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I recognize your face but I can't remember your name: Is it because names are unique?

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Burton & Bruce (1992), and Cohen (1990*a*), offer alternative accounts of the differences in 'normal' and neurologically impaired subjects' abilities to recall people's names and other pieces of biographical information. Cohen claims that the principal difference between names and other biographical information is in their relative meaningfulness, while Burton & Bruce argue that uniqueness is the crucial variable. As yet existing empirical evidence cannot be explained within the framework of either of these accounts, although the Burton & Bruce (1992) proposal has the advantage of being implemented as an interactive activation model. This paper describes the case of a patient who, following a stroke, retained the ability to access 'unique' semantic information for familiar people she is no longer able to name. It is argued that this pattern of performance provides difficulties for the Burton & Bruce model. However, it can be accounted for by Cohen's account, and a modified version of Burton & Bruce's model (Bruce, Burton & Walker, 1994).

Research has found that in comparison with other types of biographical information, people's names are particularly hard both to learn, and to recall once learnt. For example, McWeeny, Young, Hay & Ellis (1987) used well-controlled stimuli to show that the names of unfamiliar individuals took longer to learn than their occupations. Young, McWeeny, Ellis & Hay (1986) showed that it took subjects longer to name a famous face than it did to classify it by occupation. Even when response demands of the two tasks were equated, naming of famous faces took longer than classifying them by occupation (Young, Ellis & Flude, 1988). Moreover, Johnston & Bruce (1990) showed that reaction time differences were also apparent when classification was in terms not of occupation, but of other forms of semantic information such as 'dead or alive' and nationality.

Diary studies have been used to document people's day-to-day difficulties in name recall (e.g. Young, Hay & Ellis, 1985). In this study, it was shown that while it was common for a person to be able to retrieve semantic information about a familiar seen person without being able to recall his or her name, the reverse never occurred. Traditionally these results have been interpreted within the framework of Bruce & Young's (1986) model of face identification. This model proposes that name information and other kinds of biographical knowledge are stored in separate memory systems. Moreover, Bruce & Young argue that names can only be retrieved for faces after a series of discrete processing steps, involving recognition of the face,

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retrieval of semantic information, and finally access to name generation, a stage specific to proper names.

Bruce & Young's account has also proven useful in explaining cases of selective name retrieval deficits observed in acquired brain damage. Flude, Ellis & Kay (1989), for example, reported the case of patient E.S.T., whom they claim was able to retrieve detailed semantic representations for familiar people and objects he could not name. Flude *et al.* characterized E.S.T.'s proper name recall deficits as reflecting spared access to semantics, but with difficulties in accessing the phonological output forms of proper names.

However, two recent models of face identification suggest that data both from 'normal' and neurologically impaired subjects can be explained without drawing a distinction between the storage of name and semantic information. The first of these accounts is provided by Cohen (1990*a*), and the second by Burton & Bruce (1992), in their Interactive Activation and Competition (IAC) model. Both attribute the difficulty in name retrieval to the structure of semantic memory, rather than to the representation of names *per se*.

Several authors have proposed that names are more difficult to remember than other pieces of biographical information because of differences in 'meaningfulness' (Cohen, 1990*a*; Cohen & Faulkner, 1986; Lucchelli & DeRenzi, 1992; Semenza & Zettin, 1989). Cohen (1990*a*) argues that the major difference between people's names and other kinds of person identity information is that names are relatively meaningless, and difficult to image. Cohen proposes that most pieces of biographical information are linked, either through their connotative meaning or the use of imagery, to previously acquired semantic representations. On the other hand, the comparative 'meaninglessness' of people's names prevents them from being integrated into pre-existing semantic networks. According to Cohen & Faulkner (1986), the elaboration of biographical information into networks is beneficial because it produces multiple routes to retrieval. Alternatively, Cohen (1990*b*) suggests that linking information together serves to aid recall by reducing the number of 'links' that need to be searched in order to find a required piece of semantic information.

Cohen's proposals principally address the issue of the difficulties experienced by non-neurologically impaired subjects in learning and retrieving peoples' names. However, Lucchelli & DeRenzi (1992) and Semenza & Zettin (1989) argue that 'meaninglessness' is also useful in explaining the effects of acquired brain damage on name retrieval. Burton & Bruce (1992) offer an alternative interpretation which stresses the effect of ***uniqueness*** on the recall of semantic information. Their model is well specified and has the advantage of being implemented. The IAC model of person identification consists of three pools of representations: (*a*) 'face recognition units' compare view and expression independent representations of a stimulus face with stored abstract representations of previously encountered faces; (*b*) output from face recognition units is passed in cascade to 'person identity nodes' (PINs) which act as gateways to semantic representations; (*c*) biographical information is stored in 'semantic information units' (SIUs). Each semantic information unit represents an attribute and is connected to all person identity nodes for which that piece of semantic information is associated.

One important aspect of the IAC model is the existence of reciprocal connections between 'person identity nodes' and 'semantic information units'. These feedback connections allow an active semantic information unit to provide reactivation of all person identity nodes to which it is connected. This in turn serves to increase the amount of activation passing from person identity nodes to that semantic information unit. This means that a semantic information unit that is connected to many person identity nodes will receive a greater amount of activation than one that is connected to few person identity nodes. These units, therefore, not only reach threshold more quickly when the system is functioning properly (Burton, Bruce & Johnston, 1990), but are also more likely to be spared the effects of damage (Burton & Bruce, 1992).

Burton & Bruce (1992) argue that the reason names are harder to recall than other pieces of semantic information is because *they are usually unique to one person.* For example, the findings that subjects took longer to classify faces by name than by occupation (Young *et al.*, 1988), whether they are dead or alive, or by nationality (Johnston & Bruce, 1990), are explained by the fact that these attributes all apply to a large number of people, and as a consequence of the architecture of the IAC model, take less time to reach threshold than names which are linked to very few individuals.

Burton & Bruce also reinterpret E.S.T.'s impaired recall of proper names (Flude *et al.*, 1989) in terms of the model. They hypothesize that E.S.T.'s deficit can be explained as the result of an attenuation of the links between person identity nodes and semantic information units. They argue that if this reduction is the same for all links the relative activation of units will remain the same. This will mean that those semantic information units with the lowest level of activation (i.e. those representing more specific information) will fail to reach threshold, whereas 'well connected' pieces of information will still be sufficiently activated to guide a correct response.

Burton & Bruce note that the data from E.S.T.'s case suggest that E.S.T. may show some degree of impairment of semantic information about people. At the same time, some ability to recall names is clearly preserved. They maintain that this would be expected in their model in which access to biographical information is governed by the 'uniqueness', and not the type of information to be retrieved. However, no evidence is given to support the proposition that E.S.T. has impaired access to semantic information. Burton & Bruce note that in order to test this account it would be necessary to assess E.S.T.'s ability to retrieve unique semantic information.

This paper describes the case of patient B.G., who, like E.S.T. demonstrates an inability to retrieve the names of many familiar people whom she is able to identify by providing biographical information. Unlike E.S.T., however, B.G. shows a well-preserved ability to retrieve object names and action words. In this respect she is similar to patients T.L. (Carney & Temple, 1993), M.L. (Lucchelli & DeRenzi, 1992), L.S. (Semenza & Zettin, 1989), P.C. (Semenza & Zettin, 1988), and G.B.L. (McKenna & Warrington, 1980).

In this paper we explore the amount and type of biographical information available to B.G. for faces and people whom she is unable to name. Burton & Bruce's and Cohen's models of face identification make differing predictions about the types of information that will be available to B.G. Burton & Bruce note that 'the important aspect of names in Cohen's account is that they are (usually) meaningless. In contrast, the important aspect of names in the IAC account is that they are (usually) unique'

(Bruce & Burton, 1992, pp. 55–56). Thus, according to the IAC model, name retrieval difficulties should be accompanied by deficits in the retrieval of other forms of highly specific biographical information. Cohen's proposal, on the other hand, predicts that the major factor influencing a patient's ability to retrieve biographical information is the 'meaningfulness' of that information.

Clinical details

B.G. is a 68-year-old, right-handed, woman who suffered a brain haemorrhage in 1987. A CT scan taken at the time showed a large area of damage involving most of the left temporal lobe. She initially showed severe amnesic and aphasic difficulties, and a right visual field deficit. Her language and cognitive difficulties have partially resolved, allowing her to live an independent life.

On the full version of the Weschler Adult Intelligence Scale, B.G. obtained a Verbal IQ of 110, and a Performance IQ of 103, producing a full-scale score of 108. B.G. successfully completed all subtests of the Rivermead Perceptual Assessment Battery (Whiting, Lincoln, Bhavnani & Cockburn, 1984), although she failed to perform the 'cancellation', and the 'right to left' copying of words, tasks within the time limits provided. She was also tested on several subtests of the PALPA battery (Kay, Lesser & Coltheart, 1992). Thus, B.G. correctly read aloud all of the words from the PALPA 'reading by letter length test', although her response latencies were markedly affected by word length. Comprehension of text was also good but slow. For example, she correctly identified all of the stimulus words from the 'written word–picture matching tests', and all of the sentences from the sentence comprehension tests, whether presented in written or spoken form. B.G.'s performance on the above subtests of the PALPA suggest that although she appears to have relatively intact access to semantics from text, this is achieved using a letter-by-letter reading strategy.

B.G. shows normal articulation, but in conversation she occasionally experiences mild word retrieval difficulties. On a test of confrontation naming of everyday objects and animals (Ellis, Kay & Franklin, 1992), B.G. was able to produce the majority of names without difficulty. This test consists of 60 line drawings of objects and animals. Twenty of these line drawings are of items with high frequency names, 20 with medium frequency names and 20 with names of low frequency. B.G. correctly named all of the stimuli from the high and medium frequency groups. However, she incorrectly named five of the stimuli in the low frequency group. The errors on the low frequency items suggest that B.G. may have a mild level of impairment moderated by word frequency. Overall, though, B.G.'s object naming capabilities are well preserved.

On the other hand, B.G. performed poorly on several tests of the retrieval of people's names. Thus, she was only able to name 4/40 celebrities from Ellis, Young & Critchley's (1989) famous faces line-up, 5/21 of her friends when presented with photographs of their faces, and 11/30 celebrities from short biographies. However, B.G. was able to provide accurate semantic information, such as a person's occupation, for 162/172 of the famous faces, and for all of her friends. Recall of the names of exemplars from other categories of proper nouns was also found to be

impaired. Thus B.G. was only able to name 5/12 famous landmarks, 2/12 cities, 3/10 cartoon characters when presented with pictorial stimuli, and 3/10 TV programmes from description.

Experimental investigations of face processing

B.G.'s name retrieval abilities can be summarized as comprising relatively spared recall of object names with impaired performance on tests assessing the retrieval of proper nouns. In this respect B.G. is similar to patient P.C. (Semenza & Zettin, 1988) and patient L.S. (Semenza & Zettin, 1989), but unlike L.C. (Lucchelli & DeRenzi, 1992) whose deficits were confined to people's names. Analysis of B.G.'s ability to name photographs clearly indicates that she is able to access at least some semantic information for many of the people and places she cannot name. The following set of tasks examine the extent of biographical information available to B.G. The first and second tests use matching tasks to assess B.G.'s ability to access people's occupations.

1. Matching an occupation to a face

This task consisted of 30 sets of three black and white photographs of the faces of different famous people. Each set contained a photograph of a target celebrity plus two distractor celebrities. Each of the members of the triplets was rated by a group of 10 raters to be of similar familiarity. All non-facial cues to identity were masked. The experiment consisted of 30 trials in which stimuli from each of the sets were presented side by side. The position of the target face was randomized from trial to trial. B.G. was presented with a spoken occupation which corresponded to that of the target face. She was asked to select which of the three celebrities had that occupation. For example, the faces of Brian Clough, Nigel Lawson and Russell Harty, were followed by the question, 'which is the politician?'. B.G.'s performance on this task was faultless.

Several weeks later this task was repeated using names rather than faces. B.G. was presented with a spoken target occupation which was followed by the names of the three celebrities belonging to that set. The names were spoken because of B.G.'s acquired reading difficulties. As before she was asked to select the celebrity that corresponded to the target occupation. Again she produced a faultless performance.

B.G.'s good performance on both the visual and verbal versions of this test indicates that she can access information about occupation from faces and names. As a further test of her ability to access 'general' biographical information B.G. was given a test requiring her to match pairs of faces with similar occupations.

2. Face–pair–occupation matching

This task was made up of two sets of 12 photographs of famous faces. Each photograph was cut so that no clothes or jewellery were showing, but the hair was visible. Each of the sets contained six pairs of celebrities taken from the same profession. For example, Sean Connery and Roger Moore.

The stimuli from each of the sets of photographs were presented, in turn, in a random order in a 3×4 grid. B.G. was asked to point to pairs of people sharing the same occupation. At no time during the task were the names of the stimulus people mentioned by the experimenter or by B.G. Immediately following the matching task B.G. was again presented with the 24 stimulus faces. This time she was asked to try and recall the names of the celebrities.

B.G. carried out the matching test without error. However, she was able to name only 2/24 of the stimulus faces. This again suggests that B.G. is able to access biographical information for people for whom she is unable to retrieve a name.

B.G.'s superior performance on the face-pair test compared to face-naming tests may simply reflect the different cognitive demands of the two tasks. The former test requires access to information

sufficient to match two stimulus items. The latter requires access to enough information to guide an explicit verbal response. In order to test this possibility B.G. was given a task requiring her to match (*a*) famous people who have the same forenames and (*b*) famous people with the same surnames.

3. Matching faces with identical forenames/surnames

This task consisted of two sets of 12 photographs of the faces and hair of famous people. One set contained six pairs of individuals with the same forenames (e.g. James Dean and James Garner) and the other set pairs of people with the same surnames (e.g. Roger Moore and Dudley Moore). Each set was randomly spread out in a 3×4 matrix. For the first set, B.G. was asked to point to pairs of people with the same forename, and for the second set, the same surnames.

In contrast to her errorless performance on the previous matching tests, B.G. failed to match correctly a single pair in either of the name-matching conditions. This finding suggests that there is indeed a distinction between B.G.'s ability to process biographical information and name information. Furthermore, this distinction cannot be accounted for in terms of differences in task demands.

The first two tasks tested B.G.'s ability to retrieve one type of biographical information: occupations. Johnston & Bruce (1990) distinguish between semantic information that can be used to group familiar individuals together—superordinate descriptions or categorical descriptors—and more precise biographical information—subordinate descriptions or property descriptors. Johnston & Bruce give an address, a spouse, or whether somebody is dead or alive, as examples of *property* descriptors and occupation as an example of a *categorical* descriptor.

There is evidence that subordinate (property) information is more vulnerable to brain injury than superordinate (categorical) information (Martin & Fedio, 1983; Warrington, 1975). This raises the possibility that despite B.G.'s preserved ability to retrieve categorical descriptors, demonstrated by the matching tasks, she may be impaired at retrieving property descriptors. The next three tasks examined B.G.'s ability to retrieve more precise forms of biographical information.

4. Semantic classification

Two sets of 12 full-face black and white photographs of famous people were constructed. One set was made up of six politicians and six television hosts; the other, six actors and six comedians. Each set of celebrities was carefully selected so that occupation was not obvious from appearance. All the stimulus faces were judged by 10 independent raters to be highly familiar.

Each group of six celebrities could also be subdivided into smaller groups of three on the basis of more specific semantic information. Thus the politicians could be divided into members of the Labour and Conservative parties, the presenters into chat show hosts and newscasters, the comedians into double and solo acts and the actors into detectives and soap opera characters.

The task consisted of two stages, both of which were carried out in a single test session. In the first stage, B.G. was presented with each of the sets of 12 stimuli in 3×4 matrices. She was asked to divide each of the sets of 12 stimuli into two groups of six according to the categories of politicians, comedians, etc. In the second stage of the experiment, B.G. was presented with the correct groups of six stimuli in 2×3 matrices. She was asked to group the faces together according to the subdivisions of solo/double act, etc. In both parts of the experiment B.G. correctly categorized all 24 faces, except for that of Jim Davison, a British comedian, whom she failed to recognize. These results show that B.G. not only has access to general information about people's occupations but also more specific details about what they do.

The next experiment examined the availability of even more specific information.

5. Semantic probe questions

Warrington (1975) used probe questions to test the ability of two patients with progressive dementing disease to access semantic information about objects and animals. We used the same format to gauge the extent of semantic information available for people that B.G. could not name. Warrington's

questions required a yes/no response, but for the present investigation it was decided that open-ended questions formed a better comparison with name retrieval.

The stimuli consisted of 22 black and white photographs of celebrity faces masked to remove non-facial cues to identity. For each of the 22 stimulus items a series of five semantic probe questions was constructed. Three of the questions assessed retrieval of semantic information that was applicable to a large number of people (i.e. nationality, occupation, and whether the person was dead or alive), while the remaining questions required access to more specific biographical information. Before the test B.G. was told that she would be shown a series of faces and that the presentation of each face would be followed by a series of five questions read *one at a time*. For example, the probe questions for Woody Allen were:

(*a*) Is this person dead or alive?
(*b*) Which country is this person from?
(*c*) For what occupation is this person famous?
(*d*) Name one of this person's films.
(*e*) What scandal has this person recently been involved in?

Immediately after the probe testing session the stimuli were presented again in the form of a picture naming test.

Despite being able to name only two of the 22 stimulus faces, B.G. correctly answered all of the questions (66/66) probing access to 'general' biographical information. On the other hand, accuracy was very much lower for the 'specific' (15/22) and the 'highly specific' questions (16/22). A similar pattern of results was obtained when the test was repeated several weeks later using names as stimuli instead of faces (i.e. B.G. correctly answered 66/66 'general questions'; 12/22 specific questions; and, 16/22 highly specific questions).

These findings can be interpreted as supporting Warrington's (1975) and Burton & Bruce's (1992) notion of the relative vulnerability of attribute information to semantic memory impairment. However, the severity of B.G.'s naming deficit does not seem to fit with her relatively mild problems on the specific and, more importantly, the highly specific probe questions. Burton & Bruce's model predicts that the availability of semantic information should be compromised to the same extent as name retrieval. B.G.'s ability to correctly answer 16/22 of the highly specific semantic probe questions, therefore, could equally be taken as evidence against the IAC model.

An alternative account is that the disparity in B.G.'s performance on the general and specific probe questions is due to differences in the difficulty of the two sets of questions. This interpretation was tested by presenting the pictorial version of the test to B.G.'s older sister. She faultlessly answered all of the general questions but, like B.G., correctly answered far fewer of the specific (14/22) and highly specific (12/22) questions. However, in contrast to B.G.'s naming performance (2/12), her sister was able to name (16/22) of the stimulus celebrities. The pattern of results obtained can therefore be interpreted as arising from the relative difficulty of general and specific probe questions.

The next two tasks further assessed B.G.'s ability to access highly specific ('unique') biographical information.

6. *Access to specific semantic information*

Burton & Bruce (1992) suggest that, depending on the severity of the disruption of the links between Person Identity Nodes and Semantic Information Units, differing amounts of semantic information will be lost. They argue that the most selective form of semantic memory deficit will affect the recall of all types of biographical information that are unique to a single person. Burton & Bruce (1992) note that, although we probably know a lot of unique facts about individuals, this information is often heterogeneous. For instance, we may know someone's telephone number but not their car licence plate. It would be very difficult to incorporate this kind of information into an experimental design. However, there are some examples of easily testable unique information. As well as names, these include unusual birthplaces, great discoveries, spouses, and unusual means of death (Bruce, personal correspondence).

This experiment tested B.G.'s ability to recall 'unique' biographical information. The clear prediction made by the IAC model is that B.G. should be unable to retrieve 'unique' information for people whose names she also cannot retrieve.

A set of black-and-white photographs of the faces of 20 famous people was constructed. One probe question requiring access to unique biographical information was composed for each of the target celebrities. The kind of information sought included famous catch phrases, scandals in which the person had been involved, unusual means of death, and unusual illnesses. For example, the probe question for Salman Rushdie was, 'why was this person in the news?'. Each of the photographs was presented to B.G. and to five control subjects. They were asked: (*a*) to try and recall the person's name; and (*b*) to answer the appropriate probe question. The subjects' responses to these questions were noted and given to a panel of five judges to assess their accuracy.

Control subjects were matched with B.G. for age (mean age 67.6 years) and for the number of celebrities correctly identified by occupation from a set of 30 black and white photographs of their faces (control subjects $M = 24$; B.G. = 27). Other measures used to match subjects with control populations were considered inappropriate since B.G.'s mild anomia ruled out the use of the Graded Naming Test (McKenna & Warrington, 1983) and her reading impairment ruled out the use of the National Adult Reading Test (Nelson & O'Connell, 1978).

B.G. was judged to have correctly answered 15/20 probe questions (see Appendix 1). Conversely, she was able to name only one of the people (Sir Winston Churchill) for whom she could retrieve unique biographical information. In contrast, control subjects performed at comparable levels on the name recall ($M = 13.2$) and semantic probe question ($M = 12.8$) tasks. The pattern of results provided by B.G. clearly do not support the prediction made by Burton & Bruce (1992) that access to all unique forms of semantic information should be impaired.

The next section examined B.G.'s ability to access unique semantic information about people who are personally familiar to her.

7. *Access to unique information about friends*

Photographs were taken of the faces of 11 people all of whom regularly attend a day centre with B.G. Along with B.G., these 11 people sit at the same table every week. Furthermore, each of them occupies the same seat.

B.G. was given these photographs along with a drawing depicting the table and positions of chairs used by them at the day centre. She was asked to position the photographs of her friends in their respective seats. After the sorting task had been completed, B.G. was again presented with the photographs and asked to try and recall either the person's full name or their first name only.

B.G. was able to name only two of her friends. However, she was able to place all of them in their correct positions around the table. This task appears to require person-identity information to be linked with a particular location. As the same seat is always occupied by the same person, the information sought is unique.

However, it is possible that the ability to associate a particular place in a room with a certain person could be mediated by other memory processes, such as the recollection of past conversations for example. The next two tasks examined B.G.'s ability to retrieve other forms of uniquely identifying information.

8. *Describing friends from photographs*

As a result of the possible ambiguity in interpretation of seating positions, we decided simply to ask B.G. to provide as much uniquely identifying information about each of her friends as she could. Burton & Bruce (1992) predict that biographies of people B.G. was unable to name should not contain unique semantic information. In contrast to this prediction, B.G. was able to produce, without prompting, unique information for 8/12 of her friends (see Appendix 2). Thus she was able to identify the longest serving member of the day club, the organizer and the sister of the organizer, all unique pieces of biographical information. Sometimes she could provide several pieces of such information for a particular friend. However, she was able to name only three of them.

Bruce (personal correspondence) and Bruce *et al.* (1994) suggest that a useful test of access to unique information would be ability to retrieve addresses and telephone numbers. This was assessed in the next task.

9. Recall of telephone numbers and addresses of friends and family members

B.G. was presented with photographs of the faces of 10 family members, and 12 friends from a local day club. From each photograph she was asked to state the person's address, and telephone number. In addition, she was shown the photographs and asked to name the people depicted. B.G. gave correct names for all of her family members. However, she was only able to give addresses for 2/10, and telephone numbers for 1/10 of her relatives. In contrast to her faultless ability to recall family names, B.G. was able to name only 3/12 of her friends. Moreover, she could not provide a single address or telephone number. We should add that as well as asking B.G. to recall verbally telephone numbers, we also asked her simply to dial individual numbers, with the same result. Furthermore, B.G. was unable to recall her own number.

In contrast with her ability to provide unique biographical information about her friends, she is unable to recall addresses and telephone numbers for them (and for many of her relatives, indeed, for herself). The latter finding is predicted by Burton & Bruce's (1992) IAC model because the 'uniqueness' of addresses and telephone numbers makes them as vulnerable to impairment as names. This result is even more significant given that B.G. reported that she had a good memory for telephone numbers prior to her stroke.

Discussion

The first two tasks used sorting and matching tests to demonstrate that, although B.G. has severe difficulty in retrieving the names of famous people, she is able to access information about their occupations following presentation both of their faces and names. Task 4 provided evidence of access to more precise details of occupations of celebrities, such as whether a comedian was part of a double act, or worked alone. In contrast, the third task showed that despite access to information about occupations, B.G. is unable to sort famous people into pairs on the basis of whether they share the same name, either forename or surname. These findings can be comfortably accommodated, albeit in different ways, by the accounts of Bruce & Young (1986), Burton & Bruce (1992) and Cohen (1990*a*).

According to Burton & Bruce (1992), difficulties in name retrieval arise because of the relative isolation of names within the pool of 'semantic information units' (SIUs). Names receive less activation from person–identity nodes, or PINs, than other units of semantic information, because names are usually unique to particular people; pieces of semantic information such as, 'this person is a teacher', will be shared by several or many PINs. Thus, Burton & Bruce state that, 'in this account, names behave no differently to other semantic information units which are unique to a particular person' (p. 53). Furthermore, in reinterpreting the pattern of deficits shown by patient E.S.T. (Flude *et al.*, 1989), they suggest that their 'IAC account predicts that he will be severely impaired on retrieval of semantic information which is unique to known individuals' (p. 55). In the remaining tasks given to B.G., we therefore attempted to partial out the effects of uniqueness, by assessing B.G.'s ability to retrieve highly specific and 'unique' information, both about famous people and personal acquaintances. According to Burton & Bruce, B.G. should be impaired in retrieving all types of unique semantic information, including person names. We have shown, however, that B.G. is able to provide unique semantic information about famous people she is unable to name (e.g. that the comedian, Tommy Cooper, died after a heart attack while he was on stage). Furthermore, we have shown that she is also able to state detailed information about individual friends which is highly

specific, and which applies only to one person of her acquaintance (e.g. a woman who had an eye taken out early last year because she had cancer). In Burton & Bruce's terms, retrieval of 'any piece of semantic information unique to a known individual should behave similarly to name retrieval'. In contrast to this view, B.G. is able to produce information that appears to apply uniquely to one person, while still being unable to name the person.

Burton & Bruce suggest that there will almost certainly be some semantic information, unique to individuals, which nonetheless has a very high associative strength (e.g. only one emperor lost the battle of Waterloo). In such cases, it is hypothesized that the link between the person–identity node and the same SIU may have a high connection strength, and thus will be more robust to damage. The information that B.G. can provide is not usually of this type, however, and we do not feel that this account can explain our findings.

Bruce (personal communication) and Bruce *et al.* (1994) suggest that the types of idiosyncratic information that they believe would be useful to try to elicit are addresses, telephone numbers and dates of birth. With this point in mind, it is interesting to note that in accordance with the predictions of the IAC model, Lucchelli & DeRenzi report anecdotally that patient T.L. became unable to retrieve familiar telephone numbers, including his own and that of his daughter (whom he used to ring every day). They note that, 'this failure struck him, because, before his disease, he could remember the numbers of several acquaintances' (p. 222).

We asked B.G. if she could provide addresses and telephone numbers and names for 10 members of her immediate family and for 12 of her friends. Although she could name all her family members, she was unable to produce addresses for all but two, and telephone numbers for all but one. Similarly, for her friends, she was unable to tell us addresses or telephone numbers, and she also showed extreme difficulty in producing their names. Now the question is whether B.G. has simply never acquired this information or whether this ability has been impaired, along with her ability to retrieve proper names. It is, of course, difficult to answer this directly, although B.G. herself states that she used to be good at remembering this kind of information. In this respect, then, B.G. is similar to Lucchelli & DeRenzi's patient, T.L.

It therefore seems likely that, for these two patients, the ability to produce this kind of unique information can be associated with difficulties in proper name retrieval. It is pertinent to consider why. Addresses and telephone numbers are often associated with just one person that we know. As well as having unique associations, however, they also share the fact that they are generally meaningless, arbitrary, lacking in imageability and connotation (with the exception of a few addresses and telephone numbers which have a high association strength, such as 10 Downing Street, 'Pennsylvania 6-5000' and '999'). In these properties, of course, they are very similar to proper names. However, we suggest that it may be possible to distinguish these features to do with meaningfulness, arbitrariness, imageability and connotation from the notion of unique association. Our patient, B.G., does appear to be able to produce uniquely identifying information about people for whom she is unable to produce a name. Such information, although referring to just one person of her acquaintance, is clearly richer in meaning and imageability (and probably other features as well), than names, addresses and telephone numbers. However, B.G.'s

difficulties arise when she is asked to produce the latter sorts of information, which are abstract, and without inherent meaning. In this sense, we agree with Cohen in highlighting the role of meaning in accounting for particular difficulties experienced with proper names.

Bruce *et al.* (1994) clarify the IAC model of naming proposed by Burton & Bruce (1992), by suggesting that it is 'not incompatible with accounts of naming difficulty couched in terms of relative meaningfulness, imageability, frequency or any other properties which would be expected to affect ease of learning, or retrieval, from memory' (p. 13). In these terms, the unique information that B.G. is able to produce reflects the greater number or strength of links within the pool of semantic information units than information that serves a 'pure referring function', such as proper names, telephone numbers and addresses. We agree with Bruce *et al.* that this provides a further reason for names to be especially difficult, without having to conclude that they are represented in a different store.

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Appendix 1. Data from task 6—Access to unique semantic information about famous people. (Information judged to be 'unique' is italicized)

Stimulus	Named?	Question	Response
Woody Allen	No	Why has this person been in the news?	*To do with children. He wants them but so does his wife.*
Michael Heseltine	No	Why has this person been in the news?	*Had a heart attack whilst on holiday.*
Billy Connolly	No	What product does this person advertise?	*Non-alcoholic beer.*
Norman Tebbit	No	What happened to this person's wife?	*Was paralysed in a hotel bombing.*
Tommy Cooper	No	How did this person die?	*Had a heart attack when he was on stage.*
Magnus Magnusson	No	What phrase was this person famous for saying?	*'I've started so I'll finish.' He comes from Iceland.*
Dudley Moore	No	Which company did this person advertise?	Adverts for chickens
John Major	No	What was this person's father's occupation?	A bricklayer
Albert Einstein	No	What theory did this person propose?	Physics
Salman Rushdie	No	What was this man in the news for?	*Because he offended a country with his book and is now in hiding.*
J. F. Kennedy	No	How did this man die?	*Ex-president was shot in US in a car.*
Michael Caine	No	What is this person's catchphrase?	*'Not a lot of people know that.'*
Winston Churchill	Yes	What was this person's speech about the Battle of Britain?	*'We will fight them on the beaches and we will fight them in the air.'*
Mike Tyson	No	What scandal was this person involved in?	Not familiar with stimulus photograph
Paul Daniels	No	What is this person's catchphrase?	No information
Michael Jackson	No	What skin condition does this man claim to have?	*Claimed to have a skin disease to cover up the fact he had bleached his skin.*
Marilyn Monroe	No	What scandal was this person involved in?	*She was involved with the president that was assassinated.*
Humphrey Bogart	No	What phrase was this person famous for saying?	*'Play it again Sam.'*
Leslie Crowther	No	Why has the man been in the news?	*Involved in a car crash and is still suffering from brain damage.*
Dick Emery	No	What catchphrase is this person associated with?	*'You're naughty but I like you.'*

Appendix 2. Data from task 8—Recall of unique information about friends. (Unique is italicized; *** information is removed to prevent identification)

Friend	Biographical information given by B.G.
1	*Organizer of E****** Blind Club.* Deals with writing the reports.
2	Lives in L******* in a bungalow. Not from here. Very good at knitting.
3	When I used to go as a helper to Blind Club her husband and my husband were good friends. Her husband was blind. She lives in L*******. Is officious and well into her 80s.
4	*Sister of the blind organizer.* Turned her house into two flats. Her children always seem to be having children.
5	Gets asthma from dogs which is difficult with the guide dogs. Widowed, lives in a block of flats just across the carpark from the M****** Centre.
6	Highly intelligent woman. *Used to be high up in 'T*******',* the most expensive shop in E******. She is single and is well into her 80s.
7	*Is going on holiday with the D**** Blind Club over Christmas. She is the only person I know who is going. She wears a wig, but has two that are slightly different. When her mother was alive they used to dress identically, and people thought they were twins.*
8	Welsh lady, speaks very quietly, with a strong accent. Has arthritis and also goes to arthritis club. Goes and stays at son's house when they go away and looks after the dogs. Was married and lives by the hospital in E******.
9	Comes from W****. Lost her sight over 40 years ago, when her children were still babies One eye went first and then the other. *She is one of the founder members of blind club and is the longest serving member. Her husband died last February.*
10	*Had an eye taken out early last year because she had cancer.* She now has an artificial eye. *Her daughter owns a bridal shop on the Strand. It's where my daughter got her dress from. She meets her daughter every day for a glass of sherry.*
11	Shouts when talking. Not from around here. Completely blind. *Two years ago she took up ballroom dancing, and now goes twice a week.*
12	A Cornish woman. Has a dog who she spoils. Highly intelligent. Roman Catholic. Blind. Writes lovely poetry, some of which has been in the newspapers. *Often writes about her guide dog. Read out a poem about Christmas last week.* Been on TV several times, *once because of her Cornishness.* Was a nursing sister.