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Defective Recognition of Familiar People

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Although they cannot recognise people from their faces, prosopagnosic patients are frequently able to identify people from their voices or clothing. They can also retrieve information about these people in response to their name (e.g. De Haan, Young, & Newcombe, 1987). In contrast, we present details of a patient, BD, who, following herpes simplex encephalitis, has difficulty in identifying people from their face, their name, and their voice. This seems to be a form of semantic memory impairment, and for BD it appears in the context of a more general impairment of knowledge of living things. In learning tasks similar to those used by De Haan et al. (1987) and Kapur, Heath, Meudell, and Kennedy (1986), however, BD shows evidence of preserved access to information concerning people that he does not recognise from their face or name. The pattern of preserved access that is revealed is more extensive than that shown by De Haan et al.'s prosopagnosic patient PH. BD shows covert knowledge of the political background of politicians whose faces he does not recognise overtly and covert knowledge of the football teams of soccer players whose names he does not find familiar. It is suggested that unlike PH, whose difficulties seem to occur at the level of face recognition units, BD's problems also reflect difficulty in gaining overt access to, and output from, mental representations of precise person semantic information.

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INTRODUCTION

In their model of face recognition, Bruce and Young (1986) suggest that every face one knows is associated with its own recognition unit which must be activated if the face is to give the perceiver a feeling of familiarity. Activation of the appropriate recognition unit is also required if access to stored semantic information about the person (e.g. their occupation or where they are typically encountered) is to occur. Unless specific semantic information of this kind has first been activated, access to the person's name in the lexical output system is not possible. According to Bruce and Young, failure at any one of these levels can produce a breakdown in face identification. Failure to activate the appropriate recognition unit will lead to a known face being deemed unfamiliar. Failure to access semantic information will produce the state in which a perceiver finds a face familiar but cannot remember to whom it belongs. A failure to progress beyond the semantic level will render one unable to retrieve the name of a person even though one may remember a lot of other information about them, and may produce a tip-of-the-tongue state (Yarmey, 1973). Failures of all three kinds have been documented for normal subjects by Young, Hay, and Ellis (1985) and Hanley and Cowell (1988).

Although, for most people, experiences such as these are not uncommon in everyday life, they occur with nothing like the severity and regularity that one encounters in patients suffering from brain injuries, and a potentially important application of functional models of face processing is in understanding the effects of different types of brain injury. For instance, the prosopagnosic patient PH described by De Haan et al. (1987) is unable to recognise anyone from their face following a closed head injury: to PH nearly all faces seem unfamiliar. Since PH, in common with other prosopagnosics, is often able to identify the same people from their voices or names, he does not suffer from a general deficit in recognising people. In terms of the model of Bruce and Young (1986), this would suggest that PH's problems arise primarily at the face recognition unit level, and do not spill over into defects at the level of person semantic information or name retrieval.

This picture is complicated, however, by the finding that some prosopagnosic patients show covert recognition of once familiar faces. Bauer (1984) and Tranel and Damasio (1985) have described patients who show electrodermal responses to familiar faces which they fail to recognise overtly. De Haan et al. (1987) have shown that PH is faster at matching familiar than unfamiliar faces, even though he failed to recognise the familiar faces overtly. PH also showed interference from faces he could not recognise overtly on name classification, and he showed covert recognition of famous people in learning tasks in which he was taught to associate photographs

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of celebrities with either their true name or the name of another celebrity. For example, PH learnt more quickly that the name "Neil Kinnock" went with a photo of Neil Kinnock than that the name of "Roy Hattersley" went with a photo of Cyril Smith (De Haan et al., 1987). In terms of Bruce and Young's (1986) model, it therefore appears that some prosopagnosic patients are able to activate recognition units for certain faces but the output from the recognition units to the cognitive system is impaired, depriving the patients of any feeling of familiarity when they look at faces. For such patients, face recognition continues to take place, but awareness of recognition is lost.

PH also learnt to associate a photo of a celebrity with her or his occupation more readily than he learnt to associate a celebrity's face with the wrong occupation (e.g. learning that Paul Newman is an actor more easily than that Bob Monkhouse is a politician). Such a finding is consistent with the possibility that prosopagnosic patients such as PH are able to gain covert access to semantic information as well as to recognition units from familiar faces. Young and De Haan (1988, p.332) argued that if this really is occurring, however, it remains a puzzle as to why PH is able to gain overt access to semantic information from names if he can only access the same information covertly from faces. On the one hand, it is not inconceivable that face recognition units provide access to a different semantic system from that accessed via names or voices, and that only the face semantic system has become disconnected from the cognitive system. A simpler alternative, however, would be that PH is in fact not gaining covert access to precise semantic information when he looks at familiar faces, despite De Haan et al.'s (1987) results, but instead to something more superficial. This possibility was supported by the findings of Young and De Haan (1988), who used learning tasks to demonstrate the boundaries of covert recognition effects for PH. Of particular interest here is that when Young and De Haan (1988) taught PH precise semantic information to faces, such as the political backgrounds of politicians or the exact sport of sportspeople, he learnt true pairings (e.g. the term "Liberal" to Cyril Smith's face) no better than untrue pairings (e.g. the term "SDP" to Roy Hattersley's face). Young and De Haan (1988) thus suggested that, for PH, only relatively general information is covertly accessed when he looks at a face, and that this may reflect some rudimentary "semantic" organisation at the recognition unit level.

In this paper we present details of a patient, BD, whose problems in identifying people are more widespread than those of PH. BD is *not* prosopagnosic. Instead he has difficulties in recognising people from face, name, or voice. Unlike prosopagnosic patients such as PH, whose difficulties seem to occur at the level of face recognition units, BD's problems also seem to reflect impairment of overt access to semantic information.

In addition, he shows a rather more extensive pattern of covert learning effects than PH. As a result, we argue that BD, unlike PH, has preserved access to precise semantic information from both faces and names of people that he fails to recognise overtly.

CASE REPORT

Clinical History

BD, a right-handed man born in 1929, was diagnosed as suffering from herpes simplex encephalitis in September 1974. He was discharged from hospital five weeks after admission, having made a rapid clinical recovery. Approximately one year later he returned to his job as a skilled tool grinder, and he remained in this employment until 1984. Following his re-presentation in January 1976 with a complaint of an inability to recognise familiar people, a series of neurological examinations took place. BD's visual fields were reported as full both on confrontation and perimetry. A CAT-scan showed a low-density area in the right temporal region. The abnormal area was seen to involve posterior aspects of the superior temporal gyrus on the right. The identified lesion lies at the anterior end of the inferior longitudinal fasciculus. EEG showed a small excess of theta activity arising in the right temporal lobe. We do not, of course, wish to imply that BD has suffered exclusively right temporal lobe damage, since additional left temporal lobe damage would almost certainly be present following herpes encephalitis. These investigations do, however, show that in BD's case the right-hemisphere damage is more extensive.

Spontaneous Complaints

Since 1976, BD has consistently complained of an inability to remember information that he has read in books and newspapers. He also complains of severe topographical problems, having frequently lost his way home despite having lived in the same house for many years prior to his illness. He states that he is unable to form a mental picture of previously well-known routes and relies on familiar landmarks. His claim is that he can recognise these landmarks but has lost his sense of where they are with respect to each other; instead, he relies on remembering a verbal description of how to get from one landmark to another. His route-finding difficulties are thus more severe at night-time, when these landmarks are less obvious. His wife ensures that he has change for the telephone before he goes out in case he gets lost, and he claims sometimes to rely on his dog, who generally accompanies him, to get him hom
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Neuropsychology

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months later, on immediate and de
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as was memory for the Rey Oster
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span is normal.

Clinical tests have revealed no
normal performance on the Bos
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accompanies him, to get him home. He also complains of difficulties in remembering where he and his wife are sitting if he has to leave the room while out at a dance.

BD reports that his worst problem, however, is an inability to identify people other than his wife, his immediate family, and close friends. He continually fails to recognise both new acquaintances and people he once knew, which he finds disturbing because as shop steward and works councillor he had a wide circle of acquaintances prior to his illness. Sometimes BD describes this as a problem of recognising familiar faces, but it is clear that he also does not recognise people's voices when they begin to talk to him. Instead, he will respond to a greeting from anyone who seems to recognise him, and he has developed a repertoire of strategies that can allow him to maintain a conversation when he doesn't know who he is talking to. He reports, however, that old workmates and neighbours have very little sympathy for his problems. The severity of BD's difficulties in remembering people can be seen in the fact that he still only recognises one of us (JRH), though we have been to see him many times. He does, however, readily remember helping to push AY's car when it wouldn't start. He remains keen on listening to music and dancing, and claims to experience no difficulty in remembering dance steps—however he often does not know who he is dancing with!

Neuropsychology

Neuropsychological assessments shortly after BD re-presented in 1976 revealed a verbal IQ of 107, consistent with his previous education and employment, and a performance IQ of 99. The block design score was well preserved but there was a relatively poor performance on the picture-arrangement sub-test and on object assembly. See Table 1 for details.

BD's memory abilities have been monitored since 1976, when his Wechsler memory quotient was 88. In 1977 his MQ was reported as being as high as 114, but was only 96 when tested in 1980. In 1986 MQ was 97; Table 1 gives a breakdown of his sub-test scores together with his performance, 5 months later, on immediate and delayed recall (after 1 hour) of the memory passages. Performance on Warrington's (1985) Recognition Memory Test in 1986/7 was low, however, with scores of 32/50 for words and 30/50 for faces, as was memory for the Rey Osterrieth figure (27/36 on immediate copying and 4/36 on drawing from memory after 45 minutes). Short-term memory span is normal.

Clinical tests have revealed no evidence of language abnormality, with normal performance on the Boston and the Halstead-Wepman aphasia screening test and the Eisenson examination for aphasia. He also performed

TABLE 1
BD's Performance on the WAIS (1977) and the Wechsler Memory Scale (1986)

WAIS (Scaled Score)		*WMS*	
Verbal IQ	107	MQ	97
Performance IQ	99	Information	5/6
Information	11	Orientation	5/5
Comprehension	12	Mental Control	9/9
Arithmetic	13	Memory Passages	7.5/25
Similarities	9	Digits	9/15
Digit Span	9	Visual Reproduction	3/14
Vocabulary	11	Paired Associate Learning	11.5/21
Verbal Score	65		
Digit Symbol	9		
Picture Completion	9	Immediate recall of memory passages 6.5.	
Block Design	9	Delayed recall of memory passages 5.75.	
Picture Arrangement	6		
Object Assembly	7		
Performance Score	40		

well on the Burt reading test. He performs at the bottom end of the normal range on the "Pyramids and Palm Trees test" (Howard & Orchard-Lisle, 1984) which requires matching line drawings on the basis of general, rather than purely lexical, knowledge (e.g. associating a picture of a pyramid with a palm tree rather than a pine tree). He performed at a similar level on Kay, Lesser, and Coltheart's (Note 1) "Written Word-Picture Matching" (37 correct out of 40) and "Spoken Word-Picture Matching" test (38 correct out of 40).

OBJECT IDENTIFICATION AND SEMANTICS

Basic Visual Abilities

We cannot find anything wrong with BD's basic visual abilities. As already mentioned, there is no visual field defect. Contrast sensitivity is normal for all spatial frequencies, and there is no impairment of colour vision (total error score of 88 on Farnsworth-Munsell 100 hue test). He recognises everyday objects without difficulty, whether these are in the form of real objects (21/21), photographs (21/21), or line drawings (21/21). Recognition of photographs of everyday objects taken from unusual views (cf. Warrington & Taylor, 1978) is also unimpaired (10/10). He performs within the normal range on an "Object Decision Test" (see Riddoch & Humphreys,

TABLE 2
The Ability of BD and Control Subjects to Identify Members of Categories from Pictures

	Category of Pictures								
	Garden Tools (n=12)	*Musical Instruments (n=12)*	*Cars (n=12)*	*Animals (n=18)*	*Dog Breeds (n=30)*	*Fruit (n=12)*	*Flowers (n=12)*	*Vegetables (n=16)*
Word	16.50	7.80	–	29.50	1.30	20.90	13.70	11.80

E 1
d the Wechsler Memory Scale (1986)

	WMS
MQ	97
Information	5/6
Orientation	5/5
Mental Control	9/9
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Word Frequencies	16.50	7.80	–	29.50	1.30	20.90	13.70	11.80
Controls (Proportion)	11.60 (0.97)	10.10 (0.84)	5.60 (0.47)	16.00 (0.89)	19.20 (0.64)	10.60 (0.88)	9.30 (0.78)	12.50 (0.78)
BD (Proportion)	12.00 (1.00)	9.00 (0.75)	4.00 (0.33)	15.00 (0.83)	4.00 (0.13)	6.00 (0.50)	5.00 (0.42)	9.00 (0.56)
No. of S.D.s between BD and controls.	–	0.80	0.60	0.80	3.20	3.80	2.80	1.70

1987, p.143) which requires the subject to detect anomalous line drawings of objects and animals (e.g. a zebra's head on a tiger's body).

Recognising Category Members from Pictures

There are occasions, however, on which BD does not recognise things. During the last nine months, he has been presented with a series of colour photographs and pictures for identification. Table 2 provides details of BD's performance in comparison with that of ten control subjects.

The controls are 10 male janitors who worked at either Newcastle Polytechnic or Lancaster University. Their average age was 56.1 years old and all of them, like BD, had left school when either 14 or 15 years of age. Table 2 reveals that BD performs particularly poorly relative to controls on the living things, with the exception of animals where he performs as well, if not better, than he does on nonliving category members. On dog breeds, however, BD performs as poorly as he does on fruits and flowers, all of which show severely impaired performance compared to the controls. BD performed worse than any of the controls on fruits, flowers, and vegetables and all the controls identified at least twice as many dog breeds. BD's ability to identify these items appeared to be related to their Thorndike-Lorge word frequencies. The mean frequencies of those he identified and those he failed to identify were, respectively, 27.8 versus 3.6 for flowers, 30.0 versus 11.7 for fruit, and 14.2 versus 8.6 for vegetables. It does not seem reasonable, however, to explain the poor performance of BD relative to controls on these categories simply in terms of word frequency. The frequencies of the garden tools and musical instruments were comparable, yet BD recognised them relatively well.

In order to compare performance further on living and nonliving things and to investigate whether deficits involved visual recognition or loss of access to semantic information, we selected 36 line drawings from Snodgrass and Vanderwart (1980) matched for frequency, concreteness, and proportion of controls who had named the pictures correctly. Nine living and 9 nonliving pictures were presented for identification. BD identified 6/9 of the living and 8/9 of the nonliving. We gave the remainder of these items to him as words and asked him to define them. We subsequently transcribed his definitions and gave them to 8 psychology students at Newcastle Polytechnic and asked them to work out what was being defined. On average 5.0 out of 9 of his "living" definitions and 6.4 out of 9 of his "nonliving" definitions were successfully interpreted. The difference was present for all 8 subjects, producing a significant effect on a t-test ($t = 7.67$, d.f. $= 7$, $P<0.001$).

TABLE 3
The Ability of BD and Control Subjects to Identify Members of Categories from Definitions

	Category of Definitions (n=12)						
	Carpenters Tools	*Musical Instruments*	*Animals*	*Dog Breeds*	*Fruits*	*Flowers*	*Vegetables*

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	Carpenters Tools	*Musical Instruments*	*Animals*	*Dog Breeds*	*Fruits*	*Flowers*	*Vegetables*
Word Frequencies	25.40	15.50	24.80	2.00	20.70	13.90	12.40
Controls (Proportion)	9.70 (0.81)	8.50 (0.71)	10.00 (0.83)	8.60 (0.72)	7.30 (0.61)	4.80 (0.40)	8.10 (0.68)
BD (Proportion)	10.00 (0.83)	8.00 (0.67)	5.00 (0.42)	5.00 (0.42)	3.00 (0.25)	4.00 (0.33)	6.00 (0.50)
Number of S.D.'s between BD and controls.	-	0.60	7.90	3.90	2.50	0.60	1.20

Recognising Category Members from Definitions

To investigate BD's performance further, we took definitions for 12 instances of each of 2 nonliving categories (carpenter's tool, musical instrument) and 12 instances of each of 5 living categories (fruits, flowers, vegetables, animals, dog breeds) from an encyclopaedia. Our reason for using 5 living categories and only 2 nonliving categories was that we were particularly interested to determine how consistent BD's impairment was across different living categories. BD was asked to tell us which category member we were describing when we read each of the definitions to him. His performance, together with that of 10 control subjects from the same population as before, is summarised in Table 3. The mean age of the controls was 57.0 years and all had left school before 16. Once more, BD performed better on the two nonliving categories than on the living categories. It is clear from Table 3 that this difference is not explicable simply in terms of word frequency. No decrement was observed on this test for flowers, which controls also appeared to find difficult, but BD performed poorly once more on fruits and dog breeds. This suggests that BD has great difficulty in accessing certain types of information in semantic memory. The most interesting difference between Table 2 and Table 3 is the performance on animals. This occurred even though all 12 animals used in the definition task were also used in the photographs task. Despite being able to identify animals from photographs as well as controls, BD is severely impaired at identifying animals from their definitions. This implies some difficulty in gaining access to semantic information even where the visual recognition unit may be working normally.

The pattern shown by BD is reminiscent of the performance of a group of four post-encephalitic patients described by Warrington and Shallice (1984). All of them appeared to suffer from a semantic memory deficit, but their problems were more severe with living than with nonliving category members. For instance, one of these patients, JBR, like BD, finds it easier to identify nonliving than living items from pictures and easier to define nonliving than living exemplars. Unlike JBR, however, there is no evidence that BD has the same sort of problems with identification of musical instruments that he encounters with living category members.

Conclusion

In conclusion, we would suggest that BD does not suffer from a general object agnosia but has difficulties in gaining overt access to detailed semantic information about members of living categories. As such, BD's performance is certainly compatible with the views of Warrington (1986) who argues for a distinction between the ways in which living and nonliving categories are represented in semantic memory. It is also consistent with

the pattern which BD shows in atter
might be considered to form a parti

PERSON RECOGN

Perceptual Processing of Face

It is BD's problems in recognising fa
concern, and that led him to seek
inability to recognise many familia
us, so a number of tests were given t
First, however, we note that BD
affecting any face processing task.
was unimpaired, scoring 46 on the
is well within the normal range. H
expressions, successfully matching
31/32 pairs of faces of different p
problems with faces are specific to t
in recognising and remembering pe

Recognising Famous Faces a

We tested BD's ability to identify
him with a line-up of photographs c
ised by Lancaster University in col
The photographs comprised 20 p
Margaret Thatcher, Queen Mothe
tures of "low-familiarity" faces (e.
Dietrich), and 20 pictures of unk
familiarity of each face on a scale
familiar), then to state the person's
name. The series is preceded by
line-up test using the people's nam
to compare BD's ability to recogni
His performance is summarised in
of 28 control subjects for the faces
comparable age). Similar normati
so the controls are 12 male janit
Their mean age was 57.08 years
school when either 14 or 15 years

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emory. It is also consistent with

the pattern which BD shows in attempting to identify people, since people might be considered to form a particular subgroup of "living things".

PERSON RECOGNITION IMPAIRMENT

Perceptual Processing of Faces

It is BD's problems in recognising familiar people that cause him the most concern, and that led him to seek further medical advice in 1976. His inability to recognise many familiar people is also of greatest interest to us, so a number of tests were given to chart the severity of this impairment. First, however, we note that BD does not suffer a general impairment affecting any face processing task. His ability to match unfamiliar faces was unimpaired, scoring 46 on the Benton Facial Recognition test, which is well within the normal range. He also performed well at judging facial expressions, successfully matching the expression as same or different on 31/32 pairs of faces of different people (controls, $\bar{x} = 29.79$). Thus his problems with faces are specific to those aspects of face processing involved in recognising and remembering people he has seen before.

Recognising Famous Faces and Names

We tested BD's ability to identify well-known faces by initially presenting him with a line-up of photographs of famous people prepared and standardised by Lancaster University in collaboration with the Radcliffe Infirmary. The photographs comprised 20 pictures of "high-familiarity" faces (e.g. Margaret Thatcher, Queen Mother, John Wayne, Henry Cooper), 20 pictures of "low-familiarity" faces (e.g. Lucille Ball, Max Bygraves, Marlene Dietrich), and 20 pictures of unknowns. The subject's task is to rate the familiarity of each face on a scale from 1 (totally unfamiliar) to 7 (highly familiar), then to state the person's occupation, and finally give the person's name. The series is preceded by 14 practice faces. We also repeated the line-up test using the people's names instead of their photographs, in order to compare BD's ability to recognise the same people from faces and names. His performance is summarised in Table 4 along with the mean performance of 28 control subjects for the faces (Radcliffe Infirmary control subjects of comparable age). Similar normative data were not available for the names, so the controls are 12 male janitors who work at Newcastle Polytechnic. Their mean age was 57.08 years (S.D. = 5.12) and all, like BD, had left school when either 14 or 15 years old.

These results suggest that BD has a problem in person identification which is not specific to faces. His familiarity ratings are lower than controls on "low-familiarity" names as well as on all the famous faces. In addition,

TABLE 4
BD's Performance in Recognising Lancaster/Radcliffe Famous Faces and Names Line-up

	Familiarity Rating (1-7 Scale)	*Correct Occupation (Max. = 20)*	*Correctly Named (Max. = 20)*
High-Familiarity Faces: BD	*4.85*	*12.00*	*6.00*
Controls (n=28)	5.98	18.86	16.25
S.Dev.	0.51	1.15	2.81
Low-Familiarity Faces: BD	*2.95*	*4.00*	*2.00*
Controls (n=28)	4.18	13.07	9.39
S.Dev.	1.02	4.54	1.14
Unfamiliar Faces: BD	*1.45*		
Controls (n=28)	1.36		
S.Dev.	0.45		
High-Familiarity Names: BD	*5.85*	*14.00*	
Controls (n=12)	6.27	19.66	
S.Dev.	0.63	0.84	
Low-Familiarity Names: BD	*4.35*	*10.00*	
Controls (n=12)	5.92	19.16	
S.Dev.	0.92	1.14	
Unfamiliar Names: BD	*1.35*		
Controls (n=12)	1.10		
S.Dev.	0.10		

he knows the occupation of only 24/40 of the famous names while controls give almost faultless performance. Similarly he can provide the occupation for just 16/40 of the faces (which is only half as many as controls), and can provide the name for only 8/40 of the faces—less than a third of the number of names that the control subjects produced. In contrast, BD does not tend to misidentify unfamiliar faces or names as belonging to familiar people. His problem is that he "misses" many of the familiars. Moreover, if he fails to recognise a person from their name, he will always fail to recognise that person's face too. There are, however, some people that BD can recognise from their name but not from their face, and this difference is more marked for people of low familiarity (10/20 were given the correct occupation from the name, 4/20 from the face). We suspect that this reflects differential frequency of encountering names and faces; we tend to read or hear about famous people (especially in newspapers) more often than we actually see them.

When BD was given the same faces and names "line-ups" some four months later, almost exactly the same result was found; his impairment is quite stable in overall degree of sev his responses to individual faces responses were consistent across bo were recognised in the first test but the second test but not the first. giving occupations to faces and 0.4 would emphasise, however, that th months apart. No such variability retested on the same items on the to recognise a particular face and minutes later.

A noteworthy feature of BD's pe it is better for high-familiarity than f arity is one of the factors affecting overtly. He does not experience th of virtually all faces that is characte familiar people, however, BD's per controls.

Voice Recognition

In order to provide more informati ing people, we administered Meu (1980) "Famous Voices Test". In thi of the voices of famous people fr 1970s. He found the test extremel for a large proportion of the voic together with the mean performa and amnesic patients. BD's perfo as poor as that of any of Meudell recognise voices as well known as and Harold Wilson, scoring a total suggestion of any decline in perfor prior to his illness. Such a decli amnesia (e.g. Albert, Butters, & I he is effectively at floor level on t

Forced-choice Tests

We have also given BD forced-c names, to provide further compa occupation judgements, and with tion of Table 4, one might draw familiarity of famous people is sli access appropriate semantic infor

E 4
adcliffe Famous Faces and Names Line-up

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4.00	*2.00*
13.07	9.39
4.54	1.14
14.00	
19.66	
0.84	
10.00	
19.16	
1.14	

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quite stable in overall degree of severity. There was, however, variation in his responses to individual faces or names. Approximately 75% of his responses were consistent across both tests, but the other 25% of people were recognised in the first test but not the second, or were recognised in the second test but not the first. Contingency coefficients were 0.35 for giving occupations to faces and 0.47 for giving occupations to names. We would emphasise, however, that these tests were carried out some four months apart. No such variability has ever been apparent when BD is retested on the same items on the same day, i.e. he does not fail overtly to recognise a particular face and then become able to recognise it a few minutes later.

A noteworthy feature of BD's performance on the line-up tasks is that it is better for high-familiarity than for low-familiarity people. Clearly familiarity is one of the factors affecting his ability to recognise a known person overtly. He does not experience the complete failure of overt recognition of virtually all faces that is characteristic of prosopagnosia. Even for highly familiar people, however, BD's performance is impaired in comparison to controls.

Voice Recognition

In order to provide more information regarding a general deficit in identifying people, we administered Meudell, Northen, Snowden, and Neary's (1980) "Famous Voices Test". In this, BD was presented with short extracts of the voices of famous people from every decade from the 1930s to the 1970s. He found the test extremely difficult and could offer no response for a large proportion of the voices. His performance is shown in Fig. 1, together with the mean performance of Meudell et al.'s control subjects and amnesic patients. BD's performance is clearly very impaired, and is as poor as that of any of Meudell et al.'s Korsakoff amnesics. He failed to recognise voices as well known as those of Winston Churchill, the Queen, and Harold Wilson, scoring a total correct of only 5 out of 69. There is no suggestion of any decline in performance in the form of a temporal gradient prior to his illness. Such a decline is often characteristic of retrograde amnesia (e.g. Albert, Butters, & Levin, 1979), but BD is so impaired that he is effectively at floor level on this task.

Forced-choice Tests

We have also given BD forced-choice recognition tests with faces and names, to provide further comparisons of his ability with familiarity and occupation judgements, and with face and name recognition. From inspection of Table 4, one might draw the conclusion that BD's sense of the familiarity of famous people is slightly better preserved than his ability to access appropriate semantic information. The demands of these two parts

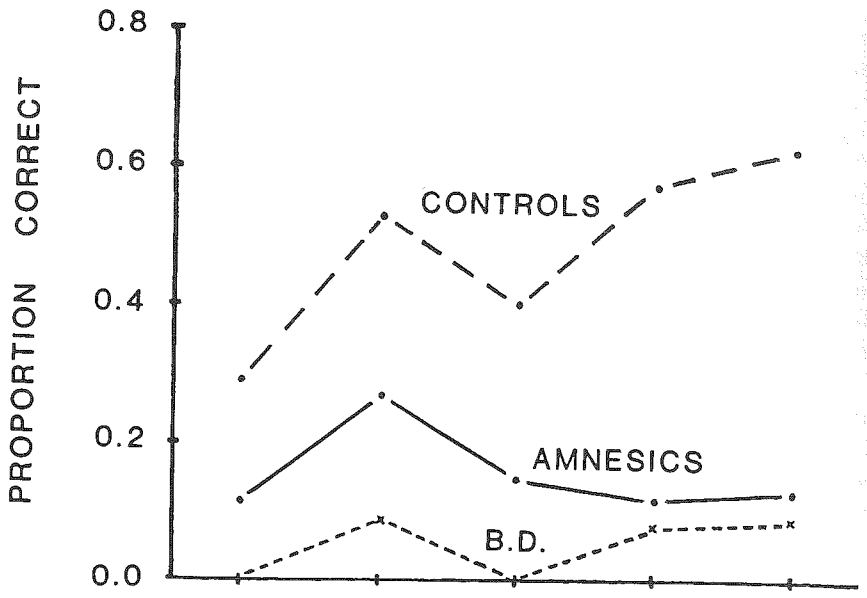

FIG. 1 BD's performance on Meudell et al.'s (1980) test of famous voices. Data for Meudell et al.'s amnesic patients and control subjects are presented for comparison.

of the line-up task are, however, quite different (familiarity rating vs. recall of semantic information). Thus we introduced a forced-choice task which tested access to familiarity or semantic information with equivalent demands.

BD was given 48 cards, on each of which were 4 names. On 24 of the cards all 4 names were of famous people (a sportsperson, a politician, an actor/actress, a musician) and BD had to state which one was the sportsperson on 6 of the cards, which one was the politician on 6 of the cards, etc. For example:

"Which is the Politician?"
Carl Lewis
Jim Prior
Robert De Niro
Andrew Lloyd-Webber

On the other 24 cards, 3 of the names were unfamiliar and 1 was well known. BD was asked to state which was the famous name. On all 48

trials, BD was told to guess if unsu
BD was given the test again, but th
judgements had been required pre
nonfamous judgement, and vice v
investigate whether BD might be b
than occupation judgements. If, for
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emerged; he scored 30/48 on the fa
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44/48 and 45/48 respectively on the

On our second forced-choice tes
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member of the public. The task wa
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with faces. He scored 101/128 cor
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Conclusion

In summary, then, BD shows impai
familiar people, in the context of
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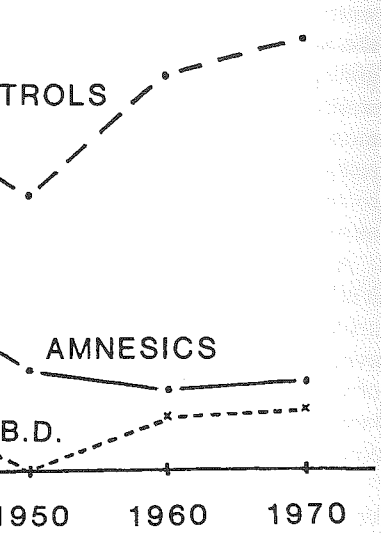

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were unfamiliar and 1 was well was the famous name. On all 48

trials, BD was told to guess if unsure. An hour after completing the task, BD was given the test again, but this time the names for which occupation judgements had been required previously were associated with a famous/nonfamous judgement, and vice versa. The purpose of this test was to investigate whether BD might be better at making familiarity judgements than occupation judgements. If, for instance, BD's problems occurred more at the level of specific person semantic information than at the level of recognition units, he might perform much better on the famous/nonfamous questions than on the occupation questions. In fact no such difference emerged; he scored 30/48 on the famous/nonfamous judgements and 27/48 on the occupation judgements. Both scores were markedly lower than those of a control patient with a right temporal lobe lesion, ELD, who scored 44/48 and 45/48 respectively on the two types of decision.

On our second forced-choice test, BD was shown 128 pairs of faces, one of which was of a well-known person and one of which was of an ordinary member of the public. The task was to indicate which of the two was well known. The task was subsequently repeated with the people's names instead of their faces. BD performed both tasks slowly, but was particularly hesitant with faces. He scored 101/128 correct on names and 97/128 on faces. It is interesting to compare BD's performance with that of De Haan et al.'s prosopagnosic patient PH, who performed much worse than BD on faces (65/128 correct) and rather better on names (118/128) (Young & De Haan, 1988). Normal subjects are essentially at ceiling on this task.

Conclusion

In summary, then, BD shows impaired access to semantic information about familiar people, in the context of a more general impairment of semantic memory. This impairment affects recognition of people, be it from their name, their face, or their voice. Of these three, performance sometimes appears to be slightly less impaired with names. However, it may be that any such variation in performance comes about simply because one encounters the name of a person more frequently in conversation or in the media than one sees their face or hears their voice. Because BD is unable to access specific semantic information about many well-known people, his difficulties are consequently much deeper than a problem with recognition units only. Such difficulties provide an interesting contrast with the problems of prosopagnosic patients such as those of PH (De Haan et al., 1987). PH's problems in recognising faces are more severe than those of BD, but he does not encounter anything like the same difficulties with names, voices, and person semantics as BD. In this regard, it is interesting that BD's observed lesion site is more anterior along the inferior longitudinal fasciculus than is often the case in prosopagnosia (Bauer & Rubens, 1985; Meadows, 1974).

A somewhat different interpretation of BD's problems in person identification would be that they come about as a result of a general amnesia. Consistent with this, BD does complain that he cannot remember information that he has read in books and newspapers, and he is impaired on Warrington's Recognition Memory Test for words as well as for faces. Furthermore, although BD's Wechsler memory quotient remains roughly consistent with his IQ, it has been argued with good reason (e.g. Parkin, 1987) that the WMS is not always sensitive to episodic memory impairment. We believe, however, that BD's problems in identifying people are rather more severe and more extensive than one would normally associate with the amnesic syndrome. For instance, on his most recent testing, SS, the post-encephalitic amnesic patient described by Cermak and O'Connor (1983), was able to identify 77/180 of the famous faces from Albert et al.'s (1979) Retrograde Amnesia Battery. While the materials employed are of course different, it seems unlikely that this level of impairment is as severe as that experienced by BD. Furthermore, there is no evidence that BD is able to recognise faces of people who were famous in decades prior to his illness any better than faces famous in more recent years. This is quite different from the pattern displayed by the temporal lobe amnesic HM (Marslen-Wilson & Teuber, 1975) and the diencephalic amnesic NA (Cohen & Squire, 1981). HM remains able to recognise people he knew before his illness, while NA, whose accident occurred in 1960, was better able to identify faces from the 1930s and 1940s than any of the control subjects with whom he was compared, even though he was worse than any of the controls on faces from the 1970s. By contrast, BD reports that the most disturbing of all his problems is his inability to recognise people that he knew before his illness. Finally, PH's performance on several memory tasks is worse than BD's (De Haan et al., 1987). For example, PH remembers nothing of the Wechsler memory passages an hour after testing, whereas BD achieves a score of 5.75. PH does not, however, encounter the same problems with voices, names, and with person semantics as BD. Therefore, while we would not wish to play down BD's general memory problems, we prefer, at present, to characterise his difficulties with person identification as a form of semantic memory impairment affecting knowledge of familiar people against the background of a more general impairment of knowledge of living things.

INVESTIGATION OF PRESERVED ACCESS TO INFORMATION CONCERNING FAMILIAR PEOPLE NOT RECOGNISED OVERTLY

We now turn to the question as to whether BD has forgotten altogether the information about people which he cannot overtly retrieve, or whether

he shows any evidence of preserved
of preserved access would suggest th
functions, but has become partially
nitive system. Because BD has pr
names, interference tasks such as th
3 and 4) are not suitable, and we
learning tasks used by De Haan e
Haan (1988), and Kapur et al. (198

Task 1

In the initial investigation, BD's ab
he had not identified from paired
equivalent to Task 7 in De Haan e
learn the correct name of faces he
the incorrect name. Since the face
subject fails to identify on a two-ite
rigorous criterion for initial absenc

Stimuli and Procedure

Initially, BD was shown a series
was given two alternative names f
name and one was the name of ano
this series, six photographs were c
face was unfamiliar and chosen th
were paired with their true names:
and three photographs were given
was given the name James Hunt
Moore, and James Hunt the name

The six photographs were laid
matrix. He was twice told which
faces occupying a different locati
The faces were then laid out aga
BD was asked to point to the cor
wrong answer, the photograph he
This continued over 12 trials with
before each new trial began.

Results and Discussion

Each of the 12 trials contained
pointed to the correct face for tr

of BD's problems in person identifi-
t as a result of a general amnesia.
in that he cannot remember infor-
newspapers, and he is impaired on
for words as well as for faces. Fur-
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affecting knowledge of familiar
general impairment of knowledge

ACCESS TO INFORMATION NOT RECOGNISED OVERTLY

her BD has forgotten altogether
nnot overtly retrieve, or whether

he shows any evidence of preserved access to this information. Evidence of preserved access would suggest that BD's person recognition system still functions, but has become partially disconnected from the rest of the cognitive system. Because BD has problems in recognising both faces and names, interference tasks such as those used by De Haan et al. (1987, Tasks 3 and 4) are not suitable, and we have relied instead on variants of the learning tasks used by De Haan et al. (1987, Tasks 5-8), Young and De Haan (1988), and Kapur et al. (1986).

Task 1

In the initial investigation, BD's ability to learn the names of faces which he had not identified from paired choice was examined. This task was equivalent to Task 7 in De Haan et al. (1987), in which PH was able to learn the correct name of faces he failed to recognise more quickly than the incorrect name. Since the faces used in the task are ones which the subject fails to identify on a two-item forced-choice test, there is clearly a rigorous criterion for initial absence of overt recognition.

Stimuli and Procedure

Initially, BD was shown a series of photographs of famous people and was given two alternative names for each. One of these was the correct name and one was the name of another person of similar occupation. From this series, six photographs were chosen for which BD had stated that the face was unfamiliar and chosen the wrong alternative. Three photographs were paired with their true names: Norman Tebbit, Eric Sykes, Ernie Wise; and three photographs were given untrue names. A photo of Roger Moore was given the name James Hunt, Paul McCartney the name of Roger Moore, and James Hunt the name of Paul McCartney.

The six photographs were laid out on a table in front of BD in a 3 x 2 matrix. He was twice told which name to associate with each face, the faces occupying a different location in the matrix on the two occasions. The faces were then laid out again and one of the names was read out. BD was asked to point to the corresponding photograph. If BD gave the wrong answer, the photograph he should have pointed to was indicated. This continued over 12 trials with the photographs being shuffled afresh before each new trial began.

Results and Discussion

Each of the 12 trials contained 6 responses and the number of times BD pointed to the correct face for true pairings (max. = 3) and the number

of times he pointed to the correct face for untrue pairings (max. = 3) were noted for all 12 trials. The mean correct score for true pairings was 2.42, and for untrue pairings 1.50. On 9 of the 12 trials BD performed better with true pairings. On 1 of the trials he performed better with untrue pairings, and for 2 of the trials there was no difference. A sign test showed that the number of trials in which performance was better for true than untrue pairings was significantly greater than the number of trials in which performance was better for untrue than for true pairings ($n = 10$, $x = 1$, 2-tailed $P < 0.05$).

On the basis of the results, it appears reasonable to conclude that BD does have some preserved recognition of these faces, otherwise there should have been no difference in the learning of true and untrue pairings. Like PH (De Haan et al. 1987, Task 7), BD shows preserved recognition even when the stimulus faces have been carefully screened for absence of correct overt recognition in the initial phase of the task.

Task 2

Task 1 provided evidence that BD does show superior learning of the true names of familiar faces that he had initially failed to identify. However, in Task 1 no attempt was made to control whether or not BD could recognise the names of the people used. In Task 2, we once more used faces that BD could not recognise, but some were of people whose names BD was able to recognise and some were of people whose names BD had failed to recognise. The purpose of this was to investigate whether or not overt recognition of the name of the person is necessary to produce superior learning of correctly paired faces and names.

Stimuli and Procedure

BD was first shown a series of photographs of celebrities mixed with photographs of unfamiliar members of the general public, and was asked which of the faces he found familiar. Subsequently he was shown an equivalent series of names. From this, six photos of celebrities were chosen which were deemed unfamiliar but the corresponding name was recognised, and six photos were selected for which neither face nor name was deemed familiar.

In the first part of the task the 6 photos with names deemed unfamiliar were used in a design exactly the same as that used in Task 1 except that 10 trials were used instead of 12. The 3 true pairings were Mary Decker, Sharon Davies, and Nanette Newman. On the untrue pairings, Rula Lenska's photograph was given the name Tracy Austin; Dolly Parton's face was given the name of Rula Lenska; Tracy Austin's photograph was given the name of Dolly Parton.

A few minutes later, this procedur
names had been recognised. The thre
and Raquel Welch. On the untrue p
was given the name of Glenda Jacks
name of Barbara Streisand; Glenda
of Chris Lloyd.

Results and Discussion

Mean scores for true and untrue p
tests were used once more to compa
pairings were learned better than un
in which untrue pairings were learne
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three trials showed no difference, a
ance on untrue than true pairings. Th
the names used were familiar (n = 7
names used were unfamiliar (n = 7,
both conditions were collapsed togeth

These findings have replicated an
learns the correct name to a face m
name, even when he finds the name
the data suggest that the effect is just
This result rules out any possibility
because of some undetected strateg
via the name, that BD might have b

Because BD shows preserved acc
true than untrue pairings even when
are unfamiliar, we decided to inves
information from names. The task
obvious choice, allowing us to comp

TAB
Mean Number of Correct
to Match Stated

	Names *Faces U*
True Pairings	2.
Untrue Pairings	2.

A few minutes later, this procedure was repeated with the faces whose names had been recognised. The three true pairings were Cilla Black, Lulu, and Raquel Welch. On the untrue pairings, a photo of Barbara Streisand was given the name of Glenda Jackson; Chris Lloyd's photo was given the name of Barbara Streisand; Glenda Jackson's photo was given the name of Chris Lloyd.

Results and Discussion

Mean scores for true and untrue pairings are presented in Table 5. Sign tests were used once more to compare the number of trials in which true pairings were learned better than untrue pairings with the number of trials in which untrue pairings were learned better than true pairings. With both sets of faces, six of the trials produced better performance on true pairings, three trials showed no difference, and one trial produced better performance on untrue than true pairings. These differences were significant when the names used were familiar ($n = 7$, $x = 1$, 1-tailed $P < 0.05$), when the names used were unfamiliar ($n = 7$, $x = 1$, 1-tailed $P < 0.05$), and when both conditions were collapsed together ($n = 14, x = 2$, 2-tailed $P < 0.02$).

These findings have replicated and extended the results of Task 1. BD learns the correct name to a face more easily than he learns the incorrect name, even when he finds the name as well as the face unfamiliar. In fact, the data suggest that the effect is just as strong as when the name is familiar. This result rules out any possibility that the results of Task 1 came about because of some undetected strategy, involving overt semantics accessed via the name, that BD might have been using.

Because BD shows preserved access in the form of better learning of true than untrue pairings even when both the face and the name of a person are unfamiliar, we decided to investigate further his preserved access to information from names. The task used by Kapur et al. (1986) was an obvious choice, allowing us to compare BD with their patient ED.

TABLE 5
Mean Number of Correct Choices (Max.=3) of Face to Match Stated Name in Task 2

	Names Familiar, Faces Unfamiliar	*Names and Faces Unfamiliar*
True Pairings	2.50	1.80
Untrue Pairings	2.00	1.10

Task 3

Kapur et al. (1986) have recently reported data from a patient (ED) who suffers from a permanent selective retrograde amnesia without corresponding anterograde amnesia. In one learning task, names of famous people that ED failed to find familiar were used. The patient was taught the wrong occupation for these people (e.g. "John Newcombe—singing", "Gary Glitter—tennis") and results showed that he was able to learn these wrong occupations more quickly than any of the five matched control subjects, who complained that their past associations interfered with their ability to learn the new occupations. ED,by contrast appears to have no degree of preserved access to such knowledge about the names which he fails to recognise, and so was able to learn the new occupations relatively quickly.

It was, therefore, decided to repeat Kapur et al.'s (1986) procedure with BD. We considered that this would be a useful way of investigating whether he had preserved access to knowledge associated with names; if successful, this would provide a clear contrast with Kapur et al.'s patient. In order to provide a meaningful comparison with BD's performance on incorrectly paired items, a subsequent test was given in which some other celebrities' names were associated with their correct occupations. This, however, raises the problem of possible practice effects. Hence the entire procedure was repeated after two months, this time with the correctly paired items being learnt first.

Stimuli and Procedure

The names of 12 celebrities were selected which BD failed to find familiar. Six of these names had their occupations jumbled in such a way that each name was associated with the wrong occupation. The resulting pairings were as follows:

Anthony Blunt	—	Tennis
Olga Korbut	—	Politician
Idi Amin	—	Gymnastics
Lee Harvey Oswald	—	Spy
Bjorn Borg	—	Criminal
Airey Neave	—	Adventurer

These pairs were presented to BD on a card for 30 seconds for him to learn. Following the removal of the card, BD was given each name individually and was asked to recall the occupation. This continued over six separate trials. If BD gave the wrong occupation, he was told what the correct answer should have been. On each of the six trials, the names were presented in a different random order.

study the names and occupations fo

A few minutes after completion, the names of the other six celebrities These were:

Evil Kneivel
Mark Spitz
Maria Bueno
Anna Ford
James Earl Ray
John Nott

These pairs were presented and tes incorrectly paired items.

Two months later, the entire task only difference was that this time before the incorrectly paired items.

Results and Discussion

Performance on Task 3 is summar showed that occupations were recal paired with appropriate names tha priate names (n1 = 12, n2 = 12, U

The results show that BD is able to with a name more easily than an does not find the names familiar. able to gain access to stored inform as well as from faces he does not r

BD's performance on this task pattern shown by Kapur et al.'s (1 well on items in which the occupatio

TA
Mean Number of Occupations Succ and Incorrectly Paired Items in Ta Test Took Place Tw

	First Admi
Correctly Paired Items	3.3
Incorrectly Paired Items	1.3

sented in a different random order. In between trials, BD was allowed to study the names and occupations for a further 30 seconds.

A few minutes after completion, BD was given a card on which were the names of the other six celebrities paired with their correct occupations. These were:

Evil Kneivel	—	Adventurer
Mark Spitz	—	Swimmer
Maria Bueno	—	Tennis
Anna Ford	—	Newsreader
James Earl Ray	—	Criminal
John Nott	—	Politician

These pairs were presented and tested in exactly the same way as for the incorrectly paired items.

Two months later, the entire task was repeated in identical fashion. The only difference was that this time the correctly paired items were learnt before the incorrectly paired items.

Results and Discussion

Performance on Task 3 is summarised in Table 6. A Mann-Whitney U-test showed that occupations were recalled significantly better when they were paired with appropriate names than when they were paired with inappropriate names (n1 = 12, n2 = 12, U = 24, 2-tailed $P < 0.02$).

The results show that BD is able to learn the correct occupation associated with a name more easily than an incorrect occupation, even though he does not find the names familiar. It would appear, therefore, that BD is able to gain access to stored information from names he does not recognise as well as from faces he does not recognise.

BD's performance on this task is, therefore, quite different from the pattern shown by Kapur et al.'s (1986) patient, who performed relatively well on items in which the occupation was incorrectly paired with the name,

TABLE 6
Mean Number of Occupations Successfully Recalled (Max.=6) for Correctly and Incorrectly Paired Items in Task 3 (the Second Administration of the Test Took Place Two Months After the First)

	First Administration	*Second Administration*
Correctly Paired Items	3.33	5.00
Incorrectly Paired Items	1.33	2.50

compared to control subjects. Even though BD shows no greater overt recognition of these names than Kapur et al.'s patient he still finds it difficult to learn the wrong occupation for them. The pattern which BD shows on this task is closer to that shown by Kapur et al.'s control subjects except that they, of course, found the names familiar.

The finding that BD performed better on the second administration of the task than the first is less easy to explain unequivocally. He showed no conscious recollection of having done the task before, though it is possible that the relevant information was primed and thus made more accessible by the first administration, despite BD's lack of overt recognition. It is important to note, though, that incorrectly paired occupations, as well as correctly paired items, were recalled better on the second administration; so one cannot discount some kind of practice effect, perhaps in the form of an improved strategy, as an explanation of this finding.

General Discussion of Tasks 1-3

The results obtained so far make it clear that BD is able to activate recognition units for faces and names that he fails to find familiar. The results are also consistent with the view that BD is able to gain some form of access to contextual information about these people in the semantic system. It might, nevertheless, be argued that BD is not gaining access to person identity nodes when he learns to associate faces and names but may instead be making use of a rather more rudimentary form of organisation within the person recognition system (cf. Young & De Haan, 1988). It may be that BD is able to gain access from face recognition to name recognition units via simple associations that do not pass through the person semantic system. This might be able to explain performance in Task 1 and Task 2. It is even conceivable that if the recognition units themselves had some very basic pattern of semantic organisation, then it might be difficult for BD to learn the wrong occupation for a celebrity even if access to person identity nodes was not actually occurring.

Such an interpretation would be undermined if BD showed preserved access to more precise semantic information about people that he failed to recognise, such as the party affiliations of politicians or the teams for which footballers played. It seems unreasonable to suppose that detailed person information such as this could be represented via a rudimentary semantic organisation of recognition units. Moreover, this is exactly the kind of information that the prosopagnosic patient PH does not seem to access covertly (Young & De Haan, 1988). In the next two tasks, therefore, we investigate whether BD shows any ability to access precise person semantic information from unrecognised faces or names.

Task 4

Stimuli and Procedure

Six photographs of politicians w
familiar. The six politicians each repr
cal background or else were leaders
photographs were associated with t
Healey = Labour, Cyril Smith = Li
three photographs were linked with
= Trades Unionist, Willie Whitelaw
The learning task itself was identica
political affiliations replaced names
the course of the task, the names
tioned; only their political backgrou

Results and Discussion

Mean numbers of correct choice
for untrue pairings 1.50. On seven o
with best performance, on one trial,
pairings, and on the other two tri
$n=8$, $x=1$, 1-tailed $P < 0.05$; Wilc
$n=8$, $T = 3$, 2-tailed $P < 0.05$). It
gain access to precise semantic info
The next task examined whether t

Task 5

BD has been keen on association f
bility that he might be able to demo
team of players that he no longer

Stimuli and Procedure

BD was initially presented with
from the past. From those which
all of whom played for different t
their appropriate team (Ron Flowe
United, Colin Harvey—Everton) a
team (Ron Yeats—Southampton, T
pool). These pairs were then admi

Task 4

Stimuli and Procedure

Six photographs of politicians were selected which BD failed to find familiar. The six politicians each represented either a different British political background or else were leaders of an overseas country. Three of these photographs were associated with their true political background (Denis Healey = Labour, Cyril Smith = Liberal, Jimmy Carter = American) and three photographs were linked with the wrong background (David Owen = Trades Unionist, Willie Whitelaw = SDP, Len Murray = Conservative). The learning task itself was identical to that of Tasks 1 and 2, except that political affiliations replaced names. Ten learning trials were used. During the course of the task, the names of the people involved were not mentioned; only their political backgrounds.

Results and Discussion

Mean numbers of correct choices for the true pairings were 2.40, and for untrue pairings 1.50. On seven of the trials, true pairings were associated with best performance, on one trial, performance was better for the untrue pairings, and on the other two trials there was no difference (sign test, n=8, x=1, 1-tailed $P < 0.05$; Wilcoxon matched-pairs signed-ranks test, n=8, T = 3, 2-tailed $P < 0.05$). It appears, therefore, that BD is able to gain access to precise semantic information from faces he finds unfamiliar. The next task examined whether the same might be true for names.

Task 5

BD has been keen on association football throughout his life, so the possibility that he might be able to demonstrate preserved access to the football team of players that he no longer recognises overtly was investigated.

Stimuli and Procedure

BD was initially presented with a series of names of famous footballers from the past. From those which he found unfamiliar, six were selected, all of whom played for different teams. Three of these were paired with their appropriate team (Ron Flowers—Wolves, Pat Crerand—Manchester United, Colin Harvey—Everton) and three were paired with the incorrect team (Ron Yeats—Southampton, Terry Paine—Arsenal, Ted Drake—Liverpool). These pairs were then administered to BD in a learning task similar

to that used in Task 3 and used by Kapur et al. (1986). One month after this, the test was administered for a second time.

Results and Discussion

Mean numbers of football teams correctly recalled are shown in Table 7. Of the 20 learning trials that took place, 9 were associated with better recall of correctly paired items, 1 was associated with superior recall of incorrectly paired items, and 10 trials showed no difference. A sign test showed that the number of trials on which performance was better for true than untrue pairings was significantly greater than the number of trials on which performance was better for untrue than for true pairings ($n = 10$, $x = 1$, 2-tailed $P < 0.05$).

The superior learning which BD shows for correctly paired names and football teams supports the view that he is able to gain access from names to semantic information as specific as the football team for which the person played. In conjunction with the results from Task 4, which showed access to precise semantic information from faces, these findings provide strong evidence that BD is gaining access to both recognition units and person identity nodes for faces and names that were not overtly recognised.

Given this state of affairs, the next question to ask was whether BD was able to gain access from faces to their names in the output lexicon. It must be emphasised that none of the results obtained so far force this conclusion. It may be that when BD successfully learns the name of a face, he is associating some form of semantic information accessed from the face with semantic information accessed overtly or covertly from the name.

One way of discovering whether preserved access from faces to the name output lexicon is actually occurring is to use a task in which the pairs of items comprise a photo of a face and a first name. The absence of the second name leaves the identity of the person unknown, which means that any link that is made between face and name cannot be originating from the name itself. If BD nevertheless learns correct first names more rapidly

TABLE 7
Mean Number of Football Teams Successfully Recalled (Max.=3) to Correctly and Incorrectly Paired Names in Task 5

	First Administration	*Second Administration*
Correctly Paired Items	1.70	2.70
Incorrectly Paired Items	1.20	2.00

than incorrect first names, then it c
to their names is indeed occurring

Task 6

Stimuli and Procedure

BD was initially presented with
two alternative first names for ea
first name, and the first name of
Six of these photographs for which
used in the subsequent learning ta
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Hunt the name David). The lear
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Results and Discussion

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The finding of a difference be
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lly Recalled (Max.=3) to Correctly and
ames in Task 5

ion	*Second Administration*
	2.70
	2.00

than incorrect first names, then it could be concluded that preserved access to their names is indeed occurring from faces deemed unfamiliar.

Task 6

Stimuli and Procedure

BD was initially presented with a series of photographs and was given two alternative first names for each. The two alternatives were the true first name, and the first name of someone of similar age and occupation. Six of these photographs for which BD selected the wrong alternative were used in the subsequent learning task. Three photographs were paired with the true first name (the faces of Terry Wogan, Barry Manilow, and Michael Parkinson) and three were paired with an untrue name (the face of Ernie Wise was given the name James, David Steel the name Ernie, and James Hunt the name David). The learning task was administered in the same way as Tasks 1 and 2, with ten trials. One week later, the test was repeated but this time the full names (ie. first and second name) were used rather than the first names alone.

Results and Discussion

Performance on Task 6 is summarised in Table 8. When first names were used, three of the ten trials produced better performance on true pairings, five of the trials produced better performance on untrue pairings, and two of the trials produced no difference. When full names were used, however, eight of the trials produced better performance to true pairings and two trials produced no difference between true and untrue pairings.

The finding of a difference between true and untrue pairings for full name but not for first name learning was confirmed statistically by non-parametric analysis of the sizes of the differences between scores for true

TABLE 8
Mean Number of Choices (Max.=3) of Face to Match Stated First Name or Full Name in Task 6

	First Name	*Full Name*
True Pairings	1.50	2.50
Untrue Pairings	1.70	1.00

and untrue pairings on each trial. A Mann-Whitney U-test demonstrated a more marked difference between true and untrue pairings for full name than for first name learning (n1 = 10, n2 = 10, U = 11, 2-tailed $P < 0.02$).

The results make it clear that BD does not show any preserved access when first names only are paired with famous faces, but does show evidence of preserved recognition of the same faces if tested in an appropriate way, with full names. Because of the importance of this finding, we have subsequently repeated the first half of Task 6 using a different set of photographs, selected on the basis that BD did not find them familiar. The results were very similar to those just reported, with no hint of any preserved access when first names only are used.

These findings demonstrate that although BD is able to gain preserved access to information from well-known faces he fails to find familiar as far as the person semantic system, there is no evidence of access from an unrecognised face to the person's name in the output lexicon.

Task 6 also provides evidence against the view that differences between correctly and incorrectly paired items in some of the previous tasks might have arisen simply because the true pairings were easier to learn. Despite random allocation, one might argue that faces paired with their correct names could have been more distinctive, for instance. In Task 6, however, we demonstrated better learning of true than untrue full names, yet no advantage of true first names for precisely the same set of stimuli; hence the different patterns of findings must genuinely reflect BD's performance rather than the stimuli themselves.

The number of stimuli used in each of our learning tasks is necessarily small (usually three true pairings and three untrue pairings for any particular task), but it is clear that our findings do not arise artifactually from stimulus sampling errors. Tasks 1, 2, and 6 all included conditions consistently demonstrating superior learning of true than untrue face-name combinations, and the finding of better learning of true than untrue occupations to names was replicated within Task 3. The finding that BD can learn precise semantic information better to true than untrue pairings was replicated across the otherwise quite different Task 4 and Task 5, and his inability to learn true first names better than untrue first names was replicated with a different set of stimuli in Task 6. Hence all of our principal findings have been replicated at least once with BD. In addition, it was possible to carry out an items analysis by pooling the faces used for true and untrue pairings in both conditions of Task 2 and in the full name condition of Task 6. None of the 18 faces involved were repeated across these experiments, and all were used for 10 trials involving the learning of a full name to the face. This items analysis showed a significant difference between true and untrue pairings (Mann-Whitney U-test, n1 = 9, n2 = 9, U = 17, 2-tailed $P = 0.05$), demonstrating that the superior performance to true pairings holds across the stimulus set.

GENERAL D

Performance on Tests of Perso

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Access Versus Storage Impai

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GENERAL DISCUSSION

Performance on Tests of Person Recognition

BD has been studied to try to find the cause of his severely impaired ability to recognise familiar people. Our investigations show that this impairment affects recognition from faces, names, or voices, and it is as readily demonstrated in forced-choice tasks as in tasks which demand recall of stored information. BD is able to achieve overt recognition of a proportion of faces and names, but even for highly familiar faces and names his performance is impaired in comparison to that of normal controls. The importance of the forced-choice tasks is that they could be correctly answered in terms of the weakest of overt memories—any sense of familiarity would, for instance, suffice to pick the familiar member of a pair of faces. BD's poor performance on forced-choice tasks thus demonstrates the extent to which he has lost the sense of overt familiarity of faces and names that he does not recognise.

Unlike the prosopagnosic patient PH, however, BD is not unable to recognise all faces. Instead, as we have already remarked, there is a proportion of faces that he can identify. Our assumption is that these are the people BD has most often encountered, since familiarity influenced his performance of recognition tasks. Although BD is, in effect, better than PH at face recognition and worse than PH at name or voice recognition, for BD (as for PH) there is no sense of overt familiarity when he fails to recognise a familiar person.

Access Versus Storage Impairments

Despite his poor performance on standard tests of person recognition, BD shows a range of effects that demonstrate preserved access to information concerning people who were not initially recognised overtly. BD shows ability to access information from both faces and names he does not find familiar, and Tasks 4 and 5 demonstrated that he gains access to precise semantic information about people. All this suggests that the brain damage which BD suffered has not destroyed his knowledge of people's names and faces, nor his knowledge of who they are. Moreover, he is still able to activate this knowledge when he encounters their name or their face. His primary problem is thus one of achieving overt access to knowledge that is in some ways quite readily available (e.g. in learning tasks).

BD's pattern of performance forms a remarkable contrast to that seen (or rather, not seen) in Kapur et al.'s (1986) patient. BD demonstrates preserved access to information on precisely the same name-occupation learning task that Kapur et al.'s patient does not. Thus there may be a distinction to be drawn between memory impairments which involve a

complete loss of (or complete loss of access to) precise semantic knowledge, and those (such as BD's) in which the semantic records are themselves relatively well preserved but overt access is impaired.

Warrington and Shallice (1979) draw an important general distinction between impairments in which access to semantic representations is affected and impairments in which the store is itself degraded. They suggested that four features might be typical of access impairments; low consistency of performance across test sessions, the presence of priming effects, lack of relative preservation of superordinate information, and an absence of a pronounced frequency effect. Shallice (1987) provides an extensive discussion of these issues, and demonstrates that this conceptualisation has proved helpful in analysing the performances of several patients.

Our interpretation of BD's problem as reflecting an access rather than a storage impairment is based on the fact that he clearly can achieve access to a wide range of relevant information about people he does not recognise when they occur in learning tasks; we have referred to this phenomenon as implicating a form of preserved access. Like Warrington and Shallice (1979), we do not think it likely that such extensive "priming" effects could arise from a degraded store. BD does not, however, meet all of the criteria suggested by Warrington and Shallice (1979) and Shallice (1987) to characterise access impairments. Although his performance, when retested in separate sessions, revealed a low contingency coefficient for faces (0.35), the contingency coefficient for name recognition (0.47), whilst not particularly high, fell outside the range discussed by Shallice (1987). In addition, item familiarity, which must be closely related to item frequency, is a major determinant of BD's performance even though he is impaired both for high- and low-familiarity people. We have also suggested that the reason why BD identifies more people from their name than their face may be because we tend to read or hear about famous people more frequently than we see them.

Covert Recognition or Reinstatement of Familiarity?

It is clear that during learning tasks, BD can access information that he was initially unable to retrieve overtly. A further question that one might wish to consider is whether the learning tasks lead to the reinstatement of overt familiarity or whether they reflect covert recognition of faces and names that BD continues to find unfamiliar.

It is essential to note that the mere presence of a correct cue does not produce overt recognition for BD. His performance was no better when he was asked to select a name corresponding to a specified occupation (27/48 correct) than when he was asked to select the familiar name in a set (30/48 correct). Moreover, in some of our learning tasks, faces were chosen on the basis that BD had not identified them when given a paired

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choice of the correct and an incorrect name, yet he still showed superior learning of true than untrue face-name combinations. Finally, in Task 2 BD showed an equally marked superiority of true face-name combinations regardless of whether or not the names were familiar to him; i.e. when cueing from the names would or would not be possible.

Consequently, we are confident that BD had no feelings of overt familiarity toward a face when he was initially being taught a correct face/name pairing. It is much more difficult to assess whether or not any overt recognition of the faces of such people returned during the *course* of the learning task, however. As a result, we cannot be certain whether or not superior performance on correct pairings was mediated by overt familiarity, or whether it was caused by *covert* recognition of the faces in question. The crucial point, of course, is that BD can readily access quite detailed information about people for whom initially, at least, he has not the slightest feeling of familiarity. It must be acknowledged, however, that covert recognition per se has not been demonstrated incontrovertibly in this case.

What BD Can and Cannot Access

Comparison of the pattern of effects shown by BD with covert recognition effects seen in cases of prosopagnosia is also instructive (Bauer, 1984; De Haan et al., 1987; Tranel & Damasio, 1985; Young & De Haan, 1988). The differences between the prosopagnosic patients described in those studies and the pattern revealed by BD may be at least as enlightening as the similarities. In this respect it is interesting to compare BD with De Haan et al.'s prospagnosic patient, PH, in more detail. Although PH appears to be gaining covert access to face recognition units (De Haan et al., 1987), there is no evidence that he is also able to gain any access to nodes representing person semantic information from faces (Young & De Haan, 1988). That is, he fails to learn to associate the appropriate party affiliation with a politician's face more readily than an incorrect party affiliation. In addition, he did not learn to associate the appropriate sport with a sportsperson's face more readily than a different sport. Whereas BD does gain access to nodes containing precise semantic information about people he has failed to identify, Young and De Haan argue that the interference and learning tasks, for which PH shows covert access to semantic properties of familiar faces, tap some form of rudimentary semantic organisation at the recognition units level. Consequently, the preserved access effects reported in the present study of BD are more extensive than those found for PH.

The demonstration that the person semantic system as well as name and face recognition units can still function even where it is no longer making contact with the rest of the cognitive system extends the boundaries of implicit memory beyond those reported in previous cases of either prosopagnosia or amnesia (cf. Schacter, McAndrews, & Moscovitch, 1988). It has

been known for some time that amnesic patients sometimes reveal evidence of preserved memory in circumstances where they have no conscious recollection of the task for which they show learning. However, tasks on which amnesics perform well typically test memory for physical information such as word stem completion (Warrington & Weiskrantz, 1970), the spelling of homophones (Jacoby & Witherspoon, 1982), or perceptual-motor skills (Brooks & Baddeley, 1976), rather than semantic information. The performance of BD, however, suggests that even parts of semantic memory which are unavailable for conscious retrieval can still be accessed if tested in an appropriate way. In this respect, it is possible that BD is producing patterns of performance which are not qualitatively different from those which normal people would show for faces and names which they once knew but can no longer remember overtly. It would certainly be interesting for future research to determine whether normal subjects show any evidence of effects of the kind revealed by BD when tested with appropriate stimuli or whether they show the total forgetting more characteristic of Kapur et al.'s patient ED.

Given that BD can gain access to precise person semantics from unrecognised faces, it is interesting to note that his preserved recognition does not appear to stretch as far as the person's name in the output lexicon. BD's failure to learn to associate a correct first name with a face more rapidly than an incorrect first name suggests that when he fails to recognise a person, he cannot access information beyond the semantic system. This result enables us to draw certain conclusions about the reasons why correctly paired names and faces are learnt relatively well. Presumably, semantic information accessed from the face is integrated with semantic information accessed from the name. What we have not established, though, is whether the effects come about as a result of facilitation, interference, or a combination of these factors. That is, does BD find it difficult to create such a link if the semantic information accessed from name and face is different, or does he find it particularly easy to make the link if the semantic information is the same? Further studies of BD directed toward this issue might well prove rewarding.

It seems, then, that preserved access to information concerning unrecognised familiar people is characteristic of more than one form of neuropsychological impairment, and that detailed investigation of the similarities and differences between such patients will be highly informative concerning the functional mechanisms involved. For PH, face recognition mechanisms are disconnected from awareness, and there is no evidence of preserved access from faces to precise semantic information. Name and voice recognition remain, however, relatively intact and provide a sense of familiarity and overt access to precise semantic information concerning the person recognised. BD, in contrast, experiences impaired overt access to precise

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here is no evidence of preserved
formation. Name and voice recog-
and provide a sense of familiarity
formation concerning the person
s impaired overt access to precise

semantic information and the feeling of familiarity for many people, whether they are encountered in the form of a face, voice, or name, yet he continues to demonstrate preserved access to the appropriate representations in learning tasks.

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Implications of Pres
Abilities for the
Speech Automatisms
A Single

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University of Fr

Ernst G
Clinic Bavaria, Sc

Jürgen
Institute for
University of Fr

Claus
University of Fr

A patient is described whose oral
used stereotypical utterances (speec
mance is far better preserved. Wri
his phonological route for writing
dictation, word length and syllabic
nonwords. Picture-matching tasks
demonstrated relatively preserved
and sub-phonemic hypothesis of a

INTRO

Speech automatisms (recurring utt
ical utterances, which can occur in

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