11 Self-Knowledge of an Amnesic Individual is Represented Abstractly

Endel Tulving
Rotman Research Institute of Baycrest Centre and University of Toronto

At first glance, the problem that Klein and Loftus (chapter 1, this volume) set for themselves seems to be intractable: How can one possibly gain valid knowledge about the nature of representation of information stored in memory solely on the basis of observations of its retrieval? Because retrieval depends on a large number of complexly interacting variables, Klein and Loftus' problem seems analogous to that of seeking a unique solution of a single equation with a number of unknowns. The approach they adopted—relying on the technique of conceptual priming—is ingenious. Their results, consistent across experiments, look convincing; their case tightly argued.

The major conclusion that Klein and Loftus draw from their study is that long-term trait knowledge about the self is represented primarily in abstract, summary form, and that recollection of specific behavioral instances exemplifying traits plays at best only a secondary role in determining a person's trait knowledge of the self. The second conclusion is that behavioral exemplars and abstract trait knowledge are represented in memory independently: Accessibility of one has no implications for the accessibility of the other.

This chapter examines these conclusions in light of observations made about trait self-knowledge of a man who, because of brain injury, cannot remember any specific behaviors in which he has ever engaged, and who therefore does not possess any autobiographical knowledge of the self. What is his trait self-knowledge like?

The answer to the question is relevant to Klein and Loftus' theory. If a person's knowledge of his or her traits is inseparable from, or computed from, specific autobiographical memories, then a person who has no such memories should have a rather different trait conception of him or herself than others have

of him or her. In the limiting case the person might have *no* conception of him or herself at all: How could the individual know what his or her traits are, if he or she has no access to any relevant evidence? If, on the other hand, self-knowledge is represented in abstract or summary form, then the person's self trait conception would depend on the extent to which he or she is capable of acquiring, storing, and retrieving such abstract knowledge, even in the absence of any specific autobiographical recollections.

These issues are examined in light of observations of K. C., a 40-year-old man who, in a motorcycle accident in 1981, suffered closed-head injury, which had two consequences relevant to the issues at stake: (a) it rendered him severely amnesic, and (b) it changed his personality.

This chapter consists of four parts: (a) discussion of the distinction between episodic and semantic memory, (b) description of K. C. and his cognitive status, (c) report of a small study of K. C.'s trait knowledge of himself, and (d) discussion of the implications of the results of the study for the issues at hand. The four sections are followed by a summary.

EPISODIC AND SEMANTIC MEMORY

Students of memory distinguish among five major categories of learning and memory, or memory systems. The five are *procedural* memory, perceptual *priming*, *short-term* memory, *semantic* memory, and *episodic* memory. Each of the five systems is large and complex, comprising a number of subsystems for which evidence at the present stage of our knowledge is of variable quality (Tulving, 1991; Tulving & Schacter, 1992). The ordering of the major systems in the overall classification scheme corresponds roughly to their presumed developmental sequence, with the procedural system the earliest, and the episodic the latest. The ordering of the systems also reflects the conjectured relations among the systems: The operations of the higher ones depend on, and are supported by, the operations of the lower systems, whereas lower systems can operate essentially independently of the higher ones.

The two forms of memory relevant to the present discussion are semantic and episodic. Broadly speaking, semantic memory has to do with knowing, episodic with remembering (Tulving, 1989). Abstract or summary representation of traits can be identified with the semantic system, whereas trait-relevant behavioral memories and autobiographical knowledge about the self can be identified with the operations and functioning of the episodic system.

Semantic memory (also referred to as *generic memory*, *factual memory*, or *knowledge memory*) is concerned with acquisition, retention, and use of organized information in the broadest sense; its principal function is cognitive modeling of the world. A good deal of the semantic knowledge a person possesses may be about oneself. Such "personal semantic" memory (Cermak & O'Connor, 1983), or the "third-person" knowledge (Olson & Astington, 1987; Velmans, 1991) that one has of oneself is comparable with the third-person knowledge that one possesses about others, and is acquired, stored, and retrieved according to the same principles that govern the processing of all other information mediated by the semantic memory system. Third-person knowledge of oneself, however, is different from "first-person" knowledge of oneself, which is based on episodic, or "true" autobiographical, memory.[1]

Episodic memory shares many properties with semantic memory—and depends on semantic memory for many of its operations—but it also uniquely transcends the range of the capabilities of semantic memory (Tulving, 1987; Tulving, Hayman, & Macdonald, 1991). Episodic memory enables the individual to remember personally experienced events in subjective time as embedded in a matrix of other personal happenings. One's recollections of personal experiences that happened 10 minutes ago, or the day before, or in the more distant past depend critically on episodic memory. Such recollection is expressed in a unique kind of conscious awareness, referred to as autonoetic consciousness (Tulving, 1985, in press).

An important point in the present context is that semantic knowledge can be acquired, stored, and retrieved independently of, or even in the absence of, the episodic memory system, although typically, with normal adults, episodic memory frequently enhances the operations of semantic memory. Evidence in support of this hypothesis is derived from various sources, including studies of amnesic patients such as K. C. (For further discussion, see Tulving, in press, and Tulving et al., 1991).

AMNESIC PATIENT K. C.

K. C. was born in 1951. He grew up in a professional family near Toronto. After graduating from high school, he enrolled in a 3-year business administration course at a community college, graduating at age 25. During this time he lived at home with his parents and younger siblings. Family members and friends describe him from that time as a normal, active, outgoing, and gregarious person. The accident responsible for K. C.'s present condition occurred in 1981, at age 30. While riding his motorcycle home from work he went off the road at high speed, and suffered extensive closed-head injury. He was unconscious for several days, remained in an intensive care unit for 4 weeks, and spent over 6 months in

[1]Some writers (e.g., Brewer, 1986) include under the concept of autobiographical memory many things other than recollections of the personal past, things such as "autobiographical facts, generic personal information, and the self-schema" (p. 33). In these accounts, episodic memory is a subcategory of autobiographical memory. Episodic memory mediates recollection of not just specific events, but also "summarized events" and "extended events" (Barsalou, 1988), if such recollection is accompanied by autonoetic awareness of such events (Tulving, 1987).

a rehabilitation hospital. He was discharged home in July 1982, and since that time has remained living at home in the care of his parents.

As a result of the accident, K. C. is densely amnesic. His anterograde amnesia is as severe as that of H. M., the world's most famous and most thoroughly studied amnesic (Corkin, 1984; Milner, 1966), and his retrograde amnesia is even more severe than that of H. M., inasmuch as K. C. does not remember a single thing that has ever happened to him, unlike H. M. who can recollect events from his childhood and early teens (Corkin, 1984).

K. C.'s cognitive functioning, with the exception of long-term memory, is reasonably intact, His IQ is in the normal range, his language comprehension is normal, he can read and write without difficulty, his perceptual abilities are more or less normal, and so are his thought processes: There is no confusion, and he does not confabulate. In keeping with the typical clinical picture of the amnesic syndrome, his short-term memory is also intact: He can recall eight digits forward and five backward. A more complete picture of his neurological and cognitive status is given in Tulving, Schacter, McLachlan, and Moscovitch (1988; Tulving et al., 1991).

In addition to causing dense anterograde and retrograde amnesia, K. C.'s brain damage produced a rather profound change in his personality. Whereas he used to be outgoing, adventurous, and gregarious, he is now passive, cautious, and reticent. In face-to-face situations with others he is attentive and polite. He typically does not initiate any interactions with people around him, although he does ask questions from time to time. He has a good sense of humor, appreciates jokes and banter, and sometimes makes light remarks about things happening around him. He is only vaguely aware of his memory deficits. He admits that he has problems with memory when he is explicitly questioned, but otherwise seems unaware of it.

In describing K. C.'s memory capabilities it is useful to distinguish between two periods in his life. The *premorbid period* covers his life before the accident in 1981. During that time, of course, his ability to learn everything, to retrieve what he had learned, and to remember personal events and happenings was normal. Even today he can still retrieve much of the *semantic* knowledge he had learned premorbidly. Thus, among countless other things, he can name the three kinds of blood vessels in the human body, can explain the difference between stalagmites and stalactites, and can describe, and find on the map, the exact location of his family's summer cottage. However, as already mentioned, he does not remember any personal events or happenings from the premorbid period. The *postmorbid period* covers the time after the accident. It is characterized by K. C.'s normal or near-normal ability to acquire new perceptual–motor skills as well as normal learning and performance on various priming tasks, as is true of all amnesics (e.g., Schacter, 1987; Shimamura, 1989). But the acquisition of new semantic knowledge in the postmorbid era is highly impoverished and patchy, although he can learn new semantic and factual information under special conditions (Tulving et al., 1991). He is no more capable of recollecting personally experienced postmorbid events and happenings than he is capable of doing so for the premorbid period.

In terms of the distinction between episodic and semantic memory, K. C.'s semantic retrieval of information acquired during the premorbid period is good, although not normal; his current (postmorbid) ability to learn new semantic information is impaired, although not totally lacking; and his episodic memory capabilities are essentially totally lost: He is incapable of recollecting any events or happenings from any period of his life once they recede beyond the reach of short-term memory, or an extended short-term memory, a time span measured in a few minutes.[2]

K. C.'S TRAIT SELF-KNOWLEDGE

K. C. was tested for his knowledge of himself and one familiar other, his mother, in two sessions.

In the first session, K. C. rated himself and his mother on 72 traits, and his mother rated K. C. and herself on the same traits.[3] The 72 trait names were listed on three sheets of paper, 24 traits per sheet. Beside each trait were shown four choices: "not at all," "somewhat," "quite a bit," and "definitely." The instructions, specially constructed for the four combinations of rater and referent, were typed at the top of each page. For K. C. rating himself the instructions were as follows: "Please rate YOURSELF on the following personality traits. For each trait indicate to what extent the trait applies to YOU, by circling the appropriate phrase for each trait." Other instructions were appropriately modified.

K. C. had no difficulty with either understanding the task or its execution. He first rated himself, and then, following 45 minutes of activity on another unrelated task, rated his mother. His mother did the two ratings in immediate succession, first rating K. C. and then herself.

The purpose of this exercise was to assess the extent to which K. C. was capable of providing realistic estimates of his own traits, as well as those of his mother. The extent of the validity of his estimates was measured in terms of the agreement between K. C.'s ratings and those of his mother.

K. C.'s mother made use of all four rating scale points in her ratings of both

[2]Whether K. C. is capable of storing any episodic information—that is, information about *subjectively experienced* events *as such*—and whether his problem lies only in retrieval, is not known and cannot be known. Given the temporal-logical structure of an act of remembering, simple observation of retrieval failure is always compatible with at least three scenarios: (a) failure of storage or relevant information, (b) adequate storage but subsequent loss of relevant information, and (c) inadequate or inappropriate retrieval cues.

[3]The trait names were the same that Klein and Loftus used in their research. I thank Stanley Klein for making these materials available.

K. C. and herself. But K. C. confined his ratings, with a single exception, to only two categories—"not at all," and "somewhat."[4] To simplify the assessment of K. C.'s ability to provide realistic trait ratings, his mother's ratings were converted to a binary scale similar to that adopted by K. C.: "not at all" ratings were assigned to one category, and all the other higher ratings were assigned to the second category. Analysis of results was thus based on the revised ratings by mother.

Yule's Q was adopted as the measure of association, or dependency, between K. C.'s and Mother's ratings, with chi-square serving as a test of statistical significance of the observed Q values. The association thus measured was positive in both cases. The Q value of the comparison of K. C.'s and Mother's ratings of K. C.'s traits was .77 ($X^2 = 14.55$), and the Q value of the comparison of K. C.'s and Mother's ratings of Mother's traits was .80 ($X^2 = 13.46$).

These data suggest then that K. C.'s judgments of traits are reasonably reliable, regardless of whether he is rating himself or his mother.

Following the initial assessment as just described, a new two-alternative forced-choice trait test was constructed on the basis of K. C.'s and Mother's ratings of K. C.'s traits in the first session. The test consisted of 32 pairs of traits. Both words in every pair had been rated identically by K. C., but differently by Mother, in the first session. Thus, for instance, one of the pairs was "reliable–serious." K. C. had given himself a rating of "somewhat" on both of these traits in Session 1, whereas Mother had rated K. C. as "quite a bit" on "reliable" and "somewhat" on "serious." An attempt was also made to equate the presumed social desirability of the two traits in a pair. Some other examples of the pairs of traits were "ambitious" versus "industrious," "quarrelsome" versus "selfish," and "artistic" versus "musical."

K. C. was given the 32-pair forced-choice test on two separate occasions in Session 2, separated by a 45-minute interval. (By the time he took the test for the second time, he had, of course, no recollection of having done anything like it ever before.) There was satisfactory agreement between the two tests, with 25 choices out of 32 being identical.

Mother was given the same 32-pair forced choice test also twice. The first time she rated K. C. as he is now, and the second time she rated K. C. as he was before his accident. The two tests yielded rather different outcomes. Of the 32 ratings of pairs of traits, 16 were the same for the two time periods, and 16 were different, indicating zero correlation between the tests. These data confirm the family's observations that K. C.'s head injury changed his personality.

With the data available from the tests as described, it was possible to make three comparisons. First, K. C.'s choices on the 32-pair test, pooled over his two tests, were compared with Mother's ratings of K. C. on the 72-trait test in Session 1. His choices agreed with Mother's ratings 47 times out of 64 possible. That is, when K. C. was asked to choose between two traits for self-descriptiveness that he had rated identically in Session 1, he sided with Mother's choices 73% of the time. Second, K. C.'s own trait judgments on the 32-pair test were compared with Mother's choices for the "postmorbid K. C." on the same test, that is, for K. C. as he is now. The results again showed 73% (47 out of 64) agreement between K. C. and Mother. Third, K. C.'s own trait judgments did not agree at all with Mother's choices for the "premorbid K. C.," that is, K. C. as he was before his accident. The two sets of choices agreed in only 52% of the cases (33 out of 64), an outcome one would expect by chance alone.

As a check on the meaningfulness of the 73% agreement between K. C. and Mother on K. C.'s present traits, two professional women, in K. C.'s age range but without any memory impairment, and their mother, were given the same 32-pair trait test that had been used with K. C. and his mother. Each woman rated herself, and their mother rated each daughter. The agreement between this Other Mother and Number One Daughter, in rating the latter, was 22/32; the agreement between the Other Mother and Number Two Daughter, in rating the latter, was 24/32. These figures are rather similar to those expressing agreement between K. C. and his mother, and suggest that K. C.'s severe episodic memory impairment does not constitute a readily identifiable handicap when he makes judgments about his self.

The findings of the small study of K. C.'s trait self-knowledge can be summarized succinctly: K. C. possesses reasonably realistic trait self-knowledge. It corresponds to his present (postmorbid) self as perceived by others, and is noticeably different from his previous (premorbid) self.

IMPLICATIONS

The findings of the small study reported here must be taken with a grain of salt. They are based on a rather small database derived from observations of a single principal subject and a few others. Both the reliability and generalizability of the data are uncertain, and the tests used may have unknown limitations. Replication and extension of this kind of research is needed before more definite conclusions can be reached.

But within the constraints provided by these caveats, some tentative conclusions can be drawn. One such is suggested by the finding that K. C. seems to have acquired the necessary information about his "new" traits during the years after his accident, during the postmorbid period characterized by profound anterograde amnesia. As K. C. cannot consciously recollect any events or happenings from this period of his life—fleeting or long-lasting, single or repeated, bland or emotionally laden—any more than he can recollect any events or

[4]He has done so on previous occasions, too, when he has been asked to make numerical scale judgments about presented materials. When asked to explain this behavior, he says that he is following the instructions.

happenings from any other period of his life, the conclusion follows that his current self-knowledge of traits cannot be based on remembering of any relevant behavioral instances.

This conclusion supports Klein and Loftus' theory regarding the representation of self-knowledge in memory. Contrary to the predictions of exemplar models, trait judgments about the self can be made, and in K. C.'s case must have been made, without reference to trait-relevant autobiographical episodes. It follows then that trait knowledge about the self is represented in memory in abstract form.

K. C.'s semantic knowledge of the world at large—knowledge that he can express symbolically—is mostly derived from his premorbid period. Before undertaking the little study of K. C.'s self-trait judgments it was quite possible, and perhaps even reasonable, to entertain the hypothesis that his beliefs concerning his traits would have been based on his life experiences during the premorbid period, and that "relearning" the traits of the "new" K. C. postmorbidly would have been as unlikely as postmorbid acquisition of knowledge about the rest of the world. The data suggest otherwise: K. C. seems to have successfully acquired knowledge about his "new" self despite his profound episodic memory impairment.

The memory system that mediated K. C.'s relearning of his traits is presumably the semantic system. We already know that he is capable of acquiring, and retaining over long periods of time, other kinds of semantic information. K. C. has not only demonstrated semantic priming of premorbidly acquired semantic knowledge (Tulving et al., 1988), he has also shown new semantic learning of collections of facts such as "student withdrew—INNUENDO" (Tulving et al., 1991) and "a civilized custom that ought to be imported to Canada—SIESTA" (Hayman, Macdonald, & Tulving, in preparation). There are reasons to believe that repetition, meaningfulness, and minimization of response-competition interference are important determinants of K. C.'s learning of new factual information. At least one of these factors, repetition, fits well with Klein and Loftus' suggestion, based on their review of the relevant literature, that a person's formation of abstract knowledge of traits, either one's own or a familiar other's, is a function of the extent of relevant experience. The other two relevant conditions—meaningfulness of the to-be-acquired information and minimization of interference—also seem to be reasonably well satisfied in the case of acquisition of trait knowledge from individual instances that are not subsequently remembered.

Thus, it seems reasonable to hypothesize, along with Klein and Loftus, that the abstract representations of traits are held in semantic memory, whereas individual behavioral instances that can also serve as a source of relevant knowledge are maintained in and retrieved from episodic memory. Klein and Loftus' suggestion that the two representational bases of trait knowledge are independent follows directly from this hypothesis, inasmuch as semantic and episodic memory are independent in the sense that once information has been stored, it can be retrieved from either system independently of the existence or retrievability of the same or different information in the other system. (For further discussion see Tulving, 1987, 1992; Tulving et al., 1991).

SUMMARY

Can a person who does not remember a single event or happening from his life, and who does not know how he has behaved in any particular instance, know what kind of a person he is? Can he possess accurate self-knowledge? The observations reported here about K. C., a densely amnesic person, suggest that the answers to both questions are affirmative. Since the accident that caused his profound amnesia and changed his personality K. C. has relearned his trait self-knowledge. He has done so despite the fact that his episodic memory system is severely impaired and that, as a consequence, and as far as we know, he has no access to any behavioral instances from which the traits can be inferred.

The facts of the case suggest that K. C.'s self-knowledge is represented in a memory system other than episodic memory. This other system is presumably semantic memory, because none of the other currently known memory systems could support his performance on the trait judgment tasks. K. C.'s self-knowledge belongs to the same category as all his other knowledge about the world.

Thus, the results of the small case study of a single special individual and the implications of these results are in excellent agreement with the theory that Klein and Loftus have constructed on the basis of their own much more sophisticated and extensive study and analysis.

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