

# Failure of preference formation in amnesia

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**Article abstract**—Information about the frequency of a stimulus influences the formation of preference judgments in normal subjects. In contrast, results show that patients who have amnesic syndromes have difficulty forming preferences on the basis of frequency information. It is unlikely that difficulty in forming preferences is caused merely by poor attentional capacity. Patients with amnesia may lack the affective response to stimuli that may be important for remembering events.

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Patients with amnesia tend to become detached from and emotionally uninvolved with the environment.<sup>1-3</sup> New information does not seem to acquire differential salience for them, and they have difficulty expressing a preference for a particular stimulus. An effective means of influencing preferences in normal subjects is to manipulate the frequency with which a stimulus appears. Increasing the frequency enhances the attractiveness of a stimulus. When a series of stimuli are presented to normal subjects, the stimuli seen most often are rated more pleasant than those seen less often.<sup>4-6</sup> Further, there is significant test-retest correlation when subjects rate the same stimuli a week later, suggesting that the frequency-preference effect is stable. The relationship between frequency and preference has long been recognized and is now well established.<sup>7-11</sup>

In normal subjects, preference and frequency are related even when subjects are not instructed to pay attention to frequency or preference ahead of time.<sup>12-15</sup> In addition, the effect of frequency on preference may not depend on recognition ability. For example, in a study where subjects were repeatedly exposed to irregular octagon shapes, at the end of the experiment these "old" shapes were preferred significantly more than "new" octagon shapes, even though recognition of old versus new shapes was at chance levels.<sup>16</sup> Other studies have also shown that an ability to make preference discriminations may be independent of explicit recognition.<sup>17-20</sup> Therefore, memory deficits of amnesic patients should not keep them from forming preferences based on frequency. We examined the effect of frequency on preference formation in patients with amnesia.

**Methods.** *Subjects.* The experimental group consisted of eight volunteers, seven men and one woman; their neurologic and neuropsychological histories have been reported previously.<sup>21-23</sup> Their mean age was 49 ± 12.4 years, and their mean education level was 16 ± 3.4 years. They had amnesia after different kinds of brain injury: global hypoxic ischemia, rupture and repair of anterior communicating artery aneurysm with vasospasm, stroke, and trauma. Although our subjects had variable etiologies, their only cognitive complaint was memory dysfunction, as indicated by the results of standard neuro-

psychological tests. The average full-scale Wechsler Adult Intelligence Scale (WAIS) score was  $119 \pm 9.5$ . The average Wechsler Memory Scale (WMS) was  $85.6 \pm 9.2$ , and none of the patients learned more than one of the difficult word pairs on the associate learning subtest. In our study, as in others,<sup>24</sup> the difference between any amnesia patient's WAIS and WMS scores was at least 20 points; in our group of patients, the average difference exceeded 30 points. All patients could draw a cube and a house in perspective, and none had perceptual or linguistic impairment. They had no difficulty with auditory comprehension or apraxia as measured by the Tolden Test. The average percentile score in the Tolden Progressive Matrices was  $83.9\% \pm 12.5$ , a score comparable with their above-average WAIS performance.<sup>25</sup> In addition, our subjects did not confabulate, manifested no psychiatric difficulties, and were oriented.

Control subjects were five women and three men who were matched to the age, socioeconomic status, and educational level of the amnesic subjects. They did not differ significantly from the experimental group in age ( $45.25 \pm 12.2$  years,  $t = 0.59$ ,  $p = \text{NS}$ ) or educational level ( $17 \pm 1.77$  years,  $t = 0.74$ ,  $p = \text{NS}$ ). *Stimuli.* The stimuli were black and white slides of faces taken from a medical school yearbook. The pictures were men of similar age and dress; they did not have easily discriminable features such as glasses, hats, or bald spots.

*Procedure.* The same test procedures used to study preferences in normal subjects were followed in this study. Subjects were told that their only task was to pay attention to the stimuli. Ten different target slides were shown, 2 slides at each of the following frequencies: 1, 3, 6, 12, and 24. The stimuli were randomized four times to control for any possible bias toward a particular face. Thus, there were four test sequences, and subjects were randomly assigned to one of the four sequences. Slides were presented in random order for 2 seconds each.

After the subject had seen all 92 slides, he or she rated the 10 target slides and 10 new slides that were intermixed with them. Each slide was rated on a 1 to 7 preference scale, with 7 representing the high (like very much) end of the scale. The rating method was explained in detail, and the experimenter emphasized that it was important to use the entire rating

scale from 1 to 7. An hour later, subjects again rated the 20 slides on the same 1 to 7 preference scale.

Using the same stimuli and procedure, we also tested the recognition ability of five amnesic subjects at a separate time. Instead of assigning preference ratings at the end of the experiment, subjects were asked which slides they had seen before. One-half of the slides were from the test sequence, and one-half were new faces.

A regression analysis (preference onto frequency), controlling for each subject's multiple responses, was performed on both the initial and the 1-hour-later sets of preference data.<sup>26,27</sup>

**Results.** Frequency information did not significantly influence preference formation in our patients, although it did influence preference formation in controls (figure 1). For the amnesic subjects, there was not a significant relationship between the frequency of a stimulus and its preference rating ( $r = 0.52$ ,  $F[8,39] = 1.78$ ,  $p = \text{NS}$ ). In contrast, control subjects preferred the slides they saw more frequently; there was a significant relationship between frequency and preference rating ( $r = 0.73$ ,  $F[8,39] = 5.58$ ,  $p < 0.001$ ). The difference between the regression coefficients of the two groups was also significant ( $t = 2.42$ ,  $p < 0.02$ ).<sup>28</sup>

All subjects rated the stimuli again an hour after completing the first set of preference ratings. The results were similar (figure 2). For the amnesic subjects, there was not a significant relationship between frequency and preference ( $r = 0.48$ ,  $F[8,39] = 1.48$ ,  $p = \text{NS}$ ). The control subjects again preferred the stimuli seen more often ( $r = 0.695$ ,  $F[8,39] = 4.54$ ,  $p < 0.001$ ). The difference between the regression coefficients was significant ( $t = 2.36$ ,  $p < 0.05$ ).

The recognition ability of the amnesic patients was significantly above chance. They accurately identified the previously seen faces 82% of the time (binomial test,  $p < 0.001$ ) and the new faces 76% of the time (binomial test,  $p < 0.001$ ). The patients also performed at better than chance levels (binomial test,  $p < 0.02$ ) in paired comparisons where they were presented with two pictures and asked to choose the one presented more frequently.

**Discussion.** In normal subjects, the more often a stimulus was seen, the better it was liked. Control subjects preferred the more frequent to the less frequent stimuli, and their preferences were influenced by frequency information. Amnesic subjects had difficulty in forming preferences on the basis of frequency information.

One interpretation of the subjects' difficulty in forming preferences is that they failed to recognize any of the stimuli and were therefore unable to make preference judgments. Although previously cited evidence suggests that recognition of stimuli is not necessary in preference formation, we did test

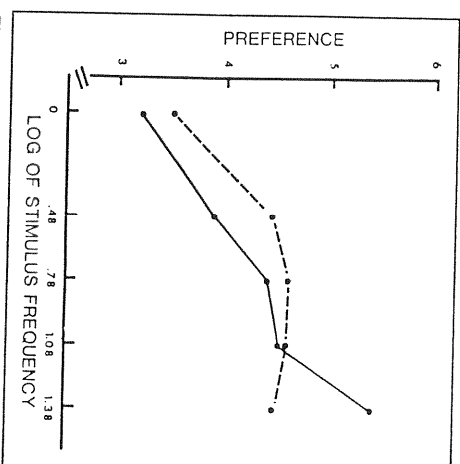


Figure 1. Initial preference ratings of stimuli appearing at different frequencies. Since increases in frequency were equal logarithmic steps, we graphed the log of the frequency instead of actual frequency.

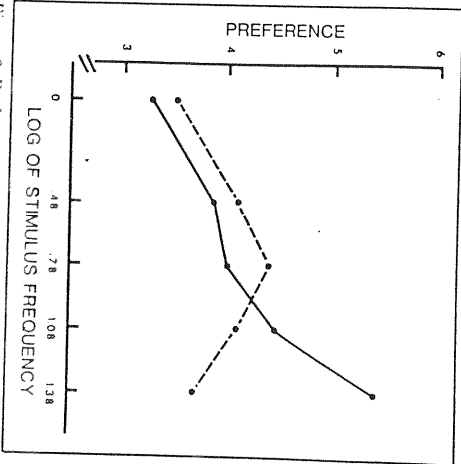


Figure 2. Preference ratings generated an hour after initial exposure to stimuli. Again, preference is graphed against the log of the frequency.

recognition in these patients and found it significantly above chance. Moreover, when recognition was extremely high (90% and above), as it was at the three highest frequency levels, the amnesic subjects showed no discrimination in their preference ratings. Their preference curve was almost flat at the highest frequencies; ratings were nearly identical.

Thus, the ability to form the preference response that normally accompanies frequency information was impaired, and the impairment did not involve a recognition failure or an inability to distinguish frequent from less frequent stimuli.

The difficulty in forming preferences and generalizing affective responses may play an important role in the memory disorder of amnesia patients. The affective component of an event is one of many discriminating cues for different memories. Items that are preferred acquire an emotional association and are more easily recalled.<sup>11</sup> If no preference response is formed, information does not take on differential salience. As a result, it may be difficult to distinguish between similar experiences. Remembering is difficult without cues that separate one item from others.

The difficulty in forming preferences may also be related to an impairment of what are called "automatic" encoding processes. Processes are called "automatic" when they occur without intention, do not improve with practice, show limited developmental trends, drain minimal energy from limited-capacity attentional mechanisms, and do not interfere with other cognitive activity.<sup>12</sup> Some studies have shown that automatic processes may be disrupted in amnesia,<sup>13</sup> and this disruption may extend to formation of preferences. Thus, preference and frequency encoding may be automatic processes in normals but not in amnesic subjects.

In summary, the patients' impaired ability to form preferences and to use affective cues may be related to their difficulty in distinguishing among stimuli and recalling them. This deficit is more than mere loss of memory; inability to form preferences may make remembering more difficult and increase the other memory difficulties of amnesic patients.

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