The Merging Tracks of Anosognosia and Neglect

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Abstract

Anosognosia and hemineglect are among the most startling neurological phenomena identified during the 20th century. Though both are associated with right hemisphere cerebral dysfunction, notably stroke, each disorder had its own distinct literature. Anosognosia, as coined by Babinski in 1914, describes patients who seem to have no idea of their paralysis, despite general cognitive preservation. Certain patients seem more than unaware, with apparent resistance to awareness. More extreme, and qualitatively distinct, is denial of hemiplegia. Various interpretations of pathogenesis are still deliberated. As accounts of its captivating manifestations grew, anosognosia was established as a prominent symbol of neurological and psychic disturbance accompanying (right-hemisphere) stroke. Although reports of specific neglect-related symptomatology appeared earlier, not until nearly 2 decades after anosognosia's inaugural definition was neglect formally defined by Brain, paving a path spanning some years, to depict a class of disorder with heterogeneous variants. Disordered awareness of body and ex-

trapersonal space with right parietal lesions, and other symptom variations, were gathered under the canopy of neglect. Viewed as a disorder of corporeal awareness, explanatory interpretations involve mechanisms of extinction and perceptual processing, disturbance of spatial attention, and others. Odd alterations involving apparent concern, attitudes, or belief characterize many right hemisphere conditions. Anosognosia and neglect are re-examined, from the perspective of unawareness, the nature of belief, and its baffling distortions. Conceptual parallels between these 2 distinct disorders emerge, as the major role of the right hemisphere in mental representation of self is highlighted by its most fascinating syndromes of altered awareness.

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Introduction

Anosognosia and hemineglect are among the more astonishing neurological phenomena that are frequently associated with right hemisphere dysfunction, often involving the parietal lobe. Current clinical literature on stroke is replete with references to both. Neglect is considered the most common behavioral syndrome, with anosognosia also quite frequent, in right hemisphere stroke [1], and

on review, effects of neglect, anosognosia, and constructional apraxia are emphasized among right hemisphere stroke disorders [2]. Despite the clinical and neuroanatomical contiguity of these startling signs, it is notable that each was relatively independently discovered and described in neurological literature during the first half of the 20th century. The emerging path of each clinical disorder is examined, integrated within a broader perspective of the right hemisphere's role in awareness of self.

Defining Anosognosia

On June 11, 1914, Joseph Babinski (1857–1932) (Fig. 1) presented to the Paris Société de Neurologie, of which he was a founding member, what was to become the landmark paper on anosognosia, published in *Revue Neurologique* [3]. Remaining unaware of an obvious hemiplegia, patients disregard demonstrable evidence of paralysis or even deny its presence [3].

Patients with anosognosia do not appear “to know,” nor to recognize, that they are paralyzed, and are “ignorant of” what should be self-evident, and what is patently obvious to the observer [4]. In a related condition, those with some apparent awareness of paralysis may nonetheless display indifference to severity of disability (anosodiaphoria) [3].

Having trained with Charcot at the Salpêtrière Hospital [5], Babinski spent most of his career at L'Hôpital la Pitié, where he served as chief [5, 6]. He was known for his methodical clinical approach and exactitude [7]; careful attention to detail was reflected in precise depictions of anosognosia. Anosognosia, also called Babinski's anosognosia, perhaps second to the fame of the eponymous reflex, rather quickly became an additional source of celebrated renown for Babinski.

Anosognosia was appreciated as an astonishing symptom commonly observed and associated with right hemisphere dysfunction. A series of papers from 1914 through the 1920s by Babinski, his students, and colleagues focused exclusively on anosognosia in hemiplegia [8]. The 5 reports on anosognosia published in the *Revue Neurologique* included Babinski's 1914, 1918, and 1923 papers, and reports of Barré et al. [9] on Babinski's anosognosia and Joltrain [10] followed, along with one in 1925 by Swedish physician Barkman [11], who had studied with Babinski in 1922 in Paris [8].

Interpreting existing literature within its appropriate historical context, Barkman's [11] thorough review cited prior reports, primarily in German literature, mentioning

Fig. 1. Joseph Babinski. Courtesy of the U.S. National Library of Medicine.

unawareness of a functional deficit. The reports, by writers including Anton in 1899 and Von Monakow in 1885, and others, depicted unawareness of cortical blindness (“psychically blind” to their own blindness), with some cases of cortical deafness as well [11]. Anton noted that patients with severe, bilateral lesions of the visual cortex tended to “deny” their blindness [12], though the reports did not include cases of anosognosia in the way Babinski described it [11]. In the French 1914 anosognosia paper [3], Gilbert Ballet briefly mentioned unawareness of blindness after cerebral tumor, and Pierre Marie noted the psychological phenomenon of unawareness of gravity of illness in visceral and urological disorders. (Déjerine's 1893 report with Vialet on cortical blindness [12] was, however, not mentioned by him.) The primary and independent focus was, nonetheless, on the specific syndrome of anosognosia for hemiplegia.

Methodological specificity distinguished Babinski's anosognosia; illustrative patients with specific unawareness of hemiplegia displayed relative intellectual preservation. Babinski in fact insisted on exclusion of cases (e.g., 1912 case of Barat) clouded by cognitive deterioration or confusion. As for the terminology, likely, usage of “anosognosia for hemiplegia” reflected the preference of neurologists of the period [13], who tended to refer to hemiplegia, rather than stroke.

Throughout the continued reports, the picture of anosognosia was enriched by detail. With unawareness of paralysis, patients seemed unable to recollect the paralyzed limbs, appeared to have loss of interest in the paralyzed limb, or have difficulty paying attention to the limb, or fixing their attention to it [8], and Babinski reiterated [14, 15] that [it is as if the subject was completely uninterested in his paralyzed arm, was incapable of fixing his attention to it, no longer had, so to speak, any recollection of it]. The singular finding of patients who seemed not to have any idea of their paralysis despite almost complete intellectual preservation was an important diagnostic feature.

Rationalizations were common. Patients sometimes perplexed by their noted difficulties, tried to explain these with unrelated reasons such as previously existing ailments (e.g., phlebitis, back pain, or diabetes), or misattributed cause (e.g., fatigue as the reason for wheelchair use). Trying to make sense out of her situation, 1 patient even stated [“It is strange; it is as if I had been paralyzed”] [10]. It was not deemed possible to explain this steadfast, fundamental unawareness of hemiplegia by dissimulation. Nor could lack of understanding of stroke-related paralysis be considered as a cause of anosognosia; Babinski [15] was struck by report of a patient who, despite fear of stroke due to family history for 2 years prior to onset, still developed anosognosia.

Babinski and colleagues contemplated various notions and early accounts of anosognosia [8], including loss of representation of the paralyzed limb and difficulty maintaining accurate mental body representation, minimization of affect, forgetting of the function (functional motor amnesia and motor neglect), apparent resistance to recognition, and the inability to “fix attention” on the paralyzed limb, emphasizing the crucial role of sensory (especially proprioceptive) losses. Building upon the centrality of sensory losses in anosognosia (Babinski, Souques, and Barré), a more recent explanation suggests that these sensory losses are not fundamentally perceived, and “must be *discovered*...by self observation and inference” (p. 233) [16].

Resistance to awareness, so characteristic of anosognosia, fostered explorations of motivated denial as “organic repression” [17], or “strong desire not to suffer the disability” [18]. This “organic repression” could be considered “adaptive, but not conscious or volitional” (p. 402) [8].

Weinstein and Kahn promoted “denial of illness” [19], suggesting that premorbid personality factors intolerant of imperfection or of a perceived inherent weakness of ill-

ness. Denial was considered an expression of symbolic meaning. Rather than anosognosia being a discrete localizable defect, brain dysfunction provides the “milieu... in which the patient may deny *anything* that he feels is wrong with him,” and “the level of brain function determines the particular perceptual-symbolic organization, or language” of its expression (p. 123) [19]. Denying the extent of illness altogether, some patients underestimated implications or overestimated abilities. When accompanied by frank denial of hemiplegia, the syndrome of anosognosia was even more striking.

From its inception, anosognosia’s literature focused on startling manifestations, often in patients’ own words. Patients who were instructed to move the paralyzed left arm stated (and believed) that they had already done so, “Voilà, c’est fait” [Here, it’s done] (p. 846) [3], or rationalized the difficulty [“It’s that it goes less quickly than the other one”] (p. 366) [14]. A patient with anosognosia finally “admitted” to staff that the left arm did not move well, although he really did not seem to “believe” it [9]. One of Babinski’s patients with anosognosia went so far as to question the need for electrical stimulation treatment, stating “It is not as if I am paralyzed” [3, 4]. Anosognosia was so meticulously detailed precisely because Babinski sought to isolate it from other psychic symptoms such as confusion, hallucination, confabulation, or global mental decline, importantly, conferring autonomous status as a specific phenomenon of unawareness. This remarkable mental alteration in anosognosia, in patients who were otherwise conscious and cognizant, drew deserving attention. In effect, this sign helped pave the path for semiological study of right hemisphere dysfunction. A centenary volume commemorating Babinski’s paper highlights the compelling contemporary relevance of anosognosia [20].

The Development of Neglect

In a sense, anosognosia was discovered within a dedicated literature, while neglect more gradually developed conceptually as a syndrome with heterogeneous variants over time. More than 2 decades passed before neglect emerged with the intense focus of neurological curiosity as anosognosia had earlier. Though depictions of isolated symptoms appeared from the 19th century, widespread interest in this curious clinical phenomenon is often traced to 1941, when the British neurologist and author of *Brain’s Diseases of the Nervous System*, Walter Russell

Fig. 2. Walter Russell Brain. Courtesy of the U.S. National Library of Medicine.

Brain (1895–1966) (Fig. 2) defined neglect as “an inattention to, or neglect of, the left half of external space” and a disorder of awareness of the left side of the body, associated with right parietal lesions (p. 246; 257) [21].

Even a few years before Brain’s key paper, a handful of reports were published that portrayed patients who behaved, rather dramatically, as though they had a psychological amputation of the left hemi-body [22, 23]. Symptoms of limb neglect included inattention to personal grooming or contralesional difficulty dressing [24], ranging “...from simple neglect of their presence to the experience of their nonexistence” (p. 912) [25].

These most glaring features of neglect were the first to be recognized; in addition to person or body, they involved functions, such as functional motor amnesia of neglect [26] (also mentioned in discussions of anosognosia) [3, 27]. Visual inattention [28], too, emerged as a specific disorder, effectively distinguishable from hemianopsia. To explain the lateralized hemi-inattention, the phenomenon of extinction was proposed. In a series of pioneering works on perception by American neurologist Morris Bender, a President of the American Neurological Association, the process of perceptual rivalry was suggested to underlie extinction, whereby stimuli on the unimpaired side suppress those on the weaker impaired side [29, 30]. Bender, citing Oppenheim’s works, promoted the method of double simultaneous stimulation to demonstrate extinction. Soon, appreciation grew for the extent of neglect’s reach, into extrapersonal space as well. Extrapersonal neglect has deficient reactions to all modality input

within a spatial area. Linkage was presumed between disordered awareness of external space and that of body, with anatomical overlap in parietal lobe lesions. Comparable attitudes of nonexistence conveyed toward space or body in left spatial agnosia (i.e., unilateral neglect) and left personal neglect were noted [31, 32].

With some exceptions, many found co-occurrence of personal, extrapersonal, and visual hemi-inattention [32–35] involving awareness-behavior asymmetry: unilateral ignorance [36] of people, objects, details when reading, drawing, dressing, or grooming, or difficulty localizing sound, all left-sided. Once considered disparate symptoms, the discrete manifestations of disorder with right hemisphere lesions were characterized as part of a syndrome.

Hemineglect thus progressed as a defined syndrome [36–38] in extensive literature afterward, deemed a class of disorder with distinct variants [39], including visual, motor, extrapersonal, bodily, other somatosensory, and representational [40]. Terminological heterogeneity reflected different symptom variations, whose dissociability and specificity contributed to the span of time before features were “clustered under the umbrella of neglect” (p. 97) [27]. Without as exclusive a focus as the predominantly French literature on anosognosia, international English writings on neglect largely concentrated on single variants of neglect and/or their concomitance, or broader parietal lobe manifestations. Thus, clinical tracks for the 2 right hemisphere disorders were laid down separately, as characteristics of each were distinct.

Anosognosia, with or versus Neglect?

Several decades after anosognosia was defined as an independent disorder, when features of neglect began to be recognized, scattered reports emerged noting anosognosia and neglect concurrently in patients with “minor” (right) hemisphere dysfunction and left hemiplegia. A parietotemporal syndrome was described [22], or symptom complex [41] comprising both anosognosia and features of neglect. Common elements were highlighted: “the syndrome may appear as anosognosia of Babinski, forgetting of the left side of the body, a sensation of the limbs being missing, or actual delusion of their absence in spite of an otherwise clear sensorium” (p. 120) [42]. A continuum of severity, from severe (denial of paralysis) to minor (recognition of change in limb, but inadequate judgment about cause), was proposed [43]. Symptoms were attributed to an underlying disturbance of body

scheme [42], a popular interpretation as concepts of the postural model [44] or mental image of self were developing [17, 18]. Both conditions were subsumed within disorders of body image [45, 46], body scheme [25, 34, 47], “corporeal agnosia” [31], or corporeal awareness [48]. A distinction between verbal anosognosia (the “explicit verbal denial of hemiplegia,” observed upon direct questioning) and the “anosognosic behavioral disturbance” of bodily hemineglect (behavioral neglect of the paralyzed side) [49] loosely classified both disorders together.

Macdonald Critchley (1900–1997) (Fig. 3), British neurologist who served as President of the World Federation of Neurology, noted in the classic *“The Parietal Lobes”* [45] that disturbances of corporeal awareness associated with right hemisphere dysfunction (e.g., unilateral neglect and anosognosia, plus anosodiaphoria, asomatognosia, and denial of hemiparesis) may not be so durably demarcated, as they may merge or alternate (p. 225) [45].

Given potential concurrence in lesions of the right hemisphere, it is interesting to discover some parallel phenomenological accounts for anosognosia and neglect. Terminological equivalents are especially noteworthy, since each disorder had relatively specific literature. Concepts of forgetting and recall, attention, and body scheme are particularly relevant. Illustrative are notions of forgetting of the paralysis or the left side (Souques in Babinski) [3], or the functioning (Meige in Babinski) [3], or condition of illness, with memory fixating on prior wellness [11] in anosognosia. Loss of recollection of the limb [14, 15] described anosognosia; similarly, amnesia for limbs [50] or half the body [21] portrayed neglect. Attentional difficulties implicated an inability “to fix” attention to the limb [14, 15] or defective attention to hemiplegic side [11] in anosognosia; so too, the patient with neglect may “pay no attention to the paralyzed side” (p. 892) [25]. Finally, disorder of body scheme was proposed, with loss of representation of paralyzed limb (Claude in Babinski) [3] for anosognosia, and loss of limb from body scheme [50] as though it had never existed (Meige in Babinski) [3], for neglect.

Nonetheless, the 2 disorders were recognized to have essential clinical distinctions. Patients with anosognosia recognized their limbs, but believed they were not paralyzed. In contrast, unlike anosognosia, patients with motor neglect behaved as if a non-paralyzed limb was paralyzed [22]. Furthermore, although both anosognosia and hemineglect are prominent disorders of awareness, their content differs. Babinski’s anosognosia reflected ignorance, or unawareness, of the existence of paralysis; in

Fig. 3. Macdonald Critchley. Courtesy of the U.S. National Library of Medicine.

contrast, in hemineglect, half the body, or half of external space itself had lost receipt of attention and conscious awareness [27]. From a different perspective, hemi-inattention (neglect) was suggested to reflect implicit denial, with anosognosia reflecting explicit (verbal) denial of hemiplegia [19].

The Dilemma of Denial

Anosognosia is identified by the tenaciously and erroneously held belief, that of *not being paralyzed*, despite obvious hemiplegia. Anosognosia may extend to a reluctant acknowledgment of paralysis, though with *belief* in insignificant disability, without appreciation of implications.

Clinical observations suggested that anosognosic patients displayed behavior beyond simple unawareness (though not necessarily volitional), refusing “to admit” paralysis, or were “resistant to recognition” [9], with “obstinate denial” of disability [51, 52]. Some patients disavowed disability; Babinski’s patient stated, “It is not as if I am paralyzed” [3,4]. Outright repudiation (denial) of hemiplegia was considered even more extreme than persistent unawareness of anosognosia; the 2 were said to reflect a difference of degree of “psychic aberration” [48].

Adding dimensionality is the longstanding and complex question of whether patients have any implicit knowledge of paralysis despite explicit verbal denial. Though demonstrable implicit awareness accompanied

explicit verbal denial [53] in some anosognosic patients, tacit knowledge of paralysis was not demonstrated in other cases [54]. In the latter, suggestion was that anosognosic patients were like Babinski's, with relatively preserved mental status, and that "denials and delusions" far exceeded explanation by any subtle cognitive issues [54]. Exploration of dissociability of implicit and explicit awareness and study of delusion and confabulations are considered in several recent models proposing motivational factors [20]. Another viewpoint postulates hemispheric disconnection [55] in verbal denial of disability and confabulation. In contrast, various contemporary explanations focus on monitoring disruptions (systems, reality monitoring, feed-forward, and feedback failures) to account for unawareness in anosognosia. These differing perspectives, accounts and their historical origins are systematically reviewed by several authors [20].

Last, anosognosia and behavioral denial have been distinguished empirically as independent reactions [56]. Denial, as a more behavioral reaction, involves adaptation or maladaptation to subjective distress [57], reserving anosognosia, as historically defined, for lack of knowledge, an ignorance or fundamental unawareness of condition.

Awareness: Attitude, Belief, and Concern

Beyond anosognosia and neglect, right hemisphere dysfunction often reveals some other subtle, or more marked, alterations in levels of awareness and associated attitudes towards paralyzed limbs or hemi-space, concern about limitations, and allied beliefs regarding illness or disability. Although some manifest less frequently, they too can present dramatically.

Anosodiaphoria, related to anosognosia and coined concurrently [3], reflects an indifference to paralysis despite some awareness. Patients with anosodiaphoria seem "not to attach any importance to it, as it were a matter of an insignificant discomfort" [3, 4]. The anosodiaphoric patient displays a minimization, or incongruity, of affect or consequence. Critchley, elaborating on anosodiaphoria, noted that indifference despite awareness marks a lack of insight into the "social and personal implications" [48].

The apparently converse reaction, termed acute "hemiconcern" [58], is associated with more anterior right parietal lobe lesions. It is marked by unrelenting over-interest, an attitude of "anxious preoccupation" [47] and repetitive stroking and manipulations of the

limb. Behavioral hyper-concern is strictly limited to the left hemibody.

Other odd or pathological attitudinal phenomena may be manifested. Critchley designated these "fantastic disorders of the body-image" (p. 235) [45] associated with the parietal lobe [45, 59, 60] as attitudinal distortions of varying degree, ranging from milder unawareness of anosognosia to more pathological denial of observable paralysis, whereby a patient has "surrendered himself to a delusional system" and has to "sink still deeper... to discount the evidence of his senses" (p. 234) [45]. Personification, as if the limb had its own identity, reflects attitudes [59] such as playfulness, parental concern, or contemptuous frustration toward the limb, often expressed in nicknames. Misoplegia, even more extreme, is an attitude of "morbid" dislike, revulsion [48] or loathing of disability [60], verbally or behaviorally expressed. Distortions of somatoparaphrenia, first designated by Gerstmann [25], involve confabulation, and "psychotic elaboration" regarding affected body part, even to the point of denying limb ownership or expressing the delusion that the limb belongs to another person. The supernumerary phantom [45] ("phantom third limb"), described by Critchley, refers to a subjective feeling that a third arm or leg is present. The many heterogeneous terms describing disturbances of body awareness have been comprehensively summarized [61]. These are among the unusual disorders described within the historical literature on neglect and anosognosia for which functions of the "minor" right hemisphere reveal their major role [40]. More recently, although outside historical literature, another possible right parietal lobe syndrome has been classified alongside supernumerary phantoms, apotemnophilia, a rare body representation disorder involving wish for disappearance or amputation of the healthy limb [62]. Contemporary perspectives on these and other emotional, attitudinal, and behavioral alterations in right hemisphere syndromes are extensively reviewed [40].

Diverse clinical phenomena associated with symptom variations also point to a "diffuse neuronal network for which the right hemisphere is dominant" (p. 10) [40] for bodily- and self-awareness. Clearly, in anosognosia as in neglect and certain other neurological or psychiatric disorders, there is a striking distortion of beliefs or discordance with reality. In other aspects, reality testing and cognition may seem relatively preserved, a discrepancy even more startling.

Belief tenacity in anosognosia seems impervious to "confrontation" with the functional disability. Nonveridical beliefs hardly appear to be affected by challenge or

resolved by demonstration of paralysis; transient improvements in awareness may last only momentarily before reverting [51], or lapsing back into false belief, such as “the false belief that she could move the arm” (p. 310) [63], where capacity lacks. Furthermore, anosognosic patients who admit paralysis to others when queried may seem, however, not to really believe it [9] and demonstrating the deficit to the patient, or telling the patient about it [49] fails to achieve awareness. Indeed, “pointing out the patients defects in the most concrete manner failed to alter the stated conviction that their extremities were normal” (p. 386) [64]. This clinical observation supports perspectives that right hemisphere damage disrupts hemispheric balance, leaving the left hemisphere to provide its explanatory rationalization for hemiplegia, even “when facing overt reality to the contrary” (p. 131) [65].

In neglect, patients with distortion of belief may believe the limb is absent, but either allow demonstrated evidence to convince of its existence, or believe the limb absent, without being amenable to reason or contrary evidence [21]. Notably, these beliefs are clutched steadfastly despite internal logical inconsistencies, placing them outside the realm of modification with rational explanation.

Distortions of beliefs in both anosognosia and neglect, and related conditions of unawareness, have begged explanation since their initial discovery. These daunting distortions may be approached from the novel perspective of how beliefs are constructed and maintained. Belief, a fundamental expression of having mentally accepted something as true, involves integration of internal and external perceptions and the “continual, interactive confrontation between actual perceptions and memories of past perceptions.” (p. 132) [65]. Beliefs, as patterns, conform with existing ways of thinking, and “New’ information that does not correspond to previous memories risks rejection because it challenges established experience and ways of thinking” (p. 130) [65]. Assimilation of veridical information surrounding body perception and function involves delicate adjustments in prior memories [65]. Difficulty updating “long-term body knowledge” regarding movement failures [66] even in those who may be aware or updating beliefs about the current state [67] is said to thus contribute to persistence of anosognosia. Neural network disruptions that compromise updating and renewal may lend themselves to adherence to premorbid representations, using past experience [63], memories of prior state of wellness [11], and beliefs regarding self.

Finally, unawareness and its concomitant beliefs may be understood from the broader perspective of disease knowledge and awareness. Critchley’s [48] appeal for

“terms with which to clothe our ideas about the normal state of affairs” (p. 545) has long been recognized, yet is just now being explored by concepts such as “nosognosia” (knowledge of disease) in the neurological literature [65]. Study of relationships between healthy optimism, adaptive awareness, and anosognosia may further elucidate the nature of beliefs in awareness disorders.

Summary and Conclusions

The roots of the 2 distinct disorders of anosognosia and neglect are examined in historical context, along with their converging clinical paths, as the intriguing problems of unawareness and adaptive self-awareness continue to beg exploration. Disruptions in neural networks that facilitate integration between current perception and past memories may play a role. The importance of integration between the “perceptive and emotional consciousness” and “analytical and linguistic processes” of the cerebral hemispheres [40] is apparent, as accounts for anosognosia and neglect continue to stimulate debate. Anosognosia and hemineglect highlight the still-challenging mysteries of unawareness syndromes and the significance of the right hemisphere in numerous facets of mental representation of body, space, and self.

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Author Contributions

K.G.L. conceptualized the research; analyzed and interpreted the literature; drafted the manuscript; and revised the manuscript. J.B. originated idea for research and formulated hypotheses reviewed; suggested directions for study; and provided critical comments of the manuscript.

Additional Information

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References

- Palmerini F, Bogousslavsky J. Right hemisphere syndromes. In: Paciaroni M, Agnelli G, Caso V, Bogousslavsky J, editors. *Manifestations of stroke*. Frontiers of neurology and neuroscience. Basel, Switzerland: Karger; 2012. Vol. 30; p. 61–4.
- Bogousslavsky J, Miklossy J, Regli F, Deruaz JP, Assal G, Delaloye B. Subcortical neglect: neuropsychological, SPECT, and neuropathological correlations with anterior choroidal artery territory infarction. *Ann Neurol*. 1988;23(5):448–52.
- Babinski J. Contribution à l'étude des troubles mentaux dans l'hémiplégie organique cérébrale (Anosognosie). *Rev Neurol*. 1914;27:845–8.
- Langer KG, Levine DN, Babinski J. (1914). Contribution to the study of the mental disorders in hemiplegia of organic cerebral origin (anosognosia). Translated by K.G. Langer & D.N. Levine. Translated from the original Contribution à l'Étude des Troubles Mentaux dans l'Hémiplégie Organique Cérébrale (Anosognosie). *Cortex*. 2014;61:5–8.
- Garrison FH. *History of medicine*. 4th ed. revised. Philadelphia: Saunders & Co. 1929.
- Philippon J, Poirier J. *Joseph Babinski: a biography*. New York: Oxford University Press; 2009.
- Tournay A. Babinski dans la vie. *Presse Med*. 1958;66:1485–9.
- Langer KG. Babinski's anosognosia for hemiplegia in early twentieth-century French neurology. *J Hist Neurosci*. 2009;18(4):387–405.
- Barré JA, Morin L, Kaiser. Étude clinique d'un nouveau cas d'anosognosie de Babinski. *Rev Neurol*. 1923;39:500–3.
- Joltrain E. Un nouveau cas d'anosognosie. *Rev Neurol*. 1924;42:638–40.
- Barkman A. De l'anosognosie dans l'hémiplégie cérébrale: contribution clinique à l'étude de ce symptôme. *Acta Med Scand*. 1925;62:235–54.
- Finger S. *Origins of neuroscience: a history of explorations into brain function*. New York: Oxford University Press; 1994.
- Paciaroni M, Bogousslavsky J. How did stroke become of interest to neurologists? A slow 19th century saga. *Neurology*. 2009;73(9):724–8.
- Babinski J. Anosognosie. *Rev Neurol*. 1918;31:365–7.
- Babinski J. Sur l'anosognosie. *Rev Neurol*. 1923;39:731–2.
- Levine DN. Unawareness of visual and sensorimotor defects: a hypothesis. *Brain Cogn*. 1990;13(2):233–81.
- Schilder P. *The image and appearance of the human body*. New York: International Universities Press; 1935.
- Sandifer PH. Anosognosia and disorders of body scheme. *Brain*. 1946;69(2):122–37.
- Weinstein EA, Kahn RL. *Denial of illness: symbolic and physiological aspects*. Springfield, IL: Charles C. Thomas; 1955.
- Jenkinson PM, Fotopoulou A. Understanding Babinski's anosognosia: 100 years later. *Cortex*. 2014;61:1–4.
- Brain WR. Visual disorientation with special reference to lesions of the right cerebral hemisphere. *Brain*. 1941;64:244–72.
- Garcin R, Varay A, Hadji-Dimo. Document pour servir à l'étude des troubles du schéma corporel (sur quelques phénomènes moteurs, gnosiques et quelques troubles de l'utilisation des membres du côté gauche au cours d'un syndrome temporo-pariétal par tumeur, envisagés dans leurs rapports avec l'anosognosie et les troubles du schéma corporel). *Rev Neurol*. 1938;69:498–510.
- Van Bogaert L. Sur la pathologie de l'image de soi. *Ann Méd-Psychol*. 1934;92(2):519–55, 744–59.
- Pinéas H. Ein Fall von räumlicher Orientierungsstörung mit Dyschirie. *Z Ges Neurol Psychiatr*. 1931;133(1):180–95.
- Gerstmann J. Problem of imperception of disease and of impaired body territories with organic lesions. *Arch Neuropsych*. 1942;48(6):890–913.
- Meige H. Les amnésies motrices fonctionnelles et le traitement des hémiplégiques. *Rev Neurol*. 1905;13:183–4.
- Langer KG, Piechowski-Jozwiak B, Bogousslavsky J. Hemineglect and attentional dysfunction. In: Bogousslavsky J, Boller F, Iwata M, editors. *A history of neuropsychology*. Frontiers of neurology and neuroscience. Basel, Switzerland: Karger; 2019. Vol. 44; p. 89–99.
- Holmes G. Disturbances of visual space perception. *Brit Med J*. 1919;2:230–3.
- Bender MB, Furlow LT. Phenomenon of visual extinction in homonymous fields and psychologic principles involved. *Arch Neurol Psych*. 1945;53(1):29–33.
- Wortis SB, Bender MB, Teuber HL. The significance of the phenomenon of extinction. *J Nerv Ment Dis*. 1948;107(4):382–7.
- Duke-Elder WS. *Text-book of ophthalmology, Vol. 4. The neurology of vision, motor and optical anomalies*. St. Louis: C.V. Mosby Co.; 1949; p. 3619–730.
- Battersby WS, Bender MB, Pollack M, Kahn RL. Unilateral "spatial agnosia" ("inattention") in patients with cerebral lesions. *Brain*. 1956;79(1):68–93.
- Paterson A, Zangwill OL. A case of topographical disorientation associated with a unilateral cerebral lesion. *Brain*. 1945;68(3):188–212.
- Hécaen H, Penfield W, Bertrand C, Malmö R. The syndrome of apractognosia due to lesions of the minor cerebral hemisphere. *AMA Arch Neurol Psychiatry*. 1956;75(4):400–34.
- Ettlinger G, Warrington E, Zangwill OL. A further study of visual-spatial agnosia. *Brain*. 1957;80(3):335–61.
- Luria AR. *The working brain. An introduction to neuropsychology* (Translated by Basil Haigh). New York: Basic Books; 1973.
- Kinsbourne M. A model for the mechanism of unilateral neglect of space. *Trans Am Neurol Assoc*. 1970;95:143–6.
- Heilman KM, Pandya DN, Geschwind N. Trimodal inattention following parietal lobe ablations. *Trans Am Neurol Assoc*. 1970;95:259–61.
- Rode G, Pagliari C, Huchon L, Rossetti Y, Pisella L. Semiology of neglect: an update. *Ann Phys Rehabil Med*. 2017;60(3):177–85.
- Carota A, Bogousslavsky J. Minor hemisphere major syndromes. In: Bogousslavsky J, editor. *Neurologic-psychiatric syndromes in focus: part I. From neurology to psychiatry*. Frontiers of neurology and neuroscience. Basel, Switzerland: Karger; 2018. Vol. 41; p. 1–13.
- Von Hagen KO, Ives ER. Anosognosia (Babinski), imperception of hemiplegia. *Bull Los Angeles Neurol Soc*. 1937;2(3):95–103.
- Ives E, Nielsen JM. Disturbance of body scheme: delusion of absence of part of body in two cases with autopsy verification of the lesions. *Bull Los Angeles Neurol Soc*. 1937;2(3):120–5.
- Cutting J. Study of anosognosia. *J Neurol Neurosurg Psychiatry*. 1978;41(6):548–55.
- Head H, Holmes G. Sensory disturbances from cerebral lesions. *Brain*. 1911;34(2–3):102–254.
- Critchley M. *The parietal lobes*. New York: Hafner Press; 1953.

- 46 Brain WR. [Diseases of the nervous system](#). 6th ed. London: Oxford University Press; 1962.
- 47 Roth M. Disorders of the body image caused by lesions of the right parietal lobe. [Brain](#). 1949;72:89–111.
- 48 Critchley M. Observations on anosodiaphoria. [Encephale](#). 1957;46(5–6):540–6.
- 49 Frederiks JAM. Disorders of the body schema. In: Vinken PJ, Bruyn GW, editors. [Disorders of speech, perception, and symbolic behavior](#). Amsterdam: North Holland Publishing Co.; New York: Wiley Interscience Division, John Wiley & Sons; 1969. p. 207–40.
- 50 Cobb S. Amnesia for the left limbs developing into anosognosia; report of a case. [Bull Los Angeles Neurol Soc](#). 1947;12(1):48–52.
- 51 House A, Hodges J. Persistent denial of handicap after infarction of the right basal ganglia: a case study. [J Neurol Neurosurg Psychiatry](#). 1988;51(1):112–5.
- 52 Willanger R, Danielsen UT, Ankerhus J. Visual neglect in right-sided apoplectic lesions. [Acta Neurol Scand](#). 1981;64(5):327–36.
- 53 Jehkonen M, Laihosalo M, Kettunen J. Anosognosia after stroke: assessment, occurrence, subtypes and impact on functional outcome reviewed. [Acta Neurol Scand](#). 2006; 114(5):293–306.
- 54 Ramachandran V. Anosognosia in parietal lobe syndrome. [Conscious Cogn](#). 1995;4(1): 22–51.
- 55 Geschwind N. Disconnexion syndromes in animals and man. II. [Brain](#). 1965;88(3):585–644.
- 56 Ghika-Schmid F, Bogousslavsky J. Affective disorders following stroke. [Eur Neurol](#). 1997; 38(2):75–81.
- 57 Goldbeck R. Denial in physical illness. [J Psychosom Res](#). 1997;43(6):575–93.
- 58 Bogousslavsky J, Kumral E, Regli F, Assal G, Ghika J. Acute hemiconcern: a right anterior parietotemporal syndrome. [J Neurol Neurosurg Psychiatry](#). 1995;58(4):428–32.
- 59 Critchley M. Personification of paralysed limbs in hemiplegics. [Br Med J](#). 1955;2(4934): 284–6.
- 60 Critchley M. Misoplegia, or hatred of hemiplegia. [Mt Sinai J Med](#). 1974;41(1):82–7.
- 61 Weinstein EA, Friedland RP, editors. [Advances in neurology, Vol. 18, Hemi-inattention and hemisphere specialization](#). New York: Raven Press; 1977.
- 62 Tatu L, Bogousslavsky J. Phantom sensations, supernumerary phantom limbs and apotemnophilia: three body representation disorders. In: Bogousslavsky J, editor. [Neurologic-psychiatric syndromes in focus: part I. From neurology to psychiatry](#). Frontiers of neurology and neuroscience. Basel, Switzerland: Karger; 2018. Vol. 41; p. 14–22.
- 63 Ullman M, Ashenurst EM, Hurwitz LJ, Gruen A. Motivational and structural factors in the denial of hemiplegia. [Arch Neurol](#). 1960;3(3):306–18.
- 64 Nathanson M, Bergman PS, Gordon GG. Denial of illness; its occurrence in one hundred consecutive cases of hemiplegia. [AMA Arch Neurol Psychiatry](#). 1952;68(3):380–7.
- 65 Bogousslavsky J, Inglin M. Beliefs and the brain. [Eur Neurol](#). 2007;58(3):129–32.
- 66 Marcel AJ, Tegnér R, Nimmo-Smith I. Anosognosia for plegia: specificity, extension, partiality and disunity of bodily unawareness. [Cortex](#). 2004;40(1):19–40.
- 67 Vocat R, Saj A, Vuilleumier P. The riddle of anosognosia: does unawareness of hemiplegia involve a failure to update beliefs? [Cortex](#). 2013;49(7):1771–81.