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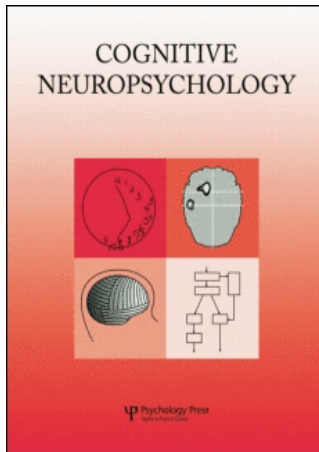
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A QUESTIONABLE SEMANTICS: THE INTERACTION BETWEEN SEMANTIC KNOWLEDGE AND AUTOBIOGRAPHICAL EXPERIENCE IN SEMANTIC DEMENTIA

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In our earlier article, we proposed that recent episodic experiences in patients with semantic dementia support the production of nongeneralisable, autobiographically constrained, “semantic-like” facts (Graham, Lambon Ralph, & Hodges, 1997). We argued that this type of “semantic-like” knowledge was distinguishable from true semantic information because our two patients with semantic dementia showed no facilitatory effect of recent autobiographical experiences on their knowledge of golf and bowls; information which was presumably learnt prior to the onset of their disease. In this paper, we discuss the implications of these results for current views relating to the nature and organisation of long-term memory.

Introduction

Over the last 2 years a number of investigations have documented striking effects of time on tests of autobiographical and semantic memory in patients with semantic dementia. These studies have consistently demonstrated better preservation of recent autobiographical and semantic information compared to memories from the more distant past (Graham & Hodges, 1997; Graham, Lambon Ralph, et al., 1997; Graham, Pratt, & Hodges, 1998; Hodges & Graham, 1998; Snowden, Griffiths, & Neary, 1994, 1995, 1996). The remote memory data from semantic dementia has important implications for our understanding of the or-

ganisation of long-term memory, as it is support for a model of memory consolidation in which the hippocampal complex and the temporal neocortex play separate, yet interactive, roles in the acquisition and storage of episodic and semantic memories (Graham, 1998; Graham & Hodges, 1997; Graham, Pratt, et al., 1998; Hodges & Graham, 1998; Murre, Graham, & Hodges, 1998; Snowden et al., 1996). In this paper, we discuss one aspect of these findings: The role played by current autobiographical experience in supporting the integrity of semantic memory in patients with semantic dementia.

This topic was first investigated by Snowden and colleagues (1994, 1995) in a series of elegant experiments which found that recent autobio-

graphical experience had a beneficial impact on the ability of their patients to produce semantic information about people, places, and objects. In our recent paper, inspired by Snowden et al.'s work, we aimed to clarify this autobiographical effect by investigating whether recent autobiographical experiences would help support semantic knowledge for sports that had been learnt many years in advance of the onset of symptoms of semantic dementia (Graham, Lambon Ralph, et al., 1997). We found that our two patients (AM and MS) possessed extremely impoverished semantic knowledge about the two sports they played regularly and, on the basis of this result, we proposed that it was unlikely that "old," previously learnt, conceptual knowledge was refreshed or maintained by recent autobiographical experiences in semantic dementia. Instead, we suggested that recent autobiographical experiences, dependent upon the hippocampal complex, provided a means of inferring semantic-like information about frequently encountered objects and concepts, despite the progressive deterioration to the semantic system commonly seen in the disorder.

In their reply to our article, Snowden, Griffiths, and Neary (1999, this issue) have raised some important theoretical issues about the interpretation of our data and the nature of the interaction between autobiographical experience and semantic memory in semantic dementia. A number of the points discussed by Snowden and colleagues concur with our paper, so these will only be mentioned briefly here. The main part of this article will concentrate, therefore, on the principal issue raised by Snowden et al.'s reply: Whether our proposed distinction between hippocampally dependent "semantic-like" information and more generalisable neocortically represented semantic knowledge is really necessary and/or valid.

Familiarity Judgements in Semantic Dementia

AM and MS were able to select as familiar the names of people who were currently and personally relevant (e.g. current golfing and bowls partners) on

a test in which they had to match a first name to a surname (an effect we termed *implicit* recognition; Graham, Lambon Ralph, et al., 1997). This result is compatible with data published by Snowden et al. (1994), in which their patients with semantic dementia also recognised current and personally relevant names as more familiar than names that were no longer personally relevant. Further studies by ourselves, and Snowden and colleagues, have expanded upon this result using famous names, revealing that patients with semantic dementia are more likely to select current famous names as familiar than those from the more distant past (Hodges & Graham, 1998; Snowden et al., 1996).

Our use of the term *implicit* recognition in this context referred solely to the ability of patients with semantic dementia to point to a name as familiar in the circumstances in which they possessed little *explicit* semantic knowledge about that person. This effect is best demonstrated in a study in which four patients with semantic dementia were tested on recognition (familiarity) and identification (knowledge) of famous names selected from four time-periods (Hodges & Graham, 1998). While the patients were able to recognise some of the names (from all time-periods) as familiar, they produced virtually no semantic information about the people used in the test (see figs. 2 and 3, Hodges & Graham, 1998). In Graham, Lambon Ralph, et al. (1997) and Hodges and Graham (1998), we argued that the locus of this effect is at the level of person identity nodes (PINS), which are thought to subserve familiarity judgements in face and name processing, and that it does not, in our opinion, reflect an impact of autobiographical experience at the level of semantic knowledge.

The results suggest that the ability of a patient with semantic dementia to make familiarity judgements about people is affected by autobiographical experience and that, for a number of reasons, personal autobiographical experience is more influential than media-based autobiographical experience (see Graham, Lambon Ralph, et al., 1997, for more details). This hypothesis explains why patients with semantic dementia may show virtually perfect recognition of personally and currently relevant names, yet more impaired recognition of the names

of people who are currently famous (Graham, Lambon Ralph, et al., 1997; Hodges & Graham, 1998; Snowden et al., 1994, 1996).

Autobiographical Experience and Vocabulary Production in Spontaneous Speech

Snowden et al. (1994, 1995) noticed that their patients with semantic dementia produced vocabulary in spontaneous speech, which was unexpected given the patients' poor performance on formal tests of picture naming. By contrast, our two patients with semantic dementia, AM and MS, rarely produced unusual low-frequency vocabulary in their spontaneous speech. In our General Discussion, therefore, we discussed four possible explanations for the contradictory findings: (1) effects of autobiographical experience at the level of the phonological representations; (2) greater damage in the right versus left temporal lobe; (3) the impact of additional post-semantic deficits; and (4) the ability to relearn "forgotten" vocabulary (see Graham, Lambon Ralph, et al., 1997, p. 830–831). Snowden et al. (this issue) reach similar conclusions to ourselves in their reply and add a fifth reason; that additional frontal lobe damage may impair vocabulary production.

Overall, it seems that none of the explanations discussed in the literature provides a single satisfactory account for the presence or absence of unusual vocabulary in patients with semantic dementia. Furthermore, it is most likely that the aforementioned factors may influence vocabulary breakdown and preservation differentially in individual patients with the disease. For example, one of our patients with semantic dementia (DM), when given a word definition task, classified animals according to whether they are mammals, reptiles, or molluscs. For three reasons, the presence of these words in his speech was extremely surprising: (1) DM had never, over 2 years of being tested, previously produced these words; (2) these were extremely "unusual" terms given his level of anomia in spontaneous speech and on neuropsychological tests of word production; and (3) he seemed to possess little semantic knowledge about these terms, to

the extent that, on a significant number of occasions, he used them inappropriately (e.g. referring to a *lion* as a "reptile"). In DM, there is empirical evidence that his ability to produce new and unusual vocabulary is probably related to relearning of words and phrases, rather than any of the other possible explanations mentioned above. A detailed study of category exemplar relearning in this patient found that his word production significantly benefited from home practice with notebooks and picture dictionaries, although when he ceased practice, he showed a rapid loss of his newly acquired vocabulary. There was little evidence from the study, although this was not tested directly, that DM also acquired new semantic knowledge about his recently learnt words (Graham, Patterson, Pratt, & Hodges, in press). In summary, therefore, further research at a single-case level will be necessary before we can draw firm conclusions about the factors that may combine to influence vocabulary production in semantic dementia.

Explicit Knowledge of Golf and Bowls

Our two patients (AM and MS) failed to show preserved semantic knowledge about people with whom they played golf and bowls and for words/phrases commonly used in their sport. These results suggest that AM's and MS's current autobiographical experiences, while enabling them to describe the events that occurred during a recent golf or bowls game (albeit anomically), were not helping them retain factual information about friends or sporting terms encountered during matches. This data initially seems incompatible with that published by Snowden and colleagues (1994), who found evidence of better semantic knowledge about current and personally relevant people compared to those from the patient's more distant past. Part of the reason for the difference between the two studies is clarified by Snowden et al.'s (this issue) reply and stems from the different methods of scoring used by the respective groups. Snowden et al. (1994) adopted a more lenient criterion, considering responses, such as "I don't know where that is" about a place as correct. Nonetheless, despite the differences in scoring methods, AM and MS still

produced information about fewer personally and currently relevant people (6/35) than Snowden et al.'s patients.

We also found no evidence that AM was able to place golf courses on a map of Britain. Snowden et al. suggest that the golf courses test was not an appropriate method for investigating AM's knowledge of golf and propose that our prediction that he would show better performance on the golf courses compared with cities would only have been true if, (1) AM had more personal experience of the golf courses compared to the cities, islands, and areas; and (2) the comparison between golf courses and cities, islands, and areas was matched for level of difficulty. These are important considerations that would influence the performance on our tests.

It is worth repeating here, therefore, that during his lifetime AM had played on all the golf courses used in our experiment and, at time of study, played on two of these courses at least once a week. He was *unable* to put either of these two places correctly on the map. By contrast, all our control subjects, many of whom had never played on AM's golf courses, correctly placed the most famous of these two golf courses. Furthermore, all of our control subjects correctly noted the golf courses that were geographically closest to them, which suggests that AM's inability to locate the two golf courses he frequented was abnormal.

In summary, therefore, we believe that there is little evidence that AM's and MS's semantic knowledge about golf/bowls, which was initially acquired by each patient at least 10 years prior to our study and presumably represented in the neocortex, was influenced or maintained by their repeated autobiographical experiences.

Procedural Memory in Semantic Dementia

In Graham, Lambon Ralph, et al. (1997), we discussed briefly how procedural memory may have supported AM's and MS's ability to play their sports at a reasonable level, despite their poor

explicit knowledge of golf and bowls on our tests. Perhaps it is not surprising that AM and MS still possessed good procedural memories for the complex motor skills necessary to drive a ball in golf or a wood in bowls: we presume that these motor skills are learnt over many years and that the motor schemata which support a good level of play are represented in areas of the brain unaffected by their disease. It is important to note, however, that one has to interpret the evidence about AM's and MS's preserved sporting skills with caution, at least until we have further experimental evidence.

Snowden et al. (this issue, p. 681) raise a related, but rather different, question in their reply: "Could preserved procedural knowledge explain the findings of a significant autobiographical experiential effect in our own patients?". The authors subsequently dismiss this possibility in favour of their semantic account, describing an intriguing situation in which their patient KE retrieved her kettle from the bathroom so that she could make tea, rather than use an unfamiliar kettle which was in the appropriate location in the kitchen (p. 681). Snowden and colleagues suggest that if good procedural memory was based on autobiographical experience, then context rather than "ownership" would have been more important. In which case, KE would have used the unfamiliar kettle rather than replacing it with her own, an action that suggests "semantic recognition" of the function of her own kettle but not of the unfamiliar alternative.¹

This example illustrates the fundamental difference in Snowden et al.'s and our approach. While Snowden et al. believe that KE has shown preserved explicit semantic information about her kettle, we would argue that the patient's behaviour is a clear demonstration of the opposite effect, whereby KE's action reveals the extent to which she *lacks* semantic information about all kettles: KE's constrained knowledge of her kettle is very different from the type of generalisable, abstract knowledge she once would have possessed about kettles. Furthermore, we would have proposed that the "information"

¹ As an aside, it is interesting to note that KE did show a significant effect of context, identifying more of her own objects in the correct location than in an incongruous location: This result suggests that both ownership and context influenced KE's ability to identify objects (see Snowden et al., 1994, p. 281).

exhibited by KE was more episodic in nature, rather than semantic, because it probably reflected learning an association between a perceptual representation of an object (her kettle as opposed to any other kettle), a particular motor skill (the action of making tea) and a specific context (the kitchen). As this issue—the nature of the semantic knowledge possessed by patients with semantic dementia—seems to be the main area of controversy between Snowden et al. and ourselves, the remainder of the paper will be a detailed consideration of this point.

A Question of Semantics

Part of the problem in resolving the differences in interpretation between Snowden et al. and ourselves relates to the fact that “semantic memory” is, in fact, a poorly defined concept. In particular, we know relatively little about the way in which we acquire and store new semantic information through our episodic experiences. The data from semantic dementia addresses this issue: In our 1997 paper, we found no evidence that recent autobiographical experiences facilitated semantic knowledge that must have been acquired many years prior to the onset of the disease, but that such episodes did seem to support the production of highly abnormal, constrained, sometimes incorrect, facts about frequently encountered objects and words/phrases (Graham, Lambon Ralph, et al., 1997). We felt it was theoretically interesting to highlight the difference between these two types of information, one of which was neocortically represented and seemed, at least in semantic dementia, *independent* of episodic experience, and another that was hippocampally mediated and, therefore, *dependent* upon repeated autobiographical experiences. In general, although Snowden et al. and ourselves agree that a critical role is played by the hippocampal system in the preservation of recent autobiographical memories and semantic-like information in semantic dementia (Graham & Hodges, 1997; Hodges & Graham, 1998; Snowden et al., 1996; Graham, Pratt, et al., 1998), we differ in our interpretation of the nature of the recent semantic-like information produced by patients with the disease.

So why did we propose (Graham, Lambon Ralph, et al., 1997) that the “semantic-like” information possessed by patients with semantic dementia was more episodic in nature than semantic? First, and most importantly, our understanding of the term semantic memory is that it refers to a knowledge base which comprises information that is shared by many people, is often abstract in nature, and is typically generalisable across similar items (e.g. all kettles can be used to boil water). By contrast, episodic memories are particular to an individual and do not generalise: whereas components of one event may overlap with another, they always relate to a separate time (and often place) of occurrence. From the examples included in Snowden et al.’s reply (and the clinical impression we have gained from patients with semantic dementia) it seems reasonable to suggest that the information produced by patients with the disease is more closely akin to episodic memory than it is to semantic memory. For example, KE’s knowledge of her kettle was specific to her kettle only and to no other kettle; WM’s knowledge of oil was constrained only to “Charringtons”; and BS’s *unusual* knowledge of a clothes-peg was that it was used to keep cereal packets shut. As the information possessed by these patients is highly specific, nonabstract, and nongeneralisable, we believe that it is confusing to equate it with the more general semantic knowledge these three patients should have possessed about kettles, oil, and clothes pegs.

Given the constrained and specific nature of the semantic-like information seen in semantic dementia, we argued in Graham, Lambon Ralph, et al. (1997) that this “knowledge” was a part of autobiographical memories rather than a component of semantic memory. Snowden et al. query this suggestion and point out, quite rightly, that sometimes there is *no* obvious temporal and spatial link between the knowledge the patients possess and the episode in which it was learnt. This is a fundamental and complicated issue, as one of the defining characteristics of semantic memory is that it “is not tied to a particular temporal and spatial context” (Snowden et al., this issue, p. 682). This statement is, of course, somewhat of a paradox: It is unlikely that the majority of our semantic knowledge is

acquired in an episodic vacuum and so at some point(s) in our life, certainly in childhood, semantic knowledge must be acquired, either explicitly or implicitly, via our autobiographical experiences². As we grow older and establish a more stable, abstract semantic knowledge base, autobiographical experience increasingly comprises familiar objects, concepts, and facts for which we now possess neocortical representations. It seems reasonable to assume that our autobiographical experiences, at this stage, influence this system in two ways: (1) strengthening existing semantic representations within the temporal neocortex; and (2) facilitating the acquisition and interleaving of new semantic knowledge (e.g. about people, public events, new hobbies, etc.) with previously acquired semantic memory (see McClelland, McNaughton, & O'Reilly, 1995, for more details concerning computational reasons for a slow, as compared to fast, semantic learning system in the human brain). It is clear from Snowden et al.'s reply that they possess a similar theoretical view.

Of interest here, however, is the interaction between autobiographical experiences and semantic memory in semantic dementia. If we view the damage in semantic dementia as a progressive loss of connectivity within the temporal neocortex, there are three predicted effects from the view briefly discussed earlier (see Murre et al., 1998, for more details): (1) a progressive deterioration to our stores of remotely acquired semantic and episodic memories with better preservation of more recent memories (see Graham, Lambon Ralph, et al., 1997; Graham, Pratt, et al., 1998; Hodges & Graham, 1998; Snowden et al., 1996); (2) reduced, or no, strengthening of existing semantic representations (AM and MS showed no benefit from recent autobiographical experiences for their knowledge of golf

and bowls, despite clearly recalling recent trips to the golf course or bowls rink; Graham, Lambon Ralph, et al., 1997; and (3) increasingly impoverished consolidation of new semantic and episodic memories into the neocortex via the hippocampal complex. Patients with semantic dementia will, therefore, become highly reliant upon their hippocampally mediated episodic memories: As increasing numbers of objects and animals, concepts and facts become unfamiliar to the patients throughout the progression of the disease, so there will be less input to the hippocampus from the semantic system and the more dependent the patients will become on other nonsemantic sensory inputs (see next section for more detail). The peculiar, autobiographically constrained "semantic-like" knowledge exhibited in patients with semantic dementia is illustrative of their dependence upon these hippocampal memories, and there are two pieces of evidence that we believe supports our hypothesis.

First, on some occasions a patient shows a clear link between their new "semantic-like" knowledge and an episodic experience. For example, a patient (GCB) was asked, on two separate sessions, to produce definitions to a spoken word and a picture. When given the spoken word, "rhinoceros", GCB responded, "I can't think what a rhinoceros is? Rhinoceros? Don't know what a rhinoceros is?". A week later, GCB was shown a picture of a rhinoceros and responded, "Oh gosh, I saw those the other day on television. What's it called? They have little babies whose bones don't grow until they are about a year old. And quite often on the television, these ones used to fight with the other males like this, and kill them. Yes. They were quite old. A lot of them died when the chap had used those horns on the top. Under their necks, under their ... it was awful when they did it." It is evident from this transcript

² It is beyond the scope of this article to discuss in more detail current theories relating to the acquisition of semantic knowledge in normal subjects and amnesic patients. Nonetheless, data from amnesic patients suggests that some types of semantic knowledge can be acquired without explicit recollection of a learning episode (Kitchener, McCarthy, & Hodges, 1998; Vargha-Khadem, et al., 1997), while other patients are support for a view in which recollective episodic memory is a necessary prerequisite for the acquisition of semantic information (Verfaellie, Croce, & Millberg, 1995). In the future, a greater understanding of the separate roles played by neuro-anatomical structures in the hippocampal complex in the acquisition of semantic knowledge will enable us to interpret the data from semantic dementia more carefully (see Aggleton & Brown, in press). In the meantime, we have to accept that, in some circumstances, a patient may be able to acquire semantic information despite little, or no, recollection of the learning episode(s) (Vargha Khadem et al., 1997).

that GCB acquired some new semantic knowledge about rhinoceri from a set learning episode, the television programme she watched 3 days earlier (see also the example in Graham, Lambon Ralph, et al., 1997, p. 818).

The second piece of evidence that reveals the episodic nature of recent "semantic-like" knowledge in semantic dementia was also evident from the example described above: After a couple of weeks GCB was no longer able to produce any information about a rhinoceros, even when shown a picture. GCB is not the only patient with semantic dementia who shows this unusual and rapid loss of newly acquired semantic information: Snowden et al. (this issue) report that their patient LB lost his "semantic" knowledge about how to eat eggs after a 3-week respite and we have reported rapid loss of relearned vocabulary in a single case of semantic dementia (Graham, Patterson, et al., in press). The vulnerability of recent "semantic-like" knowledge in semantic dementia is support for the idea that this type of semantic memory is reliant upon recent autobiographical experiences, even in circumstances where it is not possible for the patient to recall the exact learning episode. Intuitively it is clear that semantic knowledge, even when it is part of a neocortical repository, is not permanently represented: Areas of knowledge that we may have learnt well at university or school, such as pharmacology, physiology, etc., are either lost or become inaccessible when we are no longer exposed to facts related to that topic. The point we are making here, however, is that this type of neocortically represented semantic knowledge is presumably not lost at the seemingly rapid, and inefficient, rate documented for the "semantic-like" information possessed by patients with semantic dementia. Elsewhere, we have explained the increased forgetting effect for "semantic-like" information by proposing that the hippocampal system, upon which patients become increasingly reliant, is of limited capacity and sensitive to interference from new events. In normal subjects, the overwriting of hippocampal memories is usually partially countered by cortical consolidation, which becomes increasingly impaired in semantic dementia (see Murre et al., 1998, for more details).

Sensory Input Hypothesis

In the General Discussion of our 1997 article, we proposed that the hippocampal complex receives direct inputs from higher-order sensory cortices as well as the areas of the brain dedicated to the representation of long-term memories (e.g. semantic knowledge). This hypothesis was suggested to explain why we found no evidence of an autobiographical effect, at least in our patients, at the level of neocortically dependent semantic knowledge: Multiple inputs to the hippocampal complex could support the formation of episodic memories via novel conjunctions of sensory information, even when semantic memory was severely impoverished. In their response to our paper, Snowden et al. contest some aspects of this view. In particular, they do not believe that episodic memories can be formed from combinations of nonsemantic information and propose that "if the information available to a patient has no semantic content then it is difficult to see how patients succeed in behaving so remarkably normally in relation to ongoing events, since each sensory experience would be entirely novel" (this issue, p. 685). Snowden et al. seem to be assuming that it is not possible to talk meaningfully of episodic memories when there is impaired semantic interpretation of autobiographical experiences (i.e. that episodic memory is dependent upon semantic memory, Tulving, 1983, 1995). The sensory input hypothesis proposes that semantic knowledge, or the semantic interpretation of sensory inputs, is only one of many components that contribute to the formation of an episodic memory and that, in normal subjects, information from meaning works in concert with other sensory inputs (e.g. higher-order perceptual information, knowledge about spatial relationships, motor actions, etc.) to support new learning. Of course, episodic memory, by definition, comprises spatial and contextual information about an experienced event: The sensory input hypothesis proposes that, in addition to these components, preserved perceptually based episodic memory is sufficient to allow patients with semantic dementia to interact effectively with objects and people that they frequently encounter, even in the circumstances where little or no semantic

information is possessed about these objects and people, etc. This view predicts that, in the event of damage to the semantic system, new learning may still be possible through the creation of hippocampally mediated "nonsemantic" links, and that this ability to remember what happened the day before, or week before, etc., provides a substrate from which patients with semantic dementia can make limited, but "meaningful" inferences about the world.

There is now support for this proposal from recent experiments in semantic dementia, which have manipulated the relationship between targets shown at study (naming) and pictures used in a subsequent delayed recognition memory test. When targets were perceptually identical between study and test (i.e. the same picture of a telephone was presented for all tasks), patients with semantic dementia showed relatively preserved recognition memory (Graham, Becker, & Hodges, 1997; Graham, Simons, Pratt, Patterson, & Hodges, 1998). We proposed that new learning was not affected by the breakdown of semantic memory in this condition because there was sufficient perceptual information about the target, even for items with degraded semantics, to support the episodic judgement. By contrast, in a perceptually different task, in which a push-button telephone seen at study was replaced with a round-dial telephone at test or a sitting owl was replaced with a flying owl, patients were severely impaired (Graham, Simons, et al., 1998). Furthermore, in this condition the patients were less likely to select an item as one they saw previously if they possessed degraded semantic information about that item: The episodic decision was no longer able to be supported by perceptual information and now required additional semantic information about the target. It is important to note that the deficit on the perceptually different condition was not caused by a high-level perceptual impairment that interfered with the patients' ability to perceive objects from different views: All eight patients showed normal performance when asked to select which two photographs (out of three) represented the same object from different orientations (Humphreys & Riddoch, 1984).

At this point, it is interesting to comment on the similarity of these findings from recognition memory to those described by Snowden and colleagues (1994, 1999) for object use. Snowden et al.'s patient, KE, was able to use her kettle appropriately despite possessing no explicit semantic knowledge about this item. When another kettle, which was perceptually different to her own, was placed in the kitchen, however, she did not know the function of the novel kettle. In our new learning study, we demonstrated that, although degraded semantic memory does not affect an episodic judgement about whether a perceptually identical item is one seen previously, it does affect the ability to link a perceptually different representation of the same item to a previous autobiographical episode. It is striking that KE showed such a similar pattern for object use, a fact which stresses again the idea that KE does not possess semantic knowledge *per se*, only that KE has learnt a particular association between an object (her kettle) and an action (tea making). It is precisely this context-dependent associative learning which has been attributed to the hippocampal system (see Aggleton & Brown, in press; Vargha-Khadem et al., 1997). It is interesting to speculate that if KE's kettle was replaced by a new one, that she would learn to associate this new kettle, and no longer her old kettle, with the action of making tea.

The results from the new learning studies are strong support for the proposal initially raised in Graham, Becker, et al. (1997; Graham, Lambon Ralph, et al., 1997) that hippocampal inputs from higher-order sensory areas in the brain can support normal nonverbal episodic memory in semantic dementia, even when degraded semantic knowledge is possessed about an item. We believe, therefore, that inputs to the hippocampal complex from areas in the brain other than those subserving semantic memory provide sufficient *nonsemantic* information in semantic dementia to encode aspects of recent experiences, which in turn support the production of autobiographically constrained "semantic-like" facts about, and the appropriate use of, frequently encountered objects, animals, and concepts. This information is "semantic-like" rather than semantic because it is unlikely to be part

of the patient's repository of semantic knowledge (as suggested by the results from Graham, Lambon Ralph, et al., 1997); it is *not* generalisable across similar semantic instances, it is highly reliant upon continuing autobiographical experience, and it is extremely labile in nature. More specifically, we propose that recent autobiographical experiences provide a scaffold from which it is possible for patients with semantic dementia to infer superficial knowledge about the objects, actions, animals, and people comprising those episodes. Over time, progressively poor memory consolidation, in combination with a deterioration to the semantic system, will result in the patient becoming increasingly reliant upon the semantic inferences afforded by repeated recent autobiographical experiences.

In summary, many of the points raised by Snowden et al.'s reply to our article (and their other papers) are important and deserve a great deal of thought. While we disagree on the nature of the "semantic-like" knowledge exhibited by patients with semantic dementia and the validity of distinguishing between different types of semantic information, it is clear that studies of long-term memory in patients with semantic dementia are of great theoretical interest to memory researchers (see Murre et al., 1998) and that future empirical investigations will provide further insights into the nature of the relationship between episodic and semantic memory.

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