

MEMORY FOR EVENTS OCCURRING UNDER ANESTHESIA

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A number of anecdotal reports suggest that people have memories for incidents that happened while they were anesthetized. The present study investigated this possibility by studying an anesthetized patient's later memory for a word list. During an abdominal myomectomy, the patient was read a list of 100 unrelated words. Three subsequent memory tests were given, at 28, 53 and 82 hours after exposure. Recognition was at chance level. The results cast doubt on the suggestion that anesthetized patients have memory for events occurring while unconscious.

Several years ago, a California anesthesiologist, Dr. M., was accused of lewd and lascivious conduct for allegedly committing sodomy on female patients during surgery. Many civil suits were filed against Dr. M. by women who generally could not remember anything about the surgery but feared they had been victims. Some of those patients were subsequently hypnotized to "unlock" their unconscious memories of what occurred during surgery. One patient who initially remembered nothing after surgery claimed later, after hypnosis "refreshed" her memory, that she remembered a penis entering her mouth. In response to this incident, one physician interviewed by a reporter for the Sacramento Union said that there is evidence that anesthetized patients can recall minute details after surgery. Specifically, the physician said that patients can sometimes allegedly remember entire conversations and

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physical actions of operating room personnel, even though they were in a deep state of unconsciousness.

Can people recall events that occurred while they were anesthetized during surgery? A few anecdotal reports and quasi-experiments suggest that it may be possible for a patient to remember sounds and words that were spoken. For example, in one case, a female patient who had positive feelings toward her surgeon before surgery, did not afterwards. After her surgery, she recalled hearing her surgeon utter these specific words during the operation: "Well, that will take care of this old bag!" In another instance, one more closely resembling a true experiment, ten patients participated (Levinson 1967). At a specified point in time, when each patient was deeply anesthetized, the anesthetist said something like: "Just a moment. I don't like the patient's color. The lips are too blue, very blue. More oxygen please... Good everything is fine now."

One month later, the patients were told to reexperience the operation while under hypnosis. Four of the ten were able to "repeat practically verbatim the traumatic words used by the anesthetist. A further four patients displayed a severe degree of anxiety while reliving the operation... The remaining two... denied hearing anything." (Levinson 1967: 23)

Collectively, these reports hint that it may be possible for a patient to recall sounds or words spoken during surgery. However, methodological problems in the prior work render the findings problematic. For example, in many instances the person conducting the test of memory was aware of the material presented during surgery and thus might inadvertently have influenced the reported recollection. In other instances, there could have been a temporary decrease in the depth of anesthesia. Such a situation can occur where muscle relaxants are used which permit surgery to be performed with lower drug concentrations than would be possible without such relaxants (Adam 1976; Trustman et al. 1977).

We here report the results of a rigorous experimental test conducted on a patient who was undergoing an abdominal myomectomy under general anesthesia. The patient was an experimental psychologist with a keen interest in human memory in general (Loftus 1979, 1980; Loftus and Loftus 1976) and in the possibility of memory for events occurring during anesthesia; thus informed consent was freely granted. The

second author (J. Schooler) created a list of 100 words to be read to the patient by the anesthesiologist (D. Glauber) during surgery. The words were taken from a standard source (Kucera and Francis 1976) frequently utilized in research on human memory. Seventy-five minutes after oral premedication of diazepam 10 mg, anesthesia was induced with thiopental 200 mg. Following endotracheal intubation, anesthesia was maintained with nitrous oxide 60% in oxygen, together with Isoflurane in inspired concentrations of 1–3%. Surgery commenced 30 minutes after induction and a further 30 minutes later the words were read at the rate of one word every two seconds. The subject-patient was undoubtedly anesthetized throughout to a depth suitable for surgery.

Testing was initiated 28 hours after surgery. Immediately prior to formal testing, the subject attempted to recall freely any words that may have been heard. She “recalled” 20 items, none of which were on the original list.

Three formal memory tests were then administered by the third author (G. Loftus) who was blind to the correct answers. The three tests were identical and used the standard two-alternative forced-choice procedure. During the test, the experimenter read pairs of words, 100 pairs in all, and for each pair the subject indicated which word seemed familiar. Her instructions were to respond with a 1 or 2 on each trial to indicate the first or second word, and to guess when necessary. The words were tested in the same order in which they were initially given. The three tests were given at 28, 53, and 82 hours after initial exposure.

On the first recognition test, the subject correctly identified the study item 53% of the time. Her performance on the second and third tests was 53% and 45%, respectively. None of these figures is significantly different from chance performance of 50%.

A potential problem with the use of three identical tests of all items should probably be acknowledged. On the second (and third) test trials, a subject may have difficulty discriminating weakly represented “studied” items from distractors that occurred on the first (and second) test. Although this potential problem cannot account for the poor performance observed on the first test, future research may wish to employ a procedure in which a subset of the target items is tested only once on each of several tests.

It should be noted that generally recognition memory for lists of words of this type is quite good (although not usually perfect) when subjects are exposed in a waking state. In one study, subjects who were

exposed to over 500 different words and tested shortly thereafter using the same procedure correctly identified the study item in 88% of the test pairs (Shepard 1967). To test the hypothesis that the particular subject-patient used in the current research would have performed poorly whether anesthetized or not, the subject was exposed to an identical learning and testing procedure one month after her operation. A different set of words was used, taken from the same source. On tests given 28 and 55 hours after initial learning, performance was 94% and 92% respectively, well above chance.

Standard memory testing with waking subjects generally yields typical serial position functions (Zechmeister and Nyberg 1982). The serial position effect is the finding that words at the beginning and end of a list are remembered better than words in the middle of the list. There were no such serial position effects apparent in this study. For example, on the first test administered 28 hours after exposure, the subject's performance for each successive fifth of the list was: 50%, 60%, 65%, 65%, and 30%, respectively. Only one of the first three and one of the last three words were correctly recognized.

For purposes of providing some baseline performance with which to compare our results, we considered several possibilities. One was to use the generally good recognition memory for words observed in previous work, and to assume that memory for the current list would similarly be reasonably high if exposure and testing occurred during normal waking consciousness. Another was to assume simply that any significant departure from chance performance would be suggestive of some information processing during anaesthesia. As noted, this result did not obtain. Another was to test the subject at a later time, when initial learning and subsequent recall could be tested under normal waking conditions. As noted, this procedure produced reasonably good performance. As an afterthought, we tested one of the physicians who participated in the surgery, a first-year resident with some experience in abdominal myomectomies. The test was conducted 82 hours after exposure, at the same time that the patient-subject received her third test. The physician-subject and the patient-subject were shielded from the responses of each other. The physician-subject correctly identified only 50% of the words that had been spoken during surgery – exactly chance performance – and volunteered that she only felt confident about two words. She claimed to be very absorbed in the operation during the presentation of the words. What can be inferred from the

physician's failure to remember? One of our colleagues suggested, facetiously, that the failure showed that even proximity to anesthesia can produce impairments in memory storage. More seriously, we suggest that the physician's failure, if replicable, may extend the present results beyond anesthesia situations towards non-awareness studies in general. Such a conclusion awaits the outcome of future experiments conducted with a variety of tests that may be more sensitive.

It could be argued that had hypnosis been used with the patient better memory for the words would have been revealed. However, controlled laboratory studies have consistently failed to demonstrate improvement of memory under hypnosis, a conclusion reached quite explicitly in a recent and thorough review of the literature (Smith 1983). Moreover, one needs to worry, with hypnosis, about the potential for hypnotically created memory (Laurence and Perry 1983).

Although only one subject was used in the present study, the results raise a doubt as to the viability of claims that persons can be made to recall events that occurred during surgery. In instances where this has been claimed, one must consider the possibilities that the so-called memories are simple constructions or confabulations in the minds of patients, that anesthetization was not complete, or that inadvertent "coaching" on the part of the experimenter contributed to the finding.

Despite the doubt we have about memory for items that occurred while a person was anesthetized, our results do apply only to deliberate or intentional memory, that is cases in which a person is aware that he or she is remembering a particular past event. These results still leave open the possibility that information presented under anesthesia leaves some lasting impression that cannot be revealed in tests of retention that require remembering to be deliberate or intentional (Eich 1984). In a shadowing study involving the recognition and spelling of previously unattended homophones, Eich (1984) showed that information in the nonshadowed channel could bias the spelling of a homophone, even when subjects could not explicitly recognize having been exposed to that homophone. In discussing his results Eich (1984) left open the question of whether the same pattern of recognition and spelling performance would be revealed in the context of general anesthesia. However, since we used a test that demands awareness of memory, Eich would probably say our experiment was doomed before it began.

Other complaints are also possible. For example, suppose we had used a test that does not demand awareness of remembering, and still

found poor performance. We could then anticipate the criticism that the material may not have been sufficiently emotional for it to be subject to some degree of deep, semantic analysis.

Despite the fact that our study leaves many questions unanswered, our inability to observe memory for events occurring under anesthesia is of particular importance considering the various potential artifacts in previous studies. Because of the general practice of not presenting null effects, all too often published results based upon experimental artifacts or chance fluctuations may go unchallenged. We welcome the opportunity to publish in a regular journal this single-subject experiment that favors a null hypothesis; we hope our study contributes to greater skepticism regarding the notion of memory under anesthesia.

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