Mirror Image Agnosia

Sadanandavalli Retnaswami Chandra, Thomas Gregor Issac

ABSTRACT

Background: Gnosis is a modality-specific ability to access semantic knowledge of an object or stimulus in the presence of normal perception. Failure of this is agnosia or disorder of recognition. It can be highly selective within a mode. self-images are different from others as none has seen one’s own image except in reflection. Failure to recognize this image can be labeled as mirror image agnosia or Prosopagnosia for reflected self-image. Whereas mirror agnosia is a well-recognized situation where the person while looking at reflected images of other objects in the mirror he imagines that the objects are in fact inside the mirror and not outside. Material and Methods: Five patients, four females, and one male presented with failure to recognize reflected self-image, resulting in patients conversing with the image as a friend, fighting because the person in mirror is wearing her nose stud, suspecting the reflected self-image to be an intruder; but did not have prosopagnosia for others faces, non living objects on self and also apraxias except dressing apraxia in one patient. This phenomena is new to our knowledge. Results: Mirror image agnosia is an unique phenomena which is seen in patients with parietal lobe atrophy without specificity to a category of dementing illness and seems to disappear as disease advances. Discussion: Reflected self-images probably have a specific neural substrate that gets affected very early in posterior dementias specially the ones which predominantly affect the right side. At that phase most patients are mistaken as suffering from psychiatric disorder as cognition is moderately preserved. As disease becomes more widespread this symptom becomes masked. A high degree of suspicion and proper assessment might help physicians to recognize the organic cause of the symptom so that early therapeutic interventions can be initiated. Further assessment of the symptom with FMRI and PET scan is likely to solve the mystery of how brain handles reflected self-images. Conclusion: A new observation involving failure to recognize reflected self-images is reported.

Key words: Mirror Agnosia, mirror image Agnosia, reflected image processing, right parietal lobe

INTRODUCTION

Gnosis is a modality specific ability to access semantic knowledge of an object or stimulus in the presence of normal perception. Failure of this is Agnosia or disorder of recognition.Various sensory organs convey semantic information by several modes. When a peacock is seen; its beauty is appreciated, its name is read, its shrill cry and its name heard, its silky feathers felt in concerned association areas, this polymodal information is associated and stored as lexicon in the ventral temporo-parieto-occipital region. According to Lissauer, Agnosia can be Apperceptive if the elementary information such as the size, shape, loudness, and texture are not converted into a unified image or Associative if the primary capacities are recognized but not synthesized into semantic information comparing it with previous experience. Therefore, the person can
copy an image or imitate a gesture but cannot recognize which occurs in Prosapagnosia and pure Alexia.\textsuperscript{[2]} This term was introduced by Sigmund Freud in 1891 and Milner called it normal percept devoid of its meaning. Agnosias generally affect one modality only and patient will recognize by other modes. It can be also selective within one modality like Colour Agnosia and prosopagnosia. The criteria for diagnosis are failure to recognize an object in the presence of normal perception and ability to identify through intact mode and absence of significant dementia. The disturbance of higher visual perceptions can manifest as visual distortions such as metamorphopsia, palinopsias, allesthesias, simultagnosia; visual object Agnosia; and apperceptive problems.\textsuperscript{[1,3]}

**Prosopagnosia**

Faces are biologically very significant as it provides information critical for negotiation of the social world.\textsuperscript{[1]} Large numbers of faces are discretely remembered over a long period of time. The question that remain to be answered is: is there a neural circuit separately for face processing? Is there different circuits for processing of reflected self-images which are special in the sense that they have been seen only as reflected images? Reflected images of persons seen before directly; as well as inanimate objects and animals? Is it an inherited or acquired visual expertise? Is it the same as other complex visual processing?

Prosopagnosia is considered apperceptive if the person cannot match pictures of faces and associative if he can match but cannot recognize. Faces have emotions, novelty, like surgeons face, they may be familiar, famous, or reflected face in mirror. Newborns respond to simple face-like patterns at birth.\textsuperscript{[4]} This suggests that face-specific regions are present from birth. Electro cortical response study shows different response to upright versus inverted face and human versus primate face. Face-sensitive brain evoked response N170 is of shorter latency and larger amplitude for upright human faces.\textsuperscript{[5,6]} FMRI shows that inverted human faces activate bilateral face-sensitive areas of fusiform cortex, but is also activated by cars in car experts and birds in bird experts. Inverted images produce changes that are proportional to the candidates expertise in upright face (Rossan et al. 2000) though it produces increase in errors and reaction time (Vabuline 1988). PET scan shows right hippocampus activation during unfamiliar face registration, left frontal and inferior temporal for face encoding, right prefrontal, bilateral parietal, and ventral occipital for face recognition proving hemisphere encoding and retrieval asymmetry (HERA) hypothesis (HERA hypothesis by Tulving).\textsuperscript{[7,8]} Recently stored facial memory can be stored in neocortex, hippocampus, and adjacent areas and later converted to the stable form.

The way brain deals with mirror images is a source of fascination (Coballis 1991; Gregory 1996), but normal human brain does not confuse a mirror reflection of self as well as objects as long as the person knows he is looking at a mirror.\textsuperscript{[9]} Mirror images of self are special because for the image the right of the individual is the left of the image and brain has to do appropriate correction to localize the side. Reflected images of self are more peculiar as one has never seen his or her self other than in reflection and recognized by comparison with body schema unlike faces of others and objects which carry a polymodal lexicon. Different parts of the occipital lobe are reported to be involved in processing living and nonliving things (Humphreys 1996). According to the classical theory of face recognition gender, age, and expressions are processed independent of one another (Bruce and young, 1996; Ellis and Lewis 2001).\textsuperscript{[10]}

Agnosias in face recognition can be selective within the Prosapagnosia in the sense it can be for either familiar face, famous face, smiling face, crying face, laughing face or novel face and reflected face in isolation. Failure to recognize the emotions in face could be one cause of indifference in some patients with degenerative dementias and also data linking disorders like Capgras syndrome. Mirror Agnosia is a condition where even though the person knows that he is looking at mirror as evidenced by ability to identify the frame and the glass of the mirror, he fails to recognize the objects that are reflected in the mirror as reflections. Therefore, when asked to localize the object, instead of looking for the original object in its place, he will search for the object into the mirror resulting in damage to the mirror. Such patients while driving and looking at the rear view mirror imagine the vehicles behind to be in front and land themselves in accidents. Thus, his world becomes locked inside his looking glass.\textsuperscript{[11]} Mirror image agnosia is different from mirror agnosia in the sense that reflected objects are identified only in their real locations [Table 1]. There is no problem in recognizing images in the rear view mirror and locating the vehicles as coming from behind, no difficulty in

| Table 1: Mirror Agnosia and Mirror Image Agnosia |
|-----------------------------------------------|
| **Parameters** | **Mirror agnosia** | **Mirror image agnosia** |
| Identifying mirror as mirror | Yes | Yes |
| Identifying objects in mirror | Yes | Yes |
| Identifying all faces in mirror | Yes | Yes/No |
| Identifies reflected self face | Yes | No |
| Identifies inanimate objects | Yes | Yes |
| Identifies animals | Yes | Yes |
| Looks for real objects inside mirror | Yes | No |
| Talks, fights, argues with reflected self face | No | Yes |
identifying the reflected images of the inanimate objects like ornaments and dress as reflected images of their ornaments or objects, but they have specific difficulty in identifying their own reflected images in the mirror and mistake them as strangers, Gods, or enemies and behave appropriately.

In this study, we report a rare syndrome of mirror image agnosia with domain specific failure to recognize reflected image of self. To our knowledge this phenomena is not reported in the literature.

**CLINICAL DESCRIPTION [TABLE 2]**

**Patient number 1**
Sixty-two-year-old female was brought to the hospital with features of forgetfulness and getting lost in less familiar environment. She was often found attracted to the mirror in the house and was found conversing with the mirror image. Evaluation revealed moderate dementia of the posterior type. She did not suffer from weakness of limbs, deafness, or blindness. She had no apraxias, aphasias, or neglects. She was then asked to identify her close relatives at least two of them by sight and also was asked to match them with their photos. She could identify the famous face of Mahatma Gandhi, crying child, laughing child, and surgeons face. She was then shown the mirror 45 cm × 45 cm. She could identify it as a mirror. She showed unusual attraction to the mirror and ignored the physician and people around. She would go to the mirror and converse with her own image as if the image is another person but could correctly identify the reflected face of her daughter in law and the resident but she was asking her own reflection for the name and communicated to others saying that ‘here is a woman who does not know her name’. Informed consent was taken for video (Video 1).

**Patient number 2**
EIGHTY-YEAR-OLD PATIENT WITH VISUAL HALLUCINATIONS AND MEMORY IMPAIRMENT WAS FOUND TO HAVE A HMSE SCORE OF 20. SHE ALSO COULD IDENTIFY THE MIRROR AND REFLECTED IMAGES OF OTHERS, BUT SHE INITIALLY MISTOOK HER IMAGE AS GOD AND STARTED WORSHIPPING AND SOON STARTED FIGHTING, ASKING THE REFLECTED IMAGE, WHY SHE WAS WEARING HER NOSE STUD, INDICATING THAT SHE HAS CORRECTLY IDENTIFIED HER NOSE STUD. INFORMED CONSENT TAKEN FOR VIDEO (VIDEO 2). IN THIS PATIENT, WE ATTEMPTED FMRI USING THE PHOTO OF THE PATIENT AS WELL THAT OF THE REFLECTED IMAGE, AS TEST PARADIGM. HOWEVER WE WERE NOT SUCCESSFUL IN CREATING ARTIFACT FREE DATA.

**Patient number 3**
She was a retired major in the army who had classical features of Alzheimer’s disease clinically and radiologically. Her HMSE score was 23. She was found to be fighting with her image in the mirror and on two occasions she had broken the mirror with her kicks. She mistook the image as a thief. She did not give consent for video.

**Patient number 4**
She was a 69-year-old person who was disoriented to place. She declared her children as imposters. Later the relatives noted she was discussing her family matters with her own image. When asked she declared the image as an old friend. She was started on anti-cholinesterases and after 12 months, the aforementioned symptoms disappeared but other symptoms deteriorated and patient passed away after 2½ years due to an acute coronary event.

**Patient number 5**
He is a 74-year-old farmer from Bangladesh. His illness started as memory disturbances and later developed way finding problems, severe confusion in dressing but no ideational or ideomotor apraxia. He in addition had consistent difficulty in identifying his own reflected image and claimed it to be a friend. He also had difficulty with the reflected face of his son which was inconsistent, though he could identify the son by looking at him.

All patients underwent neuropsychological assessment, all mandatory investigations such as HIV, VDRL, B12, renal, hepatic and thyroid function, tests for praxis, neglects, and gnosis. All patients were started on disease-modifying drug Donepezil which was started as 2.5 mg and increased to 10 mg. None received any psychotropic agents.

**Table 2: Clinical details**

| Gender | Age | Diagnosis | Praxis | Prosopagnosia | Mirror image Agnosia for self-image | Reflected image of others | Imaging features | HMSE | Followup |
|--------|-----|-----------|--------|---------------|-----------------------------------|--------------------------|-----------------|------|----------|
| F      | 62  | AD        | N      | Nil           | +                                 | −                        | Temperoparietal Lt>Rs | 23   | Unchanged |
| F      | 80  | DLBD      | N      | Nil           | +                                 | −                        | Diffuse         | 20   | Unchanged |
| F      | 73  | AD        | N      | Nil           | +                                 | −                        | Rtparietal       | 24   | Unchanged |
| F      | 69  | AD        | N      | Capgras       | +                                 | −                        | RT parietal      | 23   | Improved |
| M      | 74  | AD        | Affected| Nil           | +                                 | +                        | Rtparietal       | 20   | Unchanged |

AD – Alzheimer’s disease; DLBD – Diffuse lwey body disease
RESULT

One patient improved during follow up at 12 months from the symptoms which were referable to her difficulty in identifying her reflected image. But whether she had regained the ability to recognize her reflected image, is not clear as the other parameters had deteriorated and patient was not fit for tests of Gnosis.

MRI done in 1.5 T showed non dominant parietal lobe atrophy in four [Figure 1]. There was temporal lobe involvement in one patient, in addition to parietal and diffuse atrophy in one case.

DISCUSSION

Reflected self-images are special because the individual has never seen his or her real face; therefore, unlike the face of others the visual elements of the lexicon are derived only from the reflected image. This is compared with the memory of the previously stored reflected image that is ‘body schema’. Body schema is in the nondominant parietal lobe. This lobe is concerned with only dressing apraxia, visuospatial disorientation, neglects and no other apraxias. Previous studies suggest that there is highly specific representation for various kinds of faces, their emotions, primate versus man, inverted versus upright, and living versus nonliving. Our five patients show a unique kind of agnosia for recognition of their own reflected image. Our hypothesis is that probably mirror images are processed in the right parietal lobe. Associated delusional misidentification and Capgras effect point to break down of data linking circuits. There is also nonsyndromic hereditary prosopagnosia reported.

Highly specialized neural circuits deal with reflected self-images and there is early break down of this in patients with posterior dementias. This probably is mistaken as a behavioral syndrome rather than as structural brain disease. As disease advances patients do not show this symptom as progression makes it more generalized. Further evaluation of a larger number of patients with PET and FMRI is likely to yield insight into the way the brain processes mirror images. A high degree of suspicion and proper assessment might help physicians to recognize the organic cause of the symptom so that early therapeutic interventions can be initiated. The attributes added to the reflected image as ‘friend’, ‘thief’, ‘God’ or just a ‘Stranger’ seems to be related to their premorbid personality and occupation like the army personnel misidentifying as ‘thief’ and the housewife as ‘God’.

REFERENCES

1. Kirshner H S. Approach to Common Neurological Problems, Part 1, Chapter 11. The Agnosias. p.133-9.
2. Ramachandran VS. Illusions of body image: Whatthey reveal about human nature. In: Linas R, Churchland P, editors. The Mind-Brain Continuum. Cambridge, MA: MIT Press; 1996. p. 29-60.
3. Riddoch G. Visual disorientation in homonymous hemifields. Brain 1935;58:376-82.
4. Haan MD, Pascalis O, Johnson MH. Specialization of neural mechanisms underlying face recognition in human infants. J Cogn Neurosci 2002;14:2-199-209.
5. Aylward EH, Park JE, Field KM, Parsons AC, Richards TL, Cramer SC, et al. Brain activation during face perception: evidence of a developmental change. J Cogn Neurosci 2005;17:308-19.
6. Eimer M, McCarthy RA. Prosopagnosia and structural encoding of faces: Evidence from event-related potentials. Neuroreport 1999;10:255-9.
7. Tulving E, Kapur S, Craik FI, Moscovitch M, Houle S. Hemispheric encoding/retrieval asymmetry in episodic memory: Positron emission tomography findings. Proc Natl Acad Sci USA 1994;91:2016-20.
8. Eimer M. Effects of face inversion on the structural encoding and recognition of faces. Evidence from event-relatedbrain potentials. Brain Res Cogn Brain Res 2000;10:145-58.
9. Haxby JV, Ungerleider LG, Horwitz B, Maisog JM, Rapoport SI, Grady CL. Face encoding and recognition in the human brain. Proc Natl Acad Sci USA 1996;93:922-7.
10. Carroll L. Through the looking glass. In: The complete works of Lewis Carroll. New York: Barnes & Noble; 1994.
11. Ramachandran VS, Altschuler EL, Hillyer S, Agnosia M. Brain and perception laboratory, centre for research on brain and cognition. Proc R Soc Lond B 1997;264:645-7.
12. Kennerknecht I, Grueter T, Welling B, Horst J, Edwards S, et al. First Report of Prevalence of Non-Syndromic Hereditary Prosopagnosia (HPA). American Journal of Medical Genetics Part A 140A:1617-1622 (2006)