Mild diffuse cerebral dysfunction with right hemisphere impairment	Friend: image kept her company	Orientation (time) Memory Executive functions (calculation, sequencing) Visuospatial (visuoperception)	DMS did not respond to antipsychotics
82F[25]	Vascular dementia with generalized atrophy and lacunar infarcts in right basal ganglia and bilateral thalamus	Persecutor: image tormented her	Orientation Memory (visual) Visuospatial (visuoperception, visuoconstruction, visual tracking)	Referred to outpatient memory disorders clinic; DMS increased
61F[26]	Probable Alzheimer's disease; no agnosia or prosopagnosia	Persecutor: patient hid from the image	Memory Language (verbal fluency, word-finding) Executive functions (abstract reasoning, calculation, sequencing) Visuospatial (visuoconstruction) MMSE = 13	Psychiatrically hospitalized; DMS became less distressing and interactions less hostile
55M[26]	Probable Alzheimer's disease; no agnosia or prosopagnosia	Persecutor: patient ranged from "mildly suspicious to frankly paranoid"	Orientation (place) Memory Language (verbal fluency, word-finding) Executive functions (abstract reasoning, calculation) Visuospatial (visuoconstruction) MMSE = 12	Psychiatrically hospitalized; DMS persisted for 8 months
83F[27]	Probable Alzheimer's disease	Persecutor: image interfered with activities and stole possessions	Memory	N/A
80F[28]	Probable Alzheimer's disease; prosopagnosia and object agnosia	Friend: patient was reassured when able to see the reflection	Orientation Memory (personal semantic memory) Language (word-finding, comprehension) Executive functions (concentration) MMSE = 10	Residential care; DMS persisted for several months

Table 1 (continued)

Patient	Diagnosis/etiology	Subjective experience of the mirror image	Areas of cognitive impairment	Treatment
70F[22,29]	Probable early dementia	Persecutor: image called her names and spied on her	N/A	Outpatient psychiatric (?) treatment; mirror sign disappeared after several days
87M[21]	Diffuse atrophy; small periventricular lacunar infarcts	Neutral: lack of emotional reaction reported	Memory (visual) Executive functions Visuospatial (visuoconstruction, visuomotor sequencing/tracking)	Admitted to a nursing home; DMS persisted for 4 years
77M[21]	Diffuse atrophy; small right posterior frontal infarct	Neutral: lack of emotional reaction, denied paranoia	Memory (visual) Executive functions Visuospatial (visuoconstruction, visuomotor sequencing/tracking)	Medically hospitalized; given haloperidol; DMS persisted for 2 years; admitted to nursing home
90M[30]	Right dorsolateral infarct; bifrontal encephalomalacia	Persecutor: image wanted to harm patient and his family	Language (confrontation naming, verbal initiation/fluency, semantic fluency) Visuospatial (visuoconstruction)	Referred to outpatient memory clinic; given clopidogrel; mirror sign persisted for 2 years
85F[31]	Probable mild dementia; right lateralized occipito-temporal hypometabolism	Persecutor: image described as "phantom border," living at her expense	Memory Language Executive functions Visuospatial MMSE = 21	Psychiatrically hospitalized
85F[32]	Dementia	Persecutor: complained she was being stared at, suspicious	Orientation (time) Memory (verbal) Language (verbal initiation/fluency, semantic fluency, confrontation naming, comprehension) Executive functions (attention, working memory, planning, set-shifting, sequencing, response inhibition) Visuospatial (visuoperception, visuoconstruction, visuomotor sequencing/tracking) MMSE = 19	Donepezil; decreased frequency of DMS; prescribed escitalopram for depression; in nursing home an "environmental intervention": allowed hand mirror only; DMS resolved
78F[33]	Dementia, most likely of the Alzheimer's type	Persecutor: image stealing her clothes and jewelry	Memory Language (comprehension) Visuospatial (visuoconstruction) MMSE = 6	Psychiatrically hospitalized; given risperidone, ziprasidone, thiothixene, and donepezil; DMS persisted
60F[34]	Posterior cortical atrophy (PCA), more characteristic of Dementia with Lewy body than Alzheimer's disease	Persecutor: complained she was being stared at, expressed fear	Memory (visual > verbal) Executive functions (calculation) Visuospatial (visuoconstruction) MMSE = 17	Medically hospitalized

Table 1 (continued)

Patient	Diagnosis/etiology	Subjective experience of the mirror image	Areas of cognitive impairment	Treatment
62F[35]	Alzheimer's disease; greater right temperoparietal atrophy	Friend: took pleasure talking to image	Orientation (place) Memory HMSE* = 23	"Brought to the hospital"; given donepezil
80F[35]	Diffuse Lewy body dementia	Persecutor: accused image of stealing her dress	Memory HMSE* = 20	Donepezil
73F[35]	Alzheimer's disease; right parietal atrophy	Persecutor: image described as a "thief"	HMSE* = 23	Donepezil
69F[35]	Alzheimer's disease; right parietal atrophy	Friend: discussed family matters with the image	Orientation (place) HMSE* = 23	Donepezil; DMS resolved in 12 months
74F[35]	Alzheimer's disease; right parietal atrophy	Friend: claimed the image was a friend	Orientation (place) Memory HMSE* = 20	Donepezil
78M[36]	Posterior brain atrophy	First friend: shared meals; later aggressive	N/A	Medically hospitalized; given escitalopram and amisulpride; DMS resolved 3 months later
53M[37]	Down's syndrome/Alzheimer's disease with severe bilateral hippocampal atrophy	Persecutor: stole his belongings	Orientation (time) Memory Language (verbal fluency) Visuospatial	Risperidone, not distressed by mirror image; donepezil, improved functioning
63M[38]	Traumatic brain injury; diffuse cortical atrophy	Friend: image performed activities with him	Language (comprehension) Executive functions (concentration) MMSE = 16	Quetiapine; DMS persisted

*Hindi Mental State Examination (Hindi adaptation of the Mini Mental State Examination)

SPECT findings (3) reported hypoperfusion in the frontal (1), occipital (1), and parietal lobes (3) bilaterally. PET findings (1) revealed right prefrontal, parietal, and occipito-temporal hypometabolism. In addition to imaging, EEG findings were reported in 9 cases. Of the 9 cases, 8 reported slowing of the background rhythm. One EEG was reportedly normal.

Clinical interventions were described in 23 of the 24 cases. In terms of hospitalizations, 3 patients were medically hospitalized, 4 patients were psychiatrically hospitalized, and 1 patient was hospitalized (unclear if it was medical or psychiatric). Four patients were admitted to nursing homes. One patient was admitted to residential care. Of the 3 patients who received outpatient treatment, 2 patients were referred to memory clinics and 1 patient was referred to outpatient psychiatric treatment. Of the 24 cases, 17 reported follow-up outcomes in terms of the mirror sign. Overall, in terms of outcomes, 7 patients showed improvement (mirror sign subsided or disappeared completely), 9 patients did not respond (mirror sign persisted), and 1 patient's symptoms worsened (mirror sign increased). In terms of pharmacological interventions, 13 patients were prescribed medications including donepezil (8), escitalopram (2), and clopidogrel (1); 6 of the 13 patients were prescribed antipsychotics (i.e., haloperidol, risperidone, ziprasidone, thiothixene, amisulpride, and quetiapine). Of the 8 patients who were prescribed donepezil, 3 patients showed improvement in symptoms and 1 patient did not respond (symptoms persisted); treatment response was not reported in the remaining 4 cases. Of the 6 patients who received antipsychotics, only 2 patients showed improvement in symptoms (of note, these 2 patients were also prescribed another medication—i.e., escitalopram and donepezil).

Additionally, 2 non-pharmacological interventions were described. In one case of a 61-year-old woman, symptoms improved following increased structure and support on a psychiatric inpatient unit in addition to removing the initiating stimuli (i.e., covering up the mirrors). In the second case of an 85-year-old woman, her mirror sign delusion disappeared subsequent to an "environmental intervention" in which her bathroom mirror was transformed into a hand mirror (i.e., the mirror reflected only her face and neck).

Case Report

This case was previously reported [8, 22]. SP is a 77-year-old right-handed woman with hearing impairment, who presented with the mirror sign after her family observed her communicating in sign language in front of a mirror. She explained to the family that she was signing the "other SP" who was signing back to her. The patient had been virtually deaf since age 5 and generally relied on sign language and lip reading to communicate. The patient's misidentification was highly selective in that she readily identified others in the mirror when they stood behind her. She was impervious to correction and the symptom persisted for at least 2 years with no response to antipsychotic medication.

On neurological examination, the only finding was a left homonymous hemianopia with normal visual acuity. The MRI scan demonstrated mild generalized atrophy and disproportionate right temporoparietal atrophy was apparent, as evidenced by enlargement of the right lateral ventricle and sylvian fissure. The latter finding was interpreted as the result of an old right temporoparietal infarct. The EEG showed bilateral cerebral dysfunction with right temporal slowing.

Neuropsychological testing revealed mild impairment in orientation, calculations, and sequencing. The patient had normal language and abstract reasoning with minimal evidence of memory impairment. There was significant visuospatial dysfunction as measured by the Benton Judgment of Line orientation, and she had mild hemispatial neglect. Facial recognition was in the borderline range and there was no clinical evidence of prosopagnosia. Overall, the presentation was consistent with focal right hemisphere dysfunction in the context of mild diffuse cerebral impairment.

Subjective Experience

In contrast to most reported cases, SP did not have a paranoid reaction to her misidentified mirror image. Rather she developed a friendly relationship with the face in the mirror. She told her examiner: "When she sees me through a mirror, she looks a little then she comes over and talks to me, and that's how we began becoming friends through our sign language. She was very nice."

Interestingly, she compared herself to her mirror image and concluded that the other SP was more limited than she. She stated, "She's not a very good lip reader. I had to do mostly in sign language for her, to make her understand … I found out she's not that bright. I hate to say that…I don't want to brag." The other SP in the mirror was a consistent friendly presence for our patient, who because of her deafness tended to be socially isolated. Indeed, the other SP in this case became an "imaginary companion" for her [22–34, 35•, 36•, 37•, 38].

Discussion

Phenomenology

To our knowledge, this is the first comprehensive survey of cases of mirror DMS. Misidentification of the mirror image resembles other forms of DMS, such as Capgras syndrome, in that the symptomatology is truly delusional. The belief that the reflection is a separate person is generally quite persistent and not amenable to correction. The patient relates to this "other" as a separate person and almost always has a strong emotional

reaction, most often paranoid but sometimes friendly or affiliative. In 4 of the paranoid cases from our review, the psychosis warranted a psychiatric hospitalization. At the same time, no patient was reported to misidentify other people or objects seen in the mirror. None of the patients had lost the ability to recognize faces or the capacity to use a mirror.

Delusional misidentification of the mirror image can be compared to other delusions where the self is misidentified. This includes a number of phenomenologically distinct conditions where the self is replaced or duplicated (physically or psychologically) [39]. The variant of "reverse intermetamorphosis" most resembles our mirror patients, as there is a delusion that the individual has developed a completely separate identity. In a review of 20 such cases [40], many patients reported marked transformations (e.g. alternate gender, robot, animal). Unlike our mirror series, these patients were younger (aged 20–62) and they had received psychiatric diagnoses (predominantly schizophrenia). None were diagnosed with a neurological condition. Eight patients did endorse the experience of "radical changes in facial identity when they saw themselves in the mirror." Nonetheless, these changes in the mirror never occurred in the absence of pervasive delusional thinking about the self.

Neuropathology and Neuropsychology

Unlike Capgras syndrome, DMS for the mirror image is uniformly associated with neurological illness and most commonly with neurodegenerative conditions. The literature review found no cases associated with schizophrenia or other idiopathic psychiatric syndromes. All patients were middle-aged or elderly individuals with evidence of cerebral dysfunction, generally dementia. As with other forms of DMS, there was an association with right hemisphere pathology in some cases and there were no cases with isolated left hemisphere lesions. Areas of the right hemisphere affected were widespread including a range of cortical and subcortical lesions. The association with of right hemisphere involvement is consistent with previous work linking self-recognition to the right prefrontal [41] and right frontoparietal cortex [42]. Overall, the most common findings included the following: generalized or localized atrophy on MRI, ventricular dilatation on CT Scan, and slowing on EEG.

Documented neurocognitive impairment ranged in severity. In some cases, no formal neuropsychological testing was administered and in a small number of instances the authors did not report evidence of cognitive impairment and based their diagnosis on imaging findings or cognitive decline at follow-up. Most patients met criteria for dementia (including Alzheimer's, vascular, and Lewy body); however, even in these cases, Mini Mental State Examination scores ranged widely from 6 to 23.

There was also a wide range of cognitive deficits within the domains of memory, visuospatial functioning, executive function, language, and orientation. The most common specific finding was impairment in visuoconstructional ability that was demonstrated in 9 of the 24 patients. Otherwise, memory impairment was the most common finding but this was generally not well described. The lack of any consistent findings with regard to the degree and the type of cognitive impairment in these patients (plus the lack of general impairment in the use of the mirror) suggests that changes in cognition, alone, may not account for this condition.

With regard to clinical management, the most common intervention involved removing the patient from the home setting, either to a hospital or long-term facility. Although all patients responded to the mirror in delusional fashion, only 6 received antipsychotic medication. This could reflect a concern about the known risks of exposing patients with dementia to this class of medications [43]. A greater number (8) received anticholinesterase inhibitors to address the underlying dementia. Although these numbers are small, there is no clear evidence of efficacy for either class of medication.

Mirror Misidentification and the Self

While there is a range of neuroanatomical and neuropsychological features that are associated with DMS for the mirror image, these factors are all commonly found in many patients with dementia or other neuropsychological conditions who do not develop any form of a DMS. Indeed, we find that DMS for the mirror image is exceedingly rare. Furthermore, in contrast to these other standard neuropsychological impairments that are shown in patients with DMS for the mirror image, as is the case with other varieties of DMS, DMS for the mirror image has a distinctly delusional character.

In order to address these aspects of delusional misidentification syndromes, Feinberg [44•, 45, 46•] has suggested that DMS, including the mirror sign, falls into a larger category of syndromes that he calls *neuropathologies of the self* (NPS). The NPS syndromes differ from more basic neurobehavioral conditions in that they are multimodal (not tied to a single neurological dysfunction), selective, involve areas of personal significance to the patient, and have delusional qualities. Other examples include delusional forms of anosognosia (generally consisting of unawareness of hemiplegia after right hemisphere stroke) and somatoparaphrenia [47] (delusional misrecognition of ownership of a limb after right hemisphere stroke). Feinberg's model explains NPS on the basis of both positive and negative factors. The theory posits three hierarchical levels of pathology. Level 1 involves cognitive deficits (negative factors), level 2 encompasses self-related deficits (also negative factors), and level 3 consists of defenses and adaptations (positive factors) that contribute to these disorders. These three elements together create the final syndrome.

As noted above, the cognitive defects and self-deficits may be necessary but are not sufficient in explaining the full range of NPS disorders. The model posits that there are critical adaptive, defensive, and motivational features that play a third and essential role in the etiology and persistence of these disorders [46•]. These features reflect the way the damaged brain adapts in a positive fashion to various psychological deficits and emotionally significant issues. At this level, Feinberg proposes that the emergence of primitive psychological defenses and the patient's personal pattern of adaptation and motivation shape the emergence of the final syndrome. For instance, with SP, the case of DMS for the mirror image detailed above, the patient used the fantasy of the imaginary companion as a source of solace. The theory posits that the neurological injuries in cases of DMS and associated conditions disrupt the brain function required to support mature adaptations and result in the disinhibition of more primitive defenses that may manifest as delusions.

Conclusions

In summary, DMS for the mirror image differs from other forms in that it is seen exclusively in patients with neurological disease. While right hemisphere dysfunction appears to be a requirement for this syndrome, patients with this condition do not have consistent neuroimaging or neuropsychological findings for a localization within the right hemisphere. Clearly, the loss of the ability to recognize oneself in the mirror is evidence of a fundamental change in the sense of self. Thus, this syndrome is consistent with the idea that not one specific area of the brain is responsible for the functions that support self-recognition and self-awareness.

Compliance with Ethical Standards

Conflict of Interest David M. Roane, Todd E. Feinberg, and Taylor A. Liberta each declare no potential conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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