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## A Cognitive Model of Dangerous Delusional Misidentification Syndromes

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**ABSTRACT:** The hallmark of the delusional misidentification syndromes is the presence of a misidentification delusion of the self or others. Delusional misidentification may present with an increased risk for dangerous behaviors. Individuals suffering from delusional misidentification syndromes may express hostility in ways ranging from serious verbal threats to homicidal acts. The causes of dangerous misidentification delusions remain for the most part undetermined. In this article, we report a series of six cases of individuals who harbored dangerous misidentification delusions. These individuals were studied phenomenologically and forensically. They were also studied biologically, including neuropsychological testing. A cognitive hypothesis aimed at explaining dangerousness and delusional misidentification is proposed. Implications of the hypothesis for further research are briefly outlined.

**KEYWORDS:** psychiatry, dangerousness, violence, delusions, misidentification, mental disorder

"Dangerous" delusions are becoming the object of increasing attention by psychiatrists and the public at large because of the putative linkage between delusions and subsequent physical harm perpetrated against others by the delusional individual [1-3]. This is also true for the delusional misidentification syndromes, which are psychiatric conditions characterized by a delusion that the self or others may undergo radical changes in physical and/or psychological makeup resulting in a new identity [4-6]. Although several delusional

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misidentification syndromes have been described [4,6,7], the best known is Capgras syndrome. In this syndrome, the affected individual believes that one or more people in his or her environment have experienced radical change in psychological identity without significant changes in physical appearance. The patient usually explains this situation by postulating the existence of doubles or impostors [8–11].

Misidentification syndromes have also become the object of intensive study from a forensic psychiatric perspective. Although the frequency of association between dangerousness and misidentification phenomena remains unknown, recent studies indicate that delusions of misidentification may lead to violent attacks on others [12–16].

The delusional misidentification syndromes have also been studied from a biological perspective and it is generally acknowledged that many individuals suffering from delusional misidentification also present with organic cerebral abnormalities [4,7,17]. There is also some evidence suggestive of non-dominant cerebral pathology [18–21] as well as frontal lobe pathology [22,23].

Despite these efforts, relatively little work has been carried out in integrating knowledge regarding cognition of delusional misidentification with potential underlying biological substrates [7,24–27]. In this article, we introduce a hypothesis that postulates potential cognitive components of dangerous delusional misidentification and then attempts to integrate them with biological substrates that may be implicated in the genesis of dangerous delusional misidentification. A series of six cases with delusional misidentification and dangerousness is studied phenomenologically, forensically, biologically, and neuropsychologically. The resulting data is utilized as part of the basis for the proposed hypothesis. Two cases are presented in detail in order to highlight important issues.

## Methods and Results

The sample consisted of six males who had been hospitalized for psychiatric treatment and whom we identified during assessments of all patients for delusional thinking including for delusional misidentification syndromes.

The definitions for delusional misidentification syndromes that we used are listed below. Capgras syndrome was defined as having a delusion in which an individual believes that others develop radical changes in psychological makeup without changes in physical appearance resulting in a new identity [5,6,8–10]. Frégoli syndrome was defined as having a delusion in which the affected individual believes that another exhibits radical changes in physical identity but no changes in psychological makeup [5,6,28]. The syndrome of intermetamorphosis was defined as having a delusion in which the patient believes that others have undergone fundamental physical and psychological changes resulting in a different identity [5,29,30]. The syndrome of subjective doubles, Capgras type, was defined as having a delusion in which physical replicas of the affected individual exist which have a different psychological identity than the original [8,11,31]. There are three misidentification syndromes where the misidentification process is thought to take place within the affected person. These delusions are also known as “reverse” types of misidentification. The syndrome of “reverse” subjective doubles (or “reverse” Capgras) is defined as having a delusion in which the affected person believes his or her psychological identity is radically changing leading to another identity [4,6]. The syndrome of “reverse” Frégoli is defined as having a delusion in which the affected individual believes that he or she has undergone radical changes in physical identity leading to a different person [6,32]. The syndrome of “reverse” intermetamorphosis is defined as having a delusion in which the patient believes he or she has undergone radical changes in physical and psychological identity leading to a different identity [6,33,34].

The patients were routinely evaluated with psychological testing that included the Benton Facial Recognition Test (BFRT), Warrington Memory Recognition Test (WMRT), Ray-

Osterrieth complex figure test (RO), and the Wisconsin Card Sorting Test (WCST). The BFRT is designed to assess immediate recognition abilities for unfamiliar faces [35]. The WMRT evaluates for memory recognition of words and unfamiliar faces [36]. The RO assesses constructional abilities [37]. The WCST may be a measure of executive function associated with frontal lobe function [38–40].

All six cases had normal electroencephalograms. The head CT scans of all cases, except for Case 1 which is described below, were unremarkable. Table 1 gives each case as a function of the types of delusional misidentification present. Table 2 gives age, diagnosis, history of hostility, and the nature of the delusionally misidentified object. Table 3 provides the results of the neuropsychological testing. Table 4 provides the type of face abnormalities consciously perceived by the six subjects.

**Case One**

Mr. A is a 49-year-old man who was admitted to a psychiatric hospital fearful that he would hurt his wife whose appearance he had begun to perceive as strange. Mr. A's psychiatric difficulties began at age 25. He believed that extraterrestrials with reptilelike appearance had been trying to control his mind since the onset of his psychiatric symptoms. For the past 15 years, Mr. A believed he had witnessed his wife intermittently being transformed into an extraterrestrial. He delusionally misidentified his wife for periods lasting from a few days to 11 months. He described his wife's identity changes as beginning with

TABLE 1—*Misidentification syndromes present in each individual.*

Case	Delusional Misidentification Syndromes Present				
	A	B	C	D	E
1	+	+	—	—	—
2	+	+	+	+	—
3	+	+	—	—	—
4	+	+	—	—	—
5	+	—	—	+	+
6	+	—	—	—	—

A = Capgras; B = intermetamorphosis; C = "subjective" Capgras; D = "reverse" Capgras; E = "reverse" intermetamorphosis.

+ = syndrome present; — = syndrome absent.

TABLE 2—*Age, diagnosis, history of hostility, and nature of misidentified object.*

Case	Age	Dx	Hostility (V/P)	Delusionally misidentified object
1	49	A	+/+	Wife
2	34	B	+/+	Mother, father
3	25	A	+/+	Brother-in-law, girlfriend
4	45	A	+/-	Father
5	39	A	+/+	Mother
6	29	A	+/+	Father

Dx = Diagnosis; A = schizophrenia, paranoid type; B = Schizoaffective disorder.

V = verbal aggression directed at a delusionally misidentified person.

P = physical aggression directed at a delusionally misidentified person.

+ = present at the time of dangerous delusional misidentification.

— = absent at the time of dangerous delusional misidentification.

TABLE 3—*Neuropsychological test results.*

Case	BFRT	WRMT-F	WRMT-W	R-O	WCST
1	37	30	46	35	32
2	45	34	42	22	40
3	41	35	39	17	34
4	45	39	47	30	28
5	46	41	50	27	18
6	41	46	50	34	20

BFRT = Benton Facial Recognition Test (corrected scores).

WRMT-F = Warrington Recognition Memory Test-Faces.

WRMT-W = Warrington Recognition Memory Test-Words.

R-O = Rey-Osterreith Complex Figure (copy).

WCST = Wisconsin Card Sorting Test (perseverative errors).

TABLE 4—*Perceived facial abnormality.*

Case	Type of perceived facial abnormality		
	Shape	Texture	Color
1	+	+	+
2	+	+	+
3	+	+	-
4	+	+	+
5	-	-	+
6	-	-	-

psychological transformation and likened her to a human clone. At times he noticed his wife's mind would be replaced by that of an alien and then he would perceive her as undergoing physical transformations. He perceived his wife's skin changing to a reptilelike scaly texture with uneven distribution in her extremities and face as well as changing from dark-brown to green color. He also noticed that her eyes became distorted, smaller and redder and that her chin became smaller than expected for a human. He perceived his wife's physical metamorphosis with the facial changes in particular as lasting for a few minutes, but believed that her internal bodily structure remained non-human for longer periods of time. Four years ago, Mr. A also thought that he had mentally become one of his acquaintances for approximately one week's duration.

At times, Mr. A would become angry and frightened at his misidentified wife. On one occasion he had awakened "only to find she was an alien" and had attempted to strangle her. Since that time his wife has refused to sleep with him. On another occasion he had hit his wife on her head with a hammer, believing she was an extraterrestrial alien because of changes in her physical appearance.

Mr. A's physical examination, including neurological examination, revealed no abnormalities. Concerning his laboratory data, his complete blood count, serum chemistries, and urinalysis were within normal limits. His head computed tomography (CT) scan showed small calcifications on the basal ganglia bilaterally. His electroencephalogram (EEG) was normal.

Mr. A met DSM-III-R diagnostic criteria for schizophrenia, paranoid type [41].

## Case Two

Mr. B is a 34-year-old man who was involuntarily hospitalized on a psychiatric inpatient ward after threatening to kill his family. He believed that his mother and father were

impostors of his real parents. Mr. B asserted that there were four copies of each parent in existence. Although he stated the copies were "identical" to his real parents, he stated that he could discern changes at times in the texture of the impostors' skin which appeared more smooth and plastic in appearance than that of his real parents. Mr. B reported having witnessed changes in their skin color as well as distortion and asymmetry in the faces of the impostors. He believed that the impostors had been created through plastic surgery and that one of his mother's impostors was in fact a man. Prior to his admission, he tried to choke his "impostor" mother stating that the impostor had a thicker neck than that of his real mother and that the "crack" he heard while choking her proved that her neck was "only plastic." His mother survived this attack only because of the intervention of other family members. On another occasion Mr. B struck the alleged "double" of his father. He believed that his brother had a double and was angry at his brother's putative double. He also believed that a hospital nurse, several prominent professional athletes, and President Clinton had robotic replacements; and he believed that identical "puppets" of former-Presidents Carter, Nixon, Kennedy, F. Roosevelt, former-Vice President Quayle, Vice President Gore, and Pope John Paul II existed.

Mr. B believed that five physical copies of himself existed. Each copy had a different mind than his own. On one occasion, he thought himself to have been Jesus Christ, but denied having undergone any bodily changes. Mr. B stated that five replicas of the city in which he lived existed as well as the existence of five different planet earths. He, however, acknowledged having lived on only one of these earths.

Mr. B had a history of several arrests for attacking police officers, whom he believed were impostor replicas of real police officers.

Mr. B experienced auditory hallucinations. He has had a history of impulsive behavior. There was no family history of mental disorders. He denied a history of severe head injury. His complete blood count, serum chemistries, and urinalysis were within normal limits. His head CT scan and EEG were unremarkable.

Mr. B met DSM-III-R criteria for schizoaffective disorder [41]. In the past Mr. B had been treated with lithium carbonate and neuroleptics with a diminution of his grandiosity, mood lability, and hallucinations. However, his delusional ideas remained. Mr. B had been hospitalized several times because of aggressive behaviors, generally occurring after he discontinued his prescribed psychotropic medications.

## Discussion

### *Phenomenology and Diagnosis*

All six patients suffered from Capgras syndrome. Five also displayed a variant of delusions of intermetamorphosis. One suffered from "subjective" Capgras syndrome and two suffered from other Capgras syndrome variants. No patient suffered from Frégoli syndrome or its variants (see Table 1). The frequency of delusional misidentification syndrome types was therefore highest with Capgras syndrome variants followed by intermetamorphosis types. The order of observed frequencies has been noted in previous studies. However, its significance, if any, remains presently unknown [15].

Five of our subjects, including Cases 1 and 2, presented with two or more types of delusional misidentification syndromes within the index episode of misidentification. The co-occurrence of delusional misidentification syndromes has been increasingly documented [4, 11, 15, 42, 43].

Five patients in our sample met DSM-III-R diagnostic criteria for paranoid schizophrenia, while Case 2 was diagnosed with schizoaffective disorder (see Table 2). The preponderance of schizophrenia in the present series is consistent with many prior studies that have observed paranoid schizophrenia to be the most frequent mental disorder associated with delusional

misidentification [10,11,15,30,44]. Schizoaffective disorder, and bipolar and other mood disorders, are associated at a lower frequency than with schizophrenia [10,34,44].

The cases of Mr. A and Mr. B are representative of delusional misidentification. Mr. A exhibited a delusion that changed from Capgras syndrome to the syndrome of intermetamorphosis, such as when he would believe that his wife's mind had been replaced by that of extraterrestrial aliens and later would see her being physically transformed into a reptilelike being. This phenomenon was also present in Mr. B who believed that his parents at times appeared as physical replicas of his real parents but with different minds, consistent with Capgras syndrome. However, at times he conceptualized them as impostors that had internal and external physical characteristics different than his real parents. Additionally, he believed that he could sometimes see physical changes in the faces and bodies of his parents. These beliefs and perceptions are consistent with the syndrome of intermetamorphosis. Mr. B also experienced Capgras syndrome involving many prominent figures as well as "subjective" Capgras syndrome because he thought physical replicas of himself existed. Mr. A had also experienced "reverse" Capgras syndrome when he thought he had psychologically become an acquaintance. In the past Mr. B had also experienced "reverse" Capgras syndrome because he had believed that he had the mind of Christ.

### *Dangerousness*

The cases in our sample presented with serious verbal threats to harm the delusionally misidentified objects. Five Cases (1,2,3,5,6) also involved physical aggression directed at the delusionally misidentified objects that were emotionally close to the delusional person, such as family members (see Table 2). The delusional misidentification patients in our sample became aggressive toward the misidentified objects because they believed that these objects were in some way threatening to the delusional person's welfare. This pattern has been previously recognized among dangerous misidentification syndromes [15].

In our sample only Cases 2 and 5 displayed misidentification delusions occurring within the patient's self. However of these two, only in case 5 did this appear to be a significant factor in elevating the subject's potential for violence. In this case, the subject believed that he was the son of privileged parents and misidentified himself both physically and psychologically. He attacked his misidentified mother whom he perceived as a malicious impostor because she "kept" his money and was unwilling to recognize his alleged identity. Previous studies have also shown that persons who suffer from delusional misidentification syndromes of the self may become hostile to others as a result of feeling omnipotent in the context of their new identities as well as being challenged by others as to their actual identities [15,45].

### *The Role of the Non-Dominant Hemisphere and Topographical Processing of Social Objects*

The biological basis for delusional misidentification remains largely unknown. However, there is evidence that right (non-dominant) hemisphere dysfunction may be implicated [17,19,21]. Feinberg and Shapiro analyzed 26 cases of Capgras syndrome from the psychiatric literature in which brain dysfunction involved only one cerebral hemisphere [19]. They found that right hemisphere dysfunction was four times more common than for the left hemisphere. Malloy and colleagues analyzed 22 cases of delusional misidentification from the psychiatric literature since 1979, in which an organic etiology was implicated. They found that a preponderance of right hemisphere abnormalities among this sample [17]. Utilizing the psychiatric literature, Fleminger and Burns analyzed two series of 50 individuals suffering from delusional misidentification syndromes and found a predominance of cerebral dysfunction occurring in the right hemisphere [21].

Recent neuropsychological studies utilizing face processing tests also lend support to the hypothesis that delusional misidentification syndromes are associated with non-dominant cerebral deficits. Young and colleagues [1990] tested four patients suffering from various misidentification delusions. Their results indicate that on tests involving labeling of facial emotional expressions, some patients exhibit deficits, while on recognition memory for faces there was some evidence of impairment in these patients. On a task involving unfamiliar face matching, the patients performed in the normal range. Their results suggest that face processing deficits may be linked to delusional misidentification. However, such an association is complex and may not be applicable to all cases of misidentification or to all stages of delusional misidentification. To the extent that delusional misidentification may be linked to face processing deficits, such evidence also implicates the non-dominant hemisphere since face processing is thought to occur in right-sided cerebral structures [47].

Preliminary neuropsychological assessments on the relation between dangerous delusions of misidentification and face processing was also presented by Silva and associates [27]. In a series involving five patients, they found that patients with dangerous delusions of misidentification, presented with various degrees of deficits in recognition memory for faces and on a task of matching unfamiliar faces. Consistent with the findings of Young and colleagues [46,48,49], some of these patients also scored within normal range on these tests. Ellis and colleagues tested three patients suffering from misidentification delusions tachistoscopically with facial stimuli and found that these individuals had lost the normal left visual field (right hemisphere) advantage and in fact showed right visual field (left hemisphere) advantage. However a control psychotic group without misidentification delusions still exhibited the normal right hemisphere advantage. They interpreted their results to indicate that in persons with the Capgras delusion there is some deficit in the face processing centers of the right hemisphere [50].

Our present results only showed limited calcification of basal ganglia bilaterally for Case 2, otherwise all other cases showed no abnormalities in head CT scans or EEG. However, the BFRT, which measures matching of unfamiliar faces showed abnormal performance (score of <40) in one case. The Warrington memory recognition subtest for faces revealed significant impairment for Cases 1, 3, and 4 (below the 10th percentile), and some suggestion of impairment (13.3 percentile) for Case 2 (see Table 3). Case 3 may represent significant face processing deficits. However, given that the score for word memory recognition as well as most other test results are abnormal, impairment may represent a more global cerebral process. Most important is the difference in scores between face and word recognition. Cases 1 and 4 show significantly worse performance on the faces subtest than the word subtest. For Cases 2 and 5 the difference in the two scores falls in the mildly impaired range. These results suggest a trend for non-dominant (right) hemisphere but not dominant (left) hemisphere deficits. The present results then are in general agreement with previous studies regarding face processing impairment [27,46].

Overall, the results of face processing studies, including the present one, suggest that non-dominant cerebral abnormalities are present in many cases of delusional misidentification. The cases of delusional misidentification with no abnormalities in face processing testing may indicate that the currently available tests lack sufficient resolution to detect mild abnormalities in face processing testing. This critique may also apply to the use of EEG and neuroimaging data. For example, careful measurement of specific brain areas [51] with adequate controls may reveal important differences in delusional misidentification subjects. Alternatively, results are also consistent with at least two sets of delusional misidentification, one which exhibits face processing deficits and one in which delusional misidentification is not associated with abnormalities in face processing.

The available neurobiological models for delusional misidentification have yet to incorporate in a systematic fashion the nature of the patient's subjective report of the visual-perceptual deficit. This is understandable, given that some of these experiences are difficult

to describe and categorize. For instance, patients who suffer from Capgras syndrome variants often present with feelings of strangeness while perceiving the faces and bodies of misidentified objects [11]. This phenomenon was first noted by Capgras [52] and later by others [9,53]. However, such phenomena are very ambiguous and therefore have resisted systematic exploration. More consciously unambiguous visual-perceptual abnormalities are reported by persons with delusional misidentification syndromes, especially those suffering from the syndrome of intermetamorphosis [27,30]. The results of our study, however, indicate that the fine phenomenological structure of these subjective visual deficits may be amenable to detection and study. This position is supported by reports of the five patients in our series who complained of perceiving unusual facial changes in others. More importantly, however, these patients provided information on basic characteristics of the faces they misperceived. Four patients complained of shape and texture abnormalities in the misidentified face. In addition, three of these patients also reported unusual color changes in the misidentified face. Case 5 only reported abnormal color changes, while Case 6 denied any abnormalities in face perception (see Table 4). Even when no subjective perceptions in the faces of others were noted, all six patients reported a strange appearance that they were otherwise unable to define in the faces of the misidentified objects. These experiences suggest that delusional misidentification syndrome patients suffer from perceptual abnormalities when perceiving faces that are within the realm of consciousness but are difficult to describe semantically [11]. We caution, however, that some of the perceptual abnormalities in delusional misidentification may involve more basic perceptual deficits [54] independent from those of face recognition processing. The result of the RO figure test, for example, show that Cases 1 and 6 experienced noteworthy constructional deficits and that Case 3 may have experienced modest constructional deficits. Constructional deficits may be associated with test scores suggestive of faulty face processing (for example, Case 1). Such deficits, however, may also not be accompanied by facial processing deficits (for example, Case 6). The results therefore suggest that at least in a subset of delusional misidentification individuals, constructional deficits independent of social object considerations may be operative.

The subjective experiences that the delusional misidentification syndrome individuals in our series reported, involved face misperceptions which included basic visual-perceptual characteristics such as color, texture, and shape detection of objects. According to recent computational vision theory the previously mentioned categories represent fundamental aspects of objects that are likely to be intrinsically involved in primate vision [55] and are known as low level vision in cognitive computational science [56]. Anatomical and physiological studies in primates also indicate that the visual system is comprised of cells in different cerebral cortical areas that are involved in the analysis of color, stereopsis, movement, and orientation [57]. Face processing in humans is likely to similarly involve brain structures that are responsible not only for "low level vision" but also complex analysis of shape that make face recognition possible [25]. It is possible that individuals who suffer from delusional misidentification syndromes experience face processing difficulties that involve "low level vision" processing as well as "high level vision processing" [58] such as complex shape analysis involved in face and bodily recognition. Additionally, specific phenomenological components comprising the subjective experience of face misperceptions by delusional misidentification syndrome individuals may be related to neuropsychological performance in tasks of face processing such as the BFRT, WRMT, and tests of facial emotion recognition. The actual relationships are likely to be complex. Correlational studies between subjective reports of facial misrecognition and face processing psychometric tasks will be a potentially fruitful approach in the elucidation of such relationships.

#### *Face Misrecognition and Dangerousness*

In a previous study of a series of five delusional misidentification subjects who exhibited various phenomenological and/or psychometric indications of facial misrecognition, facial



perceptual deficits were thought to be a significant factor in predisposing these individuals to committing aggressive actions [27]. The findings of the current series are also in agreement that delusional misidentification phenomena associated with face processing deficits are involved in the genesis of subjective perceptions of facial recognition that in turn may predispose persons to become aggressive. Furthermore, the present study suggests that basic parameters of object recognition such as object distortion, texture, and color changes may modify otherwise normal face perception to the extent that such changes lead to impressions of facial non-familiarity which in turn leads to emotions such as fear and anger [27]. Dangerous misidentification delusions are frequently associated with these emotions [15]. Perceptual abnormalities involving features such as shape distortion, edge recognition, texture, and color appreciation may be associated with face and perhaps other aspects of bodily recognition processing and may contribute significantly to dangerous delusional misidentification. This hypothesis may be further tested utilizing tests of basic parameters involved in object recognition in dangerous delusional misidentification patients and appropriate controls.

We postulate that possibly the central unifying concept underlying face misperception in delusional misidentification is due to transitions of perceptions in object topography from a highly symmetrical object into a relatively asymmetrical entity. This process is likely to be a primary function of shape distortions of symmetrical social objects such as faces. However, changes in color and texture distribution leading to irregular configurations within facial shapes may also contribute to impressions of asymmetry increase in social objects. These subjective perceptual "losses" in facial and body symmetry are likely to be especially notable in intermetamorphosis patients who tend to be more consciously aware of such misperceptions. Case 1 is an example of delusional misidentification that presents with those abnormalities. However, even in cases of Capgras and Frégoli syndrome, where visual-perceptual abnormalities may involve only preconscious processes [11,26], visual-perceptual pathology may nevertheless still be identifiable via adequate neuropsychological testing.

The idea that the delusionally misidentified objects involve a loss of object symmetry is consistent with Leyton's hypothesis that in normal human cognition, objects in general are viewed as having a history in which symmetry is postulated in the original object but may be lost later in the object's history [59]. However, in delusional misidentification syndromes, there appears to be a cognitive delusional component that attempts to explain newly developed asymmetries "seen" by the faulty visual component of delusional misidentification systems. Delusional cognition causes the affected individual to make a "story" in which the misidentified object is conceived as a person whose biographical history radically changes from a stable "good" construct (the original identity) only to be replaced by a "bad" or different object endowed with the essence of inauthenticity. It is possible that the perceptual distortions may be a necessary but insufficient requirement for the development of at least a subset of misidentification syndromes. The development of loss of reality testing is likely to be necessary in order to incorporate the delusional "story" to the perceptual distortions in delusional misidentification. The mechanism responsible for confirming the authenticity of images is therefore a necessary component to a comprehensive hypothesis of delusional misidentification.

### *Frontal Lobe Dysfunction*

Frontal lobe dysfunction has been implicated in delusional thinking. Benson and Stuss [60] have stated that the prefrontal areas are important in self analysis and hypothesize that this function should be "... of utmost importance for monitoring and reality testing and it would appear to be highly significant for both delusions and hallucinations (p. 407)." They believe that deficits in the ability to self monitor leads to an inability to recognize

and evaluate cognitive and perceptual phenomena which in turn leads to psychotic symptoms such as delusions or hallucinations. They go on to postulate that Capgras syndrome is associated with "significant bilateral structural damage involving frontal lobes (p. 407)." The work of Joseph and colleagues, which revealed bilateral frontal cerebral atrophy in patients suffering from various delusional misidentification syndromes [7,22,23], also lends supports to the role of frontal lobe dysfunction in the genesis of delusional misidentification. Given that delusional misidentification syndromes most commonly occur in schizophrenia [10,44] and that recent neuroimaging studies suggest frontal lobe abnormalities in schizophrenia [39,40] abnormal frontal lobe function may therefore play a key role in predisposing schizophrenics to the development of delusional misidentification. However, it must be emphasized that delusional misidentification occurs in many psychotic conditions [10,44] and therefore approaches that take into account symptoms or non-diagnostic categories may also prove to be effective means of studying delusional misidentification [61-63].

In our sample, the results of the WCST which showed scores of greater than 20 perseverative errors in four of the six subjects suggest that executive functions associated with frontal lobe dysfunction may be implicated. These results suggest that frontal lobe dysfunction may be a significant factor in delusional misidentification. However, it is important to emphasize that disturbance of executive function may be related to dysfunction in non-frontal lobe cerebral areas.

It is therefore possible that the hypothesized devices that fail to confirm asymmetrical images inherent in delusionally misidentified objects may in accordance to the thesis of Benson and Stuss be localizable to the frontal lobe [60]. Therefore study designs which test frontal lobe functioning in persons with delusional misidentification syndromes versus appropriate control groups may be useful in testing the hypothesis that the frontal lobe is defective in delusional misidentification patients. It is important to emphasize, however, that a dysfunctional monitoring system in psychotic illnesses is not likely to be localized in a single area and other cerebral areas should be explored [64].

## Conclusion

A comprehensive cognitive model of dangerous delusional misidentification must incorporate several components. One of these components encompasses objective neuropsychological measures of object recognition. Another important component must take into account measures of delusional cognition that may help elucidate mechanisms involved in the verification of visual image formation. A crucial component to a dangerous delusional misidentification model is adequate measurement of the perceptual phenomena reported by the affected persons, including detailed descriptions of misperceptions and their associated personal meanings. Finally, detailed measurement of the patient's emotions such as levels of fear and hostility and potentially related phenomena such as the presence of depersonalization and derealization must be collected in order to assess levels of dangerousness. Equally important is the systematic collection of biological measures such as brain area measurements, electroencephalographic parameters, and neurotransmitter measurements that may shed light regarding the underlying biological substrates of dangerous misidentification delusions.

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