Episodic memory and autonoetic consciousness: a first-person approach

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Episodic memory is identified with autonoetic consciousness, which gives rise to remembering in the sense of self-recollection in the mental re-enactment of previous events at which one was present. Auto-noetic consciousness is distinguished from noetic consciousness, which gives rise to awareness of the past that is limited to feelings of familiarity or knowing. Noetic consciousness is identified not with episodic but with semantic memory, which involves general knowledge. A recently developed approach to episodic memory makes use of 'first-person' reports of remembering and knowing. Studies using this approach have revealed many independent variables that selectively affect remembering and others that selectively affect knowing. These studies can also be interpreted in terms of distinctiveness and fluency of processing. Remembering and knowing do not correspond with degrees of confidence in memory. Nor does remembering always control the memory response. There is evidence that remembering is selectively impaired in various populations, including not only amnesic patients and older adults but also adults with Asper-ger's syndrome. This first-person approach to episodic memory represents one way in which that most elusive aspect of consciousness, its subjectivity, can be investigated scientifically. The two kinds of conscious experiences can be manipulated experimentally in ways that are systematic, replicable and intelligible theoretically.

Keywords: episodic memory; semantic memory; autonoetic consciousness; noetic consciousness; remembering; knowing

1. NEW CONCEPTS AND A FIRST-PERSON APPROACH

It is almost thirty years since Endel Tulving introduced the concept of episodic memory and contrasted it with semantic memory (Tulving 1972). Episodic memory corresponded roughly with autobiographical memory, i.e. with memory for personally experienced events, remembered as such. Semantic memory corresponded roughly with knowledge of the world, without any autobiographical context. Thus, I can well remember the last time I visited Paris, and having a particularly self-indulgent dinner at a famous brasserie on the left bank. But if asked what is the capital of France, I may simply say 'Paris' without experiencing any personal recollections of the many times I know I have been there. Memory for the dinner is episodic. Knowledge that Paris is the capital of France is semantic, as is knowledge that I have visited Paris many times in the past.

In introducing this distinction, Tulving (1972) was making the point that up until that time the experimental study of memory had been essentially confined to the study of episodic memory. Standard laboratory tasks involved presenting lists of verbal materials and then asking subjects to recall or to recognize the materials to which they had been exposed. This does not test know-ledge of the materials but memory for their occurrence in a particular personal context: that of the experiment. Thus, initially, the concept of episodic memory was

closely identified with certain kinds of memory tasks, in contrast with other tasks that were being introduced at that time which involved tests of general knowledge.

In *Elements of episodic memory*, Tulving (1983) introduced new concepts of episodic and semantic memory. Instead of being defined in terms of a distinction between memory tasks, these new concepts were defined in terms of memory systems. The proposal was that episodic and semantic memory corresponded with functionally distinct, though overlapping, mind–brain systems. Moreover, Tulving suggested that a defining property of these mind–brain systems was the phenomenal subjective experience that accompanied retrieval from them. He proposed a distinction between two kinds of consciousness, which he termed autonoetic (self-knowing) consciousness and noetic (knowing) consciousness. Autonoetic consciousness is a defining property of episodic memory. It is expressed in experiences of mental time travel, as in the mental rein-statement of personal experiences of previous events at which one was present. Noetic consciousness is expressed without any such self-recollection but simply in awareness of familiarity, of knowing. In a clear departure from previous usage and from common parlance, Tulving used the term 'remembering' to refer to expressions of auto-noetic consciousness and the term 'knowing' to refer to expressions of noetic awareness. Thus, in what follows, the words 'remember' (or 'remembering') and 'know' (or 'knowing') are used in this restricted, technical sense to refer to the two subjective states of awareness. Used in this

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sense, I remember that particular dinner, but I know that Paris is the capital of France and that I have been there many times.

A year or two later, Tulving (1985) showed that subjects could readily understand the distinction between the two kinds of awareness and could report them, using remember and know responses. For example, he asked subjects to study a list of words which were then re-presented for a recognition test, randomly mixed with other unstudied words. For each test word, subjects first made a 'Yes or No' decision about whether it had appeared in the study list. If the decision was 'Yes', then subjects additionally responded with 'remember' or with 'know'. A remember response meant that they could consciously recollect something they experienced at the time that word was studied. A know response meant that they could not do that, but recognized the word 'on some other basis' (see Tulving 1985, p. 8). In most subsequent research using this paradigm, that 'other basis' has been defined more specifically. For example, subjects are often instructed that for a know response they must be confident that the test word was in the study list because it gives rise to strong feelings of familiarity in the experimental context (see Gardiner & Richardson-Klavehn 2000). This definition of knowing emphasizes feelings of familiarity that are associated with a recent but unremembered occurrence, as distinct from 'just knowing' in the sense that one just knows that Paris is the capital of France. Though this phenomenological difference is not unimportant, knowing in each sense is an expression of noetic rather than autonoetic consciousness (see Conway *et al.* 1997; Gardiner & Conway 1999).

From a conventional point of view, recognition decisions are objective (third-person), and remember–know judgements are subjective (first-person). On this view, these two successive stages in the remember–know paradigm cross the boundary between data that are open to science and data that are not. But I think this view is mistaken not only in the light of all the evidence, as I shall shortly illustrate, but even in principle. The objective accuracy of remember and know judgements can be just as readily checked as can the accuracy of the recognition decisions into which they summate. Moreover, it is possible to check that remember and know judgements have been made in a valid way by asking subjects to describe the bases of those judgements, after they have been made.

Gardiner *et al.* (1998) described a database of descriptions of remember and know judgements elicited after the recognition test had been completed. Two such remember and know judgements were randomly selected for each of the forty-eight subjects in the experiment. The descriptions provided for remember responses always included specific contextual details connected with the study-list presentation of the test word. Examples included, for the word 'president', 'Yesterday I associated this word with the word "minister". Today I automatically remembered that association', and, for the word 'harp', 'On Friday I was in a restaurant with a harpist. I remember thinking of that yesterday.' In contrast, descriptions of know responses never included such detailed contextual information. Examples included, for the word 'gun', 'I just know that I knew it' and, for the word 'butterfly', 'It was just one of

those words that rang a bell'. Such post-test checks are useful in supporting the inference that subjects are using remember and know responses according to instructions. Converging evidence for the validity of remember and know responses has also been provided by studies of 'source memory', e.g. by showing that subjects are able to judge with some accuracy presentation details such as relative position or spatial location for items they claim to remember but not for items they claim to know (see Perfect *et al.* 1996; see also Mather *et al.* 1997).

In the fifteen years or so since Tulving's (1985) initial demonstration that subjects could use remember and know responses to report autonoetic and noetic awareness of memory, a great many studies have made use of the remember–know paradigm, especially in recognition memory tasks. These studies have been directed at a number of questions. The most general question concerns the extent to which remembering and knowing can be dissociated by different independent variables. More specific theoretical issues include the extent to which alternative processing frameworks can account for the evidence, the relation between remembering, knowing, and confidence or trace strength, and the relation between remembering, knowing and conscious control of the memory task. There is also the question of how remembering and knowing might differ in different populations. The remainder of this review provides illustrative evidence relating to each of these issues.

2. SOME GENERAL EFFECTS OF INDEPENDENT VARIABLES

Illustrated in table 1 are results from four different experiments. The first column of data shows the overall proportions of correct recognition scores, which are then partitioned between proportions of correct remember and know responses in the second and third columns. The experiments have been chosen to illustrate four possible kinds of relationship between remembering and knowing. Error data are not shown but do not affect these relationships. The first experiment is a level-of-processing experiment (Gardiner *et al.* 1996, experiment 1). In the semantic condition, when each studied word was presented, subjects had to produce a meaningful associate of the word. In the graphemic condition, when each studied word was presented subjects had to produce any two letters not present in the word. This difference in level of processing had a very large effect on correct recognition performance and this effect occurred in remembering, not in knowing.

In the conditions shown from the next experiment, study/test modality was manipulated (Gregg & Gardiner 1994, experiment 2). Subjects either studied words presented visually and then the words were presented visually in the recognition test, in an identical format, or subjects studied words presented visually and then the words were presented auditorially in the recognition test. Following normal study conditions, recognition performance is not usually much affected by this same versus different study/test modality manipulation, as indeed we showed in other conditions in this experiment. But the data shown here were from unusual study conditions that had a perceptual focus and were intended to prevent

Table 1. *Examples of functional relations between remembering and knowing in recognition memory.*

(Proportions of correct responses only.)

variable	condition	overall	remember	know
level of	semantic	0.90	0.72	0.18
processing	graphemic	0.35	0.15	0.20
study/test	visual/visual	0.63	0.11	0.52
modalities	visual/auditory	0.37	0.10	0.27
materials	words	0.44	0.28	0.16
	non-words	0.49	0.19	0.30
study trials	three	0.69	0.37	0.32
	one	0.35	0.14	0.21

more meaningful, elaborative encoding. The words were presented very rapidly and subjects were led to believe that the experiment was concerned with visual perception, not with memory. They were told to count the number of words in the list in which some of the letters were blurred and to report this number at the end of the list. It was emphasized that they did not have to remember the actual words, only keep track of the number. In fact, none of the words had any blurred letters in them, as subjects duly reported. Following these unusual study conditions there was quite a large effect of same versus different study/test modality. This effect, however, occurred in knowing, not in remembering.

The third experiment was one in which subjects studied a mixed list of words and pseudo-words, or non-words, under usual learning conditions (Gardiner & Java 1990, experiment 2). The words and non-words were all one syllable long and pronounceable, though they were presented visually. Here, there was very little effect of the manipulation on overall recognition performance. But the manipulation did have quite a strong effect on the reported states of awareness. Words gave rise to more remembering than knowing. Non-words gave rise to more knowing than remembering.

The last experiment was one in which subjects heard melodies taken from English or from Polish folk songs presented vocally, as single line melodies, without words (Gardiner & Radomski 1999). The subjects themselves were either English or Polish and they were very familiar with the melodies from folk songs in their own culture. The melodies from the other culture were foreign to them and sounded not merely novel but rather strange. Both English and Polish subjects heard both English and Polish melodies either presented once or three times in succession before the recognition test. The scores in table 1 show the effect of study trials for the melodies that were strange to the subjects, the Polish songs for the English folk, and the English songs for the Polish folk. Three study trials, compared with one, increased overall recognition substantially. But here the effect occurs not only in remembering but also in knowing. Interestingly, this parallel effect of increased study trials on remembering and knowing occurred only with the strange melodies. Additional study trials with subjects' own folk songs increased remembering but did not increase knowing.

Thus some independent variables affect remembering but not knowing. Other independent variables affect knowing and not remembering. Still others affect remembering and knowing in opposite ways and some affect remembering and knowing in parallel ways. Functionally, then, these two subjective states of awareness are independent in the sense that they are susceptible to this pattern of experimental manipulation.

In Tulving's (1983, 1985) theory, events have first to be registered in the semantic system before they can be registered in the episodic system; they can be stored in parallel in both systems and retrieval from both systems is independent (see Tulving 1995). If remembering and knowing, respectively, reflect retrieval from episodic and semantic systems this evidence clearly implies that both systems contribute to recognition memory. Just as certain autobiographical facts are known as such—I know I have visited Paris many times without any remembrance of a particular visit—so too can study list events be known to have occurred without any remembrance of them. Indeed, under certain conditions, such as those in the experiment by Gregg & Gardiner (1994), recognition memory may largely reflect the semantic rather than the episodic system. Presumably, the unusual study conditions in that experiment were sufficient to allow encoding into the semantic system but largely precluded encoding into the episodic system. Encoding into the episodic system seems to depend on the more conscious elaboration of meaning, as is also suggested by the other findings illustrated in table 1.

These findings did not, of course, stem from any strong tests of that hypothesis or, more broadly, even of the interpretation of them provided by the distinction between episodic and semantic memory. Rather, this interpretation is supported by other kinds of converging evidence, which includes evidence from amnesic patients (for a discussion of some of this evidence, see Mishkin *et al.* 1998; Squire & Zola 1998; Tulving & Markowitsch 1998). It also includes evidence from recent studies of patterns of brain activity. This evidence points clearly to both temporal and spatial differences in activations associated, respectively, with remembering and knowing (e.g. Curran 2000; Düzel *et al.* 1997; Eldridge *et al.* 2000; Henson *et al.* 1999).

3. AN ALTERNATIVE PROCESSING FRAMEWORK

At a cognitive–behavioural level, an alternative processing account of remembering and knowing has been developed by Suparna Rajaram (Rajaram 1993, 1996). This approach is complementary to the systems approach; it does not contradict it. Nor has research been much concerned in contrasting the two approaches within any given experiments. Rather, this processing account provides another framework for integrating the various findings, one that has the advantage of allowing quite specific predictions about the conditions that are likely to influence the two states of awareness.

The initial proposal (Rajaram 1993) was that the two states of awareness mapped onto a distinction between conceptual processing and perceptual processing (see e.g. Roediger *et al.* 1989). Early evidence did seem to support this possibility. Conceptual variables like level of

processing were found to influence remembering. Perceptual variables like same versus different study/test modality were found to influence knowing. More recently, however, a number of studies have shown that there are perceptual variables that influence remembering (e.g. Rajaram 1996) and conceptual variables that influence knowing (e.g. Mantyla 1997). The relationship between the process distinction and the states of awareness therefore now seems to be more of an orthogonal one. Rajaram (1996) revised this processing account and proposed instead that remembering depends largely on the distinctiveness of the processing, which could be more or less distinctive, either conceptually or perceptually, and that knowing depends largely on processing fluency, which could be more or less fluent, either perceptually or conceptually. By this account, a deeper level of processing leads not only to more conceptual encoding but also to more distinctive encoding. Such distinctive encoding is more difficult to achieve in the unusual study conditions used by Gregg & Gardiner (1994), or for non-words compared with words, or for melodies from a foreign musical culture. Following those sorts of conditions the study list encounter is more likely to increase the fluency with which studied items are perceived in the test, and hence affect knowing rather than remembering.

One of the findings that led to the distinctiveness–fluency framework had to do with recognition memory for pictorial materials, specifically for line drawings of familiar everyday objects (Snodgrass & Vandervart 1980). Picture recognition memory is affected by size congruence at study and at test. If there are larger and smaller versions of the same picture, then presenting the picture in the same size at study and test leads to higher recognition than presenting the picture in different sizes at study and test. Rajaram (1996) found that this perceptual manipulation of size congruence occurred in remembering but not in knowing. Presumably, the distinctiveness of picture encoding is likely to be more fully reinstated at test when the picture at test is the same size as the picture at study.

An orthogonal view of the relationship between the states of awareness and the kind of processing, however, suggests that if encoding conditions were impoverished, hence reducing the opportunity to achieve distinctive encoding, then the same effect might influence processing fluency. If so, the effect might then occur partially, or even wholly, in knowing (compare with Gregg & Gardiner 1994).

We investigated this possibility in an experiment that replicated Rajaram's (1996) experiment but used photographs of faces rather than pictures of everyday objects (Gardiner *et al.* 2001*a*, experiment 2). The faces were presented for study in one of two sizes, a larger or a smaller version. At test, half the faces were presented in the same larger or smaller size, and half in the alternate size. To manipulate encoding, subjects were given a level-of-processing task. For deeper processing, subjects had to rate the reliability of the person (1 = very reliable; 5 = very unreliable). For shallow processing, subjects had simply to report whether the face belonged to a female or to a male person. The results are shown in table 2.

The overall scores are shown in the first row of the table. These scores show clear effects of level of

Table 2. Proportions of recognition responses as a function of level of processing and size congruence.

response category	reliability rating			gender assignment		
	same size	different size	un-studied	same size	different size	un-studied
overall	0.76	0.53	0.10	0.43	0.23	0.09
remember	0.54	0.33	0.04	0.12	0.10	0.04
know	0.22	0.20	0.06	0.31	0.13	0.05

processing and of size congruence. Recognition was higher following reliability ratings and it was higher when the faces were presented in the same size at study and at test. Reports of the states of awareness, however, reveal a more complex pattern. Following the reliability ratings, the effects of size congruence occurred in remembering which replicates the results found by Rajaram (1996). Following gender assignment, however, the effects of size congruence occurred in knowing, not in remembering. Thus, in keeping with the processing framework, similar effects may occur either in remembering or in knowing, depending on encoding conditions. If those conditions foster more distinctive processing, the effects are likely to occur in remembering. If those conditions largely preclude more distinctive processing, the effects are likely to occur in knowing.

Of course, these findings can also be accommodated within the systems framework. The effects of encoding conditions may influence the relative ease, or difficulty, of encoding events into the episodic system. Encoding into the episodic system may depend on the distinctiveness of the encoded event and the amount of attention paid to it.

This result has been replicated in another experiment on the size congruence effect (Gardiner *et al.* 2001*a*, experiment 1), but it is not known whether similar results might be found for other kinds of effect. They might be restricted to certain kinds of perceptual effects. In line with that possibility, Curran & Hildebrandt (1999) showed that remembering is greatly reduced by alcohol but that a level-of-processing effect did not as a result then appear in know responses. That result too suggests that the appearance of the size congruence effect in know responses was not simply due to the lower level of performance in the more impoverished encoding conditions, rather than due to the qualitative nature of the encoding. Nor have lower levels of performance been shown to lead to the appearance in knowing of other effects that have been found normally to occur in remembering (see e.g. Dewhurst & Anderson 1999; Gardiner & Radomski 1999). Further evidence on this problem is clearly desirable.

But, for now, the important point is that the size congruence effect itself, as distinct from its influence on subjective awareness, was quite unaffected by level of processing. And this is the first demonstration that, at least under some circumstances, exactly the same effect (rather than two different effects, such as those illustrated

in table 1) may occur independently either in remembering or in knowing.

4. REMEMBERING, KNOWING AND CONFIDENCE

Remembering and knowing must clearly be related to confidence in memory. Indeed, Tulving (1985, p. 10) had suggested that 'the adaptive value of episodic memory and autonoetic consciousness lies in the heightened subjective certainty with which organisms endowed with such memory and consciousness believe, and are willing to act upon, information retrieved from memory.'

In contrast with the idea that it is subjective states of awareness that give rise to varying degrees of confidence in memory, it has also been suggested that the subjective states of awareness might be explained in terms of confidence (Donaldson 1996; see also Hirshman & Master 1997; Inoue & Bellezza 1998). On this view, remembering and knowing do not reflect different sources of memory, but different response criteria for the same memory trace. Remember responses reflect stricter response criteria; know responses reflect more lenient response criteria. Using these assumptions, it is possible that remembering and knowing could be accounted for by a signal detection model that provides separate estimates of the strength of the memory trace and of response criteria.

For example, Donaldson (1996) described a meta-analysis of some eighty different experimental conditions from remember–know studies and used this database for some critical tests of a detection model. A crucial prediction for this model is that the strength of the memory trace should be the same whether estimated from only remember responses (the strict criterion) or from remember-plus-know responses (the more lenient criterion, that is, overall yes–no recognition). In a re-analysis of Donaldson's (1996) database, Gardiner & Gregg (1997) showed that, though the differences were small, memory strength was consistently greater when estimated from know and remember responses than when estimated from only remember responses. Moreover, estimates of memory strength have been shown sometimes to be considerably higher when know responses are added to remember responses in individual experiments. This is the case in the conditions from the Gregg & Gardiner (1994) study in table 1, and also in the conditions from the Gardiner *et al.* (2001*a*) study in table 2 (for details, see Gardiner & Gregg 1997; Gardiner *et al.* 2001*a*). These tests of the model indicate that know responses do reflect an additional source of memory.

A number of studies that have directly compared results obtained from remember and know responses with results obtained from confidence judgements have found different patterns of results for the two kinds of responses (e.g. Gardiner & Java 1990; Parkin & Walter 1992; Rajaram 1993). These findings show that remember and know responses are not equivalent to confidence judgements. One example of this is shown in table 3. The data here are for the words and non-words in the second experiment by Gardiner & Java (1990), together with data for the same words and non-words in a third experiment. This third experiment was identical to the second experiment in all respects except for the test instructions. Instead of being instructed for remember and know

Table 3. Proportions of recognition responses for words and nonwords as a function of response category.

response category	studied		unstudied	
	words	non-words	words	non-words
remember	0.28	0.19	0.04	0.03
know	0.16	0.30	0.11	0.12
sure	0.33	0.39	0.13	0.07
unsure	0.28	0.28	0.22	0.22

responses, subjects were instructed to give binary confidence judgements, 'sure' and 'unsure'. With these confidence judgements, the proportions of correct responses form quite a different pattern. In contrast with remember and know responses, sure and unsure judgements did not differ much between the words and the non-words. Notice too that the proportion of sure judgements for studied non-words was considerably higher than the proportion of remember responses.

Compared with remember and know responses, sure and unsure judgements seem to have induced more lenient response criteria, as indicated by the relatively high proportions of unsure judgements to unstudied words and non-words. But similar kinds of outcomes would be observed for know responses if subjects elected to use know responses as if they were unsure confidence judgements instead of reports of noetic awareness. Subjects could use know responses in this more strategic way (Gardiner *et al.* 1997; Strack & Forster 1995). Indeed, noetic awareness could be completely obscured if know responses were used as if they were unsure confidence judgements and response criteria were very lenient and subjects responded 'yes' to many of the unstudied items.

Most remember–know studies have controlled for this by strongly emphasizing that know responses are not low confidence judgements and by discouraging guessing. In quite a few recent studies, another approach to this problem has been adopted. In addition to reporting remember and know responses, subjects are also instructed to report guesses. Guesses are defined as having some other reason to believe, or suspect, that a test item was encountered in the study list—some reason other than remembering or knowing. Such reasons might include strategies based on memory for the proportions of studied to unstudied items in the test, or on memory for a particular category of items that was studied, such as names of musical instruments, rather than for the particular instances from that category that were presented.

Following Donaldson (1996), we have recently put together another database of some eighty-six different experimental conditions from remember–know studies (Gardiner *et al.* 2001*b*). All of these conditions included guess responses, as well as remember and know responses. None of these conditions appeared in Donaldson's (1996) database; no condition in his database included guess responses. Thus our database is completely independent of his. Also, in our database we replicated the finding that memory strength was significantly greater when estimated from know and remember responses than when
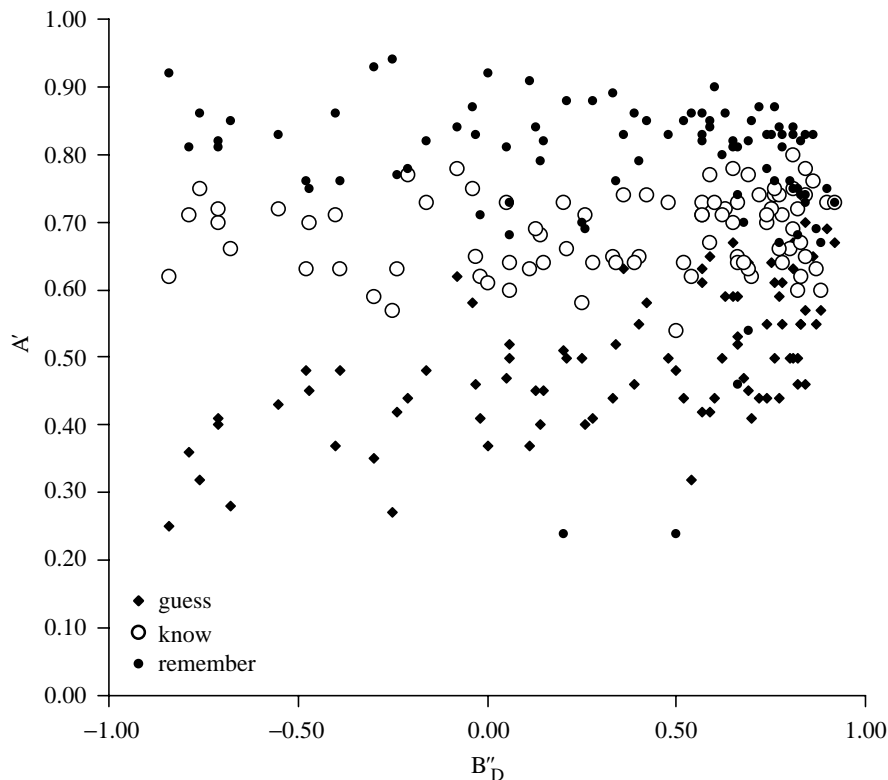
Figure 1. Separate A′ estimates of memory from remember, know and guess responses as a function of overall recognition response criteria, B″$_D$.

estimated from only remember responses. In addition, in our database, when guess responses were added to remember and know responses, the estimated strength of memory slightly but significantly decreased.

The reason for this is shown in figure 1, where, following Donaldson (1996), the strength of the memory trace is estimated by the A′ values plotted against the vertical axis. These A′ values were here estimated separately (not cumulatively) for remember responses, for know responses and for guess responses. They indicate the extent to which each of the different kinds of responses, taken alone, reflects memory for the studied lists. An A′ estimate of 1.0 represents perfect memory; 0.5 represents chance. Along the horizontal axis, these A′ estimates are shown as a function of overall yes–no recognition response criteria, moving from the most strict response criteria on the right to the most liberal response criteria on the left.

Note that not only A′ estimates for remember responses but also A′ estimates for know responses were consistently and appreciably above chance. Also, neither remember nor know responses were correlated with yes–no recognition response criteria. Guess responses, however, on average did not differ from chance and they fell away to well below chance as response criteria become more lenient. They did so because as yes–no response criteria become more lenient, there tended to be more guesses for unstudied than for studied items. Thus, there was a significant positive correlation between yes–no response criteria and guessing. Donaldson (1996) predicted, and

found, just such a correlation between yes–no response criteria and knowing in his database. We found no such correlation for knowing, but instead found the correlation in guessing. The implication is that the correlation in Donaldson's (1996) database did not reflect noetic awareness, but guessing. Thus, our results provide further evidence that the detection model does not fit remembering and knowing.

There are other difficulties in an approach of this kind. These include its lack of explanatory value and the question of whether such an approach to trying to understand the subjective states of awareness measured by remember and know responses is even appropriate methodologically. It is hard to see much explanatory value in the concept of trace strength, or how an approach based on this concept could accommodate the evidence from amnesic patients and from studies of brain activation. Also, as Tulving (1985) suggested, it is surely the subjective state of awareness that gives rise to confidence in memory, not confidence that gives rise to the state of awareness. Methodologically, tests of the detection model require response criteria to be manipulated, but manipulating response criteria risks invalidating remember and know responses as measures of autonoetic and noetic awareness. The main point made here, however, is that even if it is accepted at face value, without taking such broader considerations into account, this trace strength model does not fit the data, except under exceptional circumstances (for more discussion, see Gardiner 2000; Gardiner & Conway 1999; Gardiner *et al.* 2001*a*).

There is a final cautionary note. Although some studies have shown dissociations between remember and know responses and confidence judgements (e.g. Gardiner & Java 1990), some other studies have found evidence of convergence between these two kinds of data (e.g. Yonelinas *et al.* 1998). It is possible that evidence of such convergence may simply mean that remember and know responses (particularly know responses) are being used as confidence judgements.

5. REMEMBERING, KNOWING AND CONSCIOUS CONTROL

In another approach to recognition memory, strong assumptions are made about the relation between subjective states of awareness and conscious control. This is a dual-process model that distinguishes between two independent processes: recollection and familiarity (e.g. Jacoby 1991; Mandler 1980). It is additionally assumed that recollection is a relatively slow, effortful process, depending on conscious control, and that familiarity is a relatively fast, automatic process, not dependent upon conscious control. And the processes of recollection and familiarity have also been assumed to give rise to the corresponding subjective states of awareness, as measured by remember and know responses (see e.g. Jacoby *et al.* 1997).

A useful way of at least partially separating the relative contributions of recollection and familiarity to recognition memory is provided by a response deadline procedure in which subjects are trained to respond rapidly to each test item after either a short or a long response deadline. For example, Toth (1996) trained subjects to respond at one of two response deadlines. The shorter deadline was 500 ms after the presentation of the test item. The longer deadline was 1500 ms after the presentation of the test item. On the given signal to respond, subjects then had to make their yes–no recognition decision within 400 ms. The training phase involved a lexical decision task unrelated to the recognition memory experiment and it was interpolated between the presentation of the study list and the recognition test.

The argument is that at the shorter response deadline recognition will depend largely on the faster, more automatic, familiarity process. With the longer response deadline, recognition will depend more on the slower, more effortful, recollection process. Using this procedure, Toth (1996) found that at the shorter but not at the longer response deadline, there was an effect of same-versus-different study-test modalities, rather like the effect found by Gregg & Gardiner (1994) shown in table 1. This sensitivity of the speeded recognition decisions to perceptual match at study and test supports the argument that they largely reflected the familiarity process. Toth (1996) also found that there were level-of-processing effects at the shorter, as well as at the longer, response deadlines. That level-of-processing effects occurred at both deadlines suggests that familiarity, as well as recollection, is influenced by conceptual processing.

In contrast with the assumed effects of level of processing on the familiarity process, level-of-processing effects have not generally been found in know responses (see table 1). Toth's (1996) findings raised the question of whether level-of-processing effects might be found in

Table 4. Proportions of recognition responses as a function of level of processing and response deadline.

response category for each delay (ms)	studied				unstudied	
	semantic		phonemic			
	500	1500	500	1500	500	1500
overall	0.56	0.77	0.48	0.59	0.12	0.13
remember	0.43	0.59	0.28	0.32	0.01	0.02
know	0.09	0.15	0.10	0.21	0.05	0.07
guess	0.04	0.03	0.10	0.06	0.06	0.04

know responses at shorter response deadlines. More generally, they raised the question of how shorter and longer response deadlines relate to remembering and knowing. For example, one might expect that know responses should predominate at the shorter deadline and remember responses should predominate at the longer deadline. Similarly, one might expect that remember but not know responses should increase considerably with the longer deadline.

Table 4 summarizes the results from an experiment designed to test these predictions (Gardiner *et al.* 1999, experiment 1). The semantic study task was to rate the ease of generating an associate of each studied word. The phonemic study task was to rate the ease of generating a rhyme for each studied word. Replicating the results obtained by Toth (1996), the overall recognition results show that there were level-of-processing effects at both the shorter and the longer response deadlines. However, these level-of-processing effects occurred only in remember responses, even at the shorter deadline. Know responses did not show any level-of-processing effects, nor did they predominate at the shorter response deadline. In fact, both know and remember responses increased at the longer compared with the shorter deadline. As table 4 shows, there were also guess responses in this experiment, though guessing was discouraged in the test instructions in order to avoid any speed–accuracy trade-off. (False alarm rates were similar at each response deadline.) There was also little difference between the proportions of guess responses to unstudied and studied words.

Because the two processes of recollection and familiarity are assumed to be independent, the raw proportions of know responses underestimate the familiarity process. In an 'independence remember–know' model (see e.g. Jacoby *et al.* 1997), the recollection process is estimated by the proportions of correct remember responses (there are usually extremely few incorrect remember responses). However, the familiarity process is given by dividing the proportion of correct know responses by 1 minus the proportion of correct remember responses. Applying this model to the data in table 4 gives familiarity estimates of 0.16 and 0.14 for the semantic and phonemic conditions at the shorter response deadline. For the longer response deadline, the corresponding familiarity estimates are 0.37 and 0.31. Thus, even with this independence remember–know model, familiarity estimates do not show level-of-processing effects at the shorter deadline, nor do they

indicate that recognition at the shorter deadline largely reflects the familiarity process.

These findings, among others (for more discussion see Gardiner 2000; Gardiner & Richardson-Klavehn 2000; Richardson-Klavehn *et al*. 1996), support the conclusion that remembering and knowing do not correspond with recollection and familiarity processes as conceived in this dual-process model. Granted that the longer response deadline allows more conscious control, it then seems that knowing, as well as remembering, increases with conscious control. Conversely, granted that the shorter response deadline allows less conscious control, it then seems that remembering, as well as knowing, can occur in a relatively automatic way.

There are situations other than speeded recognition in which remembering does not seem to control the memory response. For example, there is evidence, both at a behavioural level and at the level of brain activity, of dissociations between retrieval volition and memorial awareness, i.e. between whether or not subjects consciously intended to retrieve studied words and their awareness that some of the words retrieved were studied (e.g. Java 1994; Richardson-Klavehn & Gardiner 1996; Richardson-Klavehn *et al*. 2000). This evidence shows awareness of memory in incidental (or 'implicit') tests, such as word-stem completion, under circumstances in which it can be shown that there was no conscious intention to retrieve words from the study list, only to retrieve the first words brought to mind by the incidental retrieval instructions and test cues (for a review, see Gardiner *et al*. 2001*c*).

The general conclusion is that remembering should not be identified with conscious control in the way that it has been in some theoretical models.

6. REMEMBERING AND KNOWING IN ADULTS WITH ASPERGER'S SYNDROME

There is considerable evidence that remembering and knowing differ systematically in certain special populations compared with the normal population. Most of this evidence relates to amnesic patients compared with matched controls and to older adults compared with younger adults. In both amnesia and in normal ageing, remembering is substantially reduced, if not, in some cases, essentially absent (see e.g. Tulving *et al*. 1991). In contrast, knowing has been found to remain relatively unimpaired in amnesia, with one or two exceptions (e.g. Knowlton & Squire 1995), and in old age.

There is also some evidence that a reduced capability for autonoetic consciousness is characteristic of some other problems that—unlike amnesia, or the effects of normal ageing—have not traditionally been thought of in connection with memory impairment. It has been discovered, for example, that schizophrenia is associated with a reduction in autonoetic awareness. Huron *et al*. (1995) found that schizophrenic patients showed impaired recognition memory in their remember responses but not in their know responses.

We have recently begun to investigate remembering and knowing in another population—adults with Asperger's syndrome (Bowler *et al*. 2000*b,c*). Asperger's syndrome is now regarded as part of a wider spectrum of

Table 5. *Proportions of recognition responses for adults with Asperger's syndrome and for a matched control group.*

item and response category	Asperger group (n = 10)	control group (n = 10)
true targets:		
overall	0.68	0.79
remember	0.51	0.72
know	0.17	0.07
false targets:		
overall	0.28	0.46
remember	0.27	0.43
know	0.01	0.03
non-target lures:		
overall	0.06	0.08
remember	0.01	0.03
know	0.05	0.05

autistic disorders. This syndrome includes problems common to the wider spectrum, such as problems in social communication, an inability to relate fully to others, and to understand fully what is required, or what is meant, in a given social situation. Its distinguishing characteristics are the lack of any evidence of impaired language function and the existence of intellectual abilities that fall within the normal range. Adults with Asperger's syndrome have also been observed to display remarkably good rote memories for highly specialized information, such as bus or train timetables.

There have been relatively few experimental studies of memory within the autistic spectrum and most of these have been of memory in children rather than in adults. For example, Boucher & Warrington (1976) found that, unlike matched controls, children with autism were unable to make much use of category relations among studied words (compared with unrelated words) to improve their recall. Bowler *et al*. (1997) replicated this finding in adults with Asperger's syndrome. There is also some evidence of poorer source monitoring in children with autism, in that they have been found to recall more words from previously studied lists, rather than from the currently studied list, than matched controls (Bennetto *et al*. 1996). However, Farrant *et al*. (1998) did not find evidence of poorer source monitoring when children with autism had to identify which of two experimenters had spoken the words from a study list.

In contrast with evidence of impaired free recall and source memory in individuals with autism, there is little evidence of significant memory impairment in cued recall and in recognition, at least in high-functioning individuals, including adults with Asperger's syndrome. For example, Bowler *et al*. (1997) found that both word-stem completion and word-stem cued recall were unimpaired in adults with Asperger's syndrome. And in two different experiments, Bowler *et al*. (2000*b,c*) found no significant impairments in recognition. The absence of any significant impairment in recognition, however, does not necessarily mean the absence of any impairment in autonoetic awareness. A decrease in remember responses can

sometimes be offset by an increase in know responses (see e.g. Blaxton & Theodore 1997).

Table 5 summarizes some results from the experiment by Bowler *et al.* (2000*c*, experiment 2). The adults with Asperger's syndrome in this experiment were individually matched with subjects in a control group by age and verbal intelligence quotient (IQ). The average age of both these adults and those in a control group was about 27 (range 21–35), and their verbal IQ scores were on average about 87 (range 79–133). The experiment used a version of a converging-associates paradigm introduced by Deese (1959) and subsequently developed by Roediger & McDermott (1995). This paradigm has been widely used to study false recall and false recognition—'illusions' of memory for items that were not actually presented in the study list.

In our experiment, subjects studied five sets of nine words. Each set consisted of the nine next most highly associated words for three other words that were not presented. For example, one set might be 'frigid, chilly, heat, weather, hot, air, shiver, arctic, frost' for the three non-presented associates 'winter, ice, wet'. Words within sets were blocked at study and each set was presented in succession. In the test, the words were randomly ordered and there were true and false targets. The true targets were three words that had been presented in each of the nine associated sets. The false targets were the three non-presented associates for each of the nine sets. Illusions of memory occur to the extent that subjects recognize the false targets. These illusions can be compelling— Roediger & McDermott (1995) showed that they tend to occur more in remember than in know responses.

Thus, the experiment was also designed to determine the extent to which adults with Asperger's syndrome are susceptible to illusions of memory. Other populations have been found to be differentially susceptible. For example, there is some evidence that amnesic patients are less susceptible to memory illusions (Schacter *et al.* 1996) but that adults become more susceptible to them with normal ageing (Schacter *et al.* 1997).

Remember and know responses were defined somewhat more abstractly in this experiment as 'type A' and 'type B' memories (see also Bowler *et al.* 2000*b*) and the subjects explained their remember and know responses after they made each recognition decision. This enabled the experimenter to monitor subjects' understanding and use of these responses online, throughout the test. There was no evidence from this monitoring procedure, or from the explanations given for remember and know responses, that the adults with Asperger's syndrome were using these responses any differently from subjects in the control group.

First, in table 5, consider overall recognition of true targets, the associates that were actually presented. Recognition is somewhat lower in the adults with Asperger's syndrome, though not significantly so. However, they made significantly fewer remember responses, and more know responses, than did the matched control subjects, replicating results found by Bowler *et al.* (2000*b*). Consider next false recognition of those associates that were not presented. Both groups show quite high levels of false recognition, the control group more so than the adults with Asperger's syndrome,

though that difference was not significant statistically either. And in contrast with veridical recognition, false recognition in each group was essentially restricted to remembering.

Additional signal detection analyses of these data, of the sort described earlier in this paper (§ 4), confirmed that overall A' estimates of memory strength, for both true and false targets, did not differ significantly between groups. They were, however, significantly higher for overall recognition (remember-plus-know responses) than for remember responses alone. Nor were there any between-group differences in the corresponding estimates of response criteria.

Some conclusions from this experiment are obviously qualified by the implications of the relatively small group sizes, which mean that failure to find significant differences must be accepted with caution. In contrast with our results, Beversdorf *et al.* (2000) found that high-functioning adults with autism (the distinction between the various forms of autism spectrum disorder was not clear in this group) showed significantly less false recognition in a similar converging associates paradigm. (They found no significant between-group differences in recognition of true targets.) However, in a free recall experiment Bowler *et al.* (2000*c*, experiment 1) also found no significant between-group differences in the false recall of non-presented associates, despite significantly lower recall of presented associates in the adults with Asperger's syndrome. Further evidence is needed to establish whether or not adults with Asperger's syndrome really might be less susceptible to memory illusions of this kind.

The evidence of reduced autonoetic awareness in adults with Asperger's syndrome does not suffer from this limitation. Thus the main conclusion is that there is indeed episodic memory impairment in adults with Asperger's syndrome. In terms of the distinctiveness– fluency framework, it seems that adults with Asperger's syndrome are less likely to encode items in an elaborative, distinctive way, and hence may be more likely to rely on processing fluency in recognition memory. We are currently evaluating some hypotheses as to the reasons for this impairment, including the possibility is that it may reflect attentional problems, both at encoding and at retrieval (Bowler *et al.* 2000*a*). More broadly, it may be that reduced autonoetic awareness in adults with Asperger's syndrome may have consequences for their self-awareness generally, and be related to their difficulties in goal-directed and social behaviour.

7. CONCLUSIONS

In this paper, I have illustrated a first-person approach to understanding episodic memory and consciousness, as exemplified by the remember–know paradigm. Episodic memory is identified with autonoetic awareness, measured by remember responses. Semantic memory is identified with noetic awareness, measured by know responses. Both memory systems may contribute to performance in episodic memory tasks. I have illustrated the approach by making five main points:

(i) Remembering is readily dissociable from knowing, particularly in recognition memory.

(ii) Remembering and knowing can also be interpreted within a distinctiveness or fluency of processing framework.

(iii) Remembering and knowing do not correspond with differences in confidence in memory or trace strength.

(iv) Nor does remembering correspond with conscious control of the memory task.

(v) Populations in which remembering is impaired include adults with Asperger's syndrome.

At a much broader theoretical level, it is necessary to abandon the old view of consciousness and memory that distinguished only between conscious and non-conscious forms of memory (for a review, see Toth 2000). Instead, there is a need for finer distinctions within consciousness, as evidenced by the distinction between remembering and knowing. There is also a need to distinguish between these different kinds of memorial awareness and consciousness in the sense of conscious control of the task. Remembering does not control the memory response either in speeded recognition or in some incidental tests of memory.

This approach also demonstrates one way in which the subjectivity of conscious experience, long thought to be intractable to science, can be tackled scientifically. Doing this depended on classifying conscious experiences into at least two different natural kinds, autonoetic and noetic, that could then be manipulated experimentally. It also depended on treating these natural kinds at the level of populations of experiences, not at the level of individual experiences, which are inevitably idiosyncratic. Other classifications of subjective conscious experiences of memory are undoubtedly possible and may even prove more useful, in the longer run, than this one. But they will have to retain these two essential features. And the ultimate fate, theoretically, of any such classification, including this one, will depend more on the convergence of three major sources of evidence—behaviour, mind and brain—than on any one or even any two such sources of evidence considered in isolation.

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