Delusions: A suitable case for imaging?

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Abstract

This review is intended to outline the need/opportunities for imaging research in the area of delusions. In particular, delusions of misidentification are offered as possible examples of how both spatial and temporal brain imaging may throw light upon the theoretical, parallel processes of identification and emotional arousal occurring when a familiar face is encountered. Other types of Delusional Misidentifications are also briefly explored. The review then turns to related phenomena, including the ways imaging may help elucidate different types of covert face recognition; and also further explain the distinctive (but not entirely independent) processes underlying face, voice and object recognition. Throughout the review the aim is to emphasise the potential value to cognitive neuropsychiatry of good imaging techniques.
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1. Introduction

The title to this paper includes an obvious rhetorical question. Delusions (or at least some forms of them) are eminent candidates for imaging analysis. Indeed, some success in this regard has recently been claimed, for example, by Blackwood et al. (2004) who, in a fMRI study, found that, compared with matched controls, people diagnosed with schizophrenia with persecutory delusions, when asked about the self-relevance of certain either ambiguous or non-ambiguous threat statements, revealed a significant absence of rostral-ventral anterior cingulate activation combined with an increase in activation within the posterior cingulate gyrus.

Compared with the efforts that have gone into analysing many other cognitive phenomena, however, the use of techniques such as SPECT, PET, MRI, fMRI and MEG to explore the structures underlying delusions (and, by implication, beliefs in general) has been limited. The field is clearly ready for a more systematic approach, and in this paper I shall endeavour both to outline some reasons for doing so and to add the stricture that imaging research must be based upon good models of information processing. In order to do this I shall focus on a particular set of monothematic delusions, each of

which involves inappropriate beliefs about the identity of other people or objects, that have already received extensive analysis using cognitive neuropsychiatric principles (Ellis, 1998).

1.1. Delusions

First, however, it is necessary to define "delusions". In clinical terms, the DSM-IV definition detailed in Table 1 is usually adequate: it emphasises the incorrectness and impossibility of the belief — the certainty with which it is held, its incorrigibility and its cultural atypicality (i.e. beliefs not held by a significant number of others).

While it is possible to unpick each and every one of these criteria (Bell, 2006), they do provide a sufficient working definition that has had undeniable pragmatic value and will suffice here. The group of delusions that will form the remaining focus of this paper exemplify each of the above criteria.

1.2. Delusions of misidentifications

The delusions of misidentification (DMS) comprise an interesting and theoretically challenging set of bizarre beliefs that have been of particular interest to cognitive neuropsychiatrists over the last 15 years. Each involves a distinct alteration in

Table 1
DSM-IV definition of delusions

A fixed false belief based on incorrect inference about external reality that is firmly sustained despite what almost everybody else believes and despite what constitutes incontrovertible and obvious proof or evidence to the contrary. The belief is not one ordinarily accepted by other members of the person's culture or subculture (e.g. it is not an article of religious faith).

the way others are perceived or identified (see Table 2); and, for every one, cogent explanations have been advanced that link each to some putative mechanism of normal information processing — which, of course, is the essential precept of cognitive neuropsychiatry (Ellis, 1991, 1998; David, 1993).

2. The modal model of face recognition

Ellis and Young (1990) attempted to explain most of the DMSs within an established model of face processing (Bruce and Young, 1986). Over subsequent years this model of face recognition has been extensively revised (e.g. Burton et al., 1990; Young and Burton, 1999), but, for present purposes, it serves the useful purpose of showing how a facial image is eventually identified by positing three distinct stages: an initial, structural encoding phase where basic visual information is processed via mechanisms that extract view-centred descriptions independent of expressions; the resulting description is then passed to a system containing a stored record of all faces known to the perceiver; these are called the Face Recognition Units (FRUs); the final stage is where connections are made to episodic/biographical information about the individual (i.e. where identity, and subsequently name, are established); this is called the Person Identity Nodes (PINs) stage.

Fig. 1 indicates that, potentially, these three stages may each be associated with a different DMS (Ellis and Young, 1990; Ellis, 1997; Ellis and Lewis, 2001) — although, in truth, exactly

Table 2
The four delusions of misidentification

| Paraprosopia	Faces transform into a grotesque mask (monster, vampire, werewolf). 'Autoparaprosopia' occurs when the transformation appears to the patient's own face when looking into a mirror (Ellis, 1997).
Intermetamorphosis	Faces (and objects) temporally change into that of some other, known person; some other parts of the body do not change (Courbon and Tusques, 1923).
Frégoli delusion	Named after the celebrated Italian mimic, Léopoldo Frégoli, the delusion involves the belief that significant others can disguise themselves, usually but not always, in order to persecute the patient. Essentially, there is no belief of any physical change in the person: instead the patient believes s/he is the disguised version of someone else (Courbon and Fail, 1927).
Capgras delusion	The most common delusion of misidentification (1-3% of the psychiatric population) involves the belief that others usually, but not necessarily close to the patient, have been replaced by impostors, doubles, robots, etc. (Capgras and Reboul-Lachaux, 1923). Capgras-type delusions for objects and voices have also been described (Ellis et al., 1996; Lewis et al., 2001).
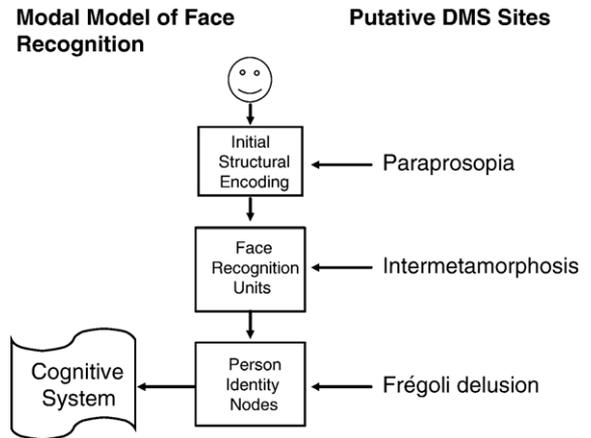
Fig. 1. The modal model of face recognition, together with putative sites for the origin of paraprosopia, intermetamorphosis and the Frégoli delusion.

how these operate in practice has not yet been established. At best one could say that there is at least a superficial plausibility that paraprosopia represents disruption at the structural encoding stage; intermetamorphosis results from excitation of the wrong FRU; and the Frégoli delusion may happen when, despite being excited by the correct FRU, an inappropriate PIN becomes activated, giving rise to the belief that the person, although veridically perceived, is actually someone else.

The important point to note here is that, however superficially the identification of delusion and face-processing stage has been identified, and acknowledging the lack of empirical support for these associations, three of the four DMSs potentially can be explained within a model of normal face recognition and thus fulfil one of the precepts of cognitive neuropsychiatry. The model, however, does not admit an explanation of the most prevalent DMS, the Capgras delusion, whereby patients normally have a reasonably veridical percept from which they could infer identity — instead of which they insist that the individual is an impostor, a double or whatever.

It should be noted that more recent models of face recognition have emphasised its distributed nature sharing early processing features of other objects within both the occipital and the temporal cortex (Haxby et al., 2001; Ishai et al., 2000). As Haxby et al. (2001) have pointed out, however, this approach is not incompatible with more modular models, such as Bruce and Young's, but, as we shall see later, it may have significance for imaging predictions.

2.1. Capgras delusion

In order to account for the Capgras delusion Ellis and Young (1990) stepped out of the psychiatric arena to consider neurological cases of prosopagnosia (Bodamer, 1947; Meadows, 1974), where, usually following specific brain injury, there is an almost absolute inability to recognise faces (leaving identification by voice, gait, dress, etc. unaffected). Some individuals with prosopagnosia, however, have been shown to reveal what has been termed covert face recognition (Bauer, 1984; Young and Ellis, 2000), suggesting that, at an unconscious