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The Processing of Frequency Information: An Automatic Mechanism?

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Aspects of the processing of frequency information were investigated in two studies. In one, students at four ages from grade two to college were either informed or not prior to the presentation of a list of words whose true frequency varied from zero to five, that their subsequent task would be to judge the number of times that each word appeared. Second graders were as prepared to process frequency differences as adults. A second study showed that practice at frequency counting does not improve the performance of young adults and neither does the provision of specific feedback regarding the accuracy of earlier performance. Frequency tagging appears to be an automatic aspect of the processing of information.

The ability to detect differences in the relative frequency with which events occur is an aspect of cognition that has implications across a wide range of behavior. It has been proposed for example that sensitivity to frequency underlies the ability of human subjects to distinguish between old and new events (Underwood, 1971). Sensitivity to frequency may also underlie the ability to match one's choices or guesses with considerable accuracy to the actual occurrence rates (Estes, 1976). Recent evidence suggests that frequency of exposure underlies our degree of certainty about the truth or validity of statements concerning events in the world (e.g., the total population of Greenland is about 50,000) whose truth value one typically does not know directly (Hasher, Goldstein, & Toppino, 1977).

In order for frequency assessment to play a role in these important aspects of cognition, it must be the case that humans are extremely sensitive to differences in the relative frequency of events. Indeed, there is substantial evidence of such sensitivity. College students can, with some accuracy, estimate the frequency with which words occur in a list (e.g., Hintzman, 1969); they can also estimate with a high correlation to actual counts, the frequency of English words (Shapiro, 1969), of single letters (Attneave, 1953), and perhaps most surprisingly, of pairs of letters (Underwood, 1971). That we can rank order events with as seemingly little meaning as bigrams suggests that the processing of frequency may fall into the domain of what Posner and Snyder (1975) have called "automatic processes." That is, of processes which the organism runs off both without any awareness of the operation, with no intention of doing so, and with little effort, in the sense that tagging of frequency has little impact on one's ability to simultaneously attend to other aspects of a situation, such as the interpretation of an ongoing conversation.

Evidence bearing on the automaticity of frequency counting comes from a set of studies that compare the frequency discrimination ability of subjects given explicit information that a frequency judgment task will follow the presentation of an experimental list with that of subjects given no such information (Flexser

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& Bower, 1975; Howell, 1973; Rose & Rowe, 1976, Experiment 1).[1] Instructing subjects to attend to frequency during the presentation of a list does not improve their ability to discriminate among words occurring at different frequencies; subjects given general memory instructions do as well as do the informed subjects.

If frequency tagging is indeed a cataloging operation which humans engage in on an automatic basis, without awareness and potentially for all stimuli whether seemingly meaningful (e.g., words) or not (e.g., bigrams) and at which we do not improve even when forewarned, then it becomes reasonable to ask the question of whether it is also one of those rare cognitive processes which shows no developmental trend (cf. Brown, 1975). It is conceivable that children discriminate frequency as well as adults. Experiment 1 is a test of this question.

The subjects for this experiment were selected from an age range, second grade to college, over which many memory skills, especially those which influence processing efficiency, show developmental changes (cf. Brown, 1975; Hagen, Jongeward, & Kail, 1975). Processing efficiency refers to the speed with which verbal material can be acquired and the ease with which it can be recalled on an immediate test. For example, the salient attributes that are abstracted from words (Bach & Underwood, 1970) change across this age span, as do patterns of rehearsal (Ornstein, Naus, & Liberty, 1975) and of utilization of mediators (Rohwer, 1973). In light of the evidence of the development of memory through the age span represented in this experiment, a demonstration of no developmental trend in the ability to discriminate frequency would be especially dramatic.

A second study asks the question of whether or not frequency discrimination improves with practice, either across successive lists or with feedback given to subjects concerning the accuracy of their frequency estimates. Improvement in performance across successive lists within the same task has been demonstrated for most human learning processes subsumed within the traditional verbal learning tasks (cf. Postman, 1969): College students improve across successive serial lists, paired-associate lists and free-recall lists. Retrieval strategies change (Hasher, 1973), problem solving strategies change (Bourne, 1967), and so does the ability to use organizational strategies (Postman, Burns, & Hasher, 1970). In light of the demonstrated plasticity of human cognitive behavior, it would be remarkable to find no such improvement for frequency discrimination.

Experiment 1

Amount of rehearsal activity, the organization of that rehearsal activity and elaboration are among those memory processes that are known to develop with age (cf. Flavell, 1970). In the case of each of these there is evidence that young children can be instructed and trained to process information in the manner of older children and adults and that when the younger children do so, their recall levels and learning speed show some improvement (Liberty & Ornstein, 1973; Rohwer, 1973). Because instructions to use more sophisticated devices have been so successful in improving performance of children, we believed it would be especially important to include an instructional manipulation in the present study. Thus, half of the subjects at each of the four grade levels in this study were instructed prior to the presentation of the list that their task after seeing the list would be to judge the frequency of occurrence of the words in the list, and half were given nonspecific memory instructions regarding the experimental task. While for other tasks, instructions may be especially beneficial to younger children, fre-

[1] This assertion is based on a comparison of the two conditions "intentional" and "nonspecific" that were or were not aware, respectively, prior to list presentation, of the forthcoming frequency judgment task (see their Figure 1, p. 144).

quency instructions may make little difference for them, as they do for adults in a frequency discrimination task. This would be the case if frequency tagging were something that even younger children engage in automatically.

Method

Design

Subjects in the second, fourth, and sixth grades and in college were instructed either before or after they saw a list of words that an absolute frequency judgment task would follow. Those who were given frequency instructions only after the list was presented were, prior to the presentation of the list, given general memory instructions. The critical presentation frequencies were 0, 1, 2, 3, and 4. In addition, an equal number of male and female subjects served in each condition of the experiment. Since sex was associated with no significant effects either singly or in interaction with other variables (all Fs < 1), the design may be considered to be a 4 (grade level) $\times 2$ (instructions) $\times 5$ (frequency of occurrence) factorial.

Subjects

A total of 160 students enrolled in the second, fourth, and sixth grades, with mean ages of 8 years 1 month, 10 years 1 month, and 12 years 1 month, respectively, and in college participated in this study. The grade-school children attended a Catholic elementary school that serves a neighborhood whose older students form a portion of the population of the university from which the college-age students who participated in this study were sampled.

Forty children at each grade level were selected from the pool of children reading at or beyond their own grade level. The college students were Temple University undergraduates who were attending summer session classes and who volunteered to participate in psychology experiments.

Procedure

All students were tested individually in a private, quiet room. The children had heard about the experiment in their classrooms the week prior to their participation; the experimenter was introduced by the principal and he then spent several minutes talking about research. Consequently, when each child arrived to participate in the experiment, he or she had already met the experimenter and a short conversation ensued reminding the child of this. Care was taken that each student seemed reasonably relaxed before the actual experiment began. Appointments with the college students were made either by telephone or by appointment hours posted on a bulletin board.

When the experiment began, each student was informed that he or she would see a list of familiar words, some of which might occur more than once. Twenty of the forty students at each grade level were instructed prior to the presentation of the list they they would be given a frequency judgment task after seeing all the items (Informed condition). They were instructed to attend to each word so that later they could say how many times each had occurred. The other twenty students were instructed prior to the presentation of the list that they should remember the words they were about to see so they could later answer questions concerning them. No mention was made of a frequency test (Uninformed condition). As part of initial instructions, all subjects were told that some of the words might appear more than once.

The list of words was then presented using an externally timed Kodak Carousel projector, with each word exposed for 4 seconds. Approximately .8 seconds elapsed during the slide-change sequence. The students were required to say each word aloud as it appeared on the screen.

After the entire set of 70 slides was presented each student was instructed to write down how many times he or she had seen each word. They were cautioned to produce a frequency estimate next to each word on a mimeographed sheet. Students were asked to mark any words they had not seen on the list with a frequency estimate of zero. No upper limit was set for the frequency estimates.

Materials

A pool of 96 nouns was chosen from the van der Veur (1975) list of 1000 words found in the oral vocabulary of first graders. All the nouns had previously been rated (Paivio, Yuille, & Madigan, 1968) by college students as high in imagery (>5 on a 7-point scale). The words were also relatively high in frequency of occurrence with more than two-thirds of them in the highest frequency ranges according to the Thorndike–Lorge (1944) count.

The initial pool of items was divided into two sets of 48 words each in such a way as to minimize within a list both the number of words that shared their initial letter and also any categorical and associative relations. The two lists were approximately equivalent in their mean number of one, two, and three syllable words, their mean imagery rating (6.12 and 6.23) and their mean frequency of occurrence.

List structure. The actual list presented to a subject was comprised of 70 slots which were allocated as follows: The first and last five slots served as primacy and recency buffers, so that the words representing the critical variable, frequency of occurrence, did not occur before, at the earliest, the sixth slot in the list or after, at the latest, the 65th slot. In each of the buffers there were three words that were presented once and one word that was presented twice. Thus the multiple occurrence of items was apparent to all subjects quite early in the presentation sequence.

Within the critical middle portion of 60 slots, each of the actually presented levels of the frequency variable (1, 2, 3, and 4) occurred four times. In order to distribute any progressive error effects across all frequency levels, the following counterbalancing procedure was adopted: The 60 slots were divided into four equal segments of 15 slots each and each of the four levels of the frequency variable was represented by one word in each segment. As a result, the average position of occurrence of all items representing critical frequencies was equivalent.

Ten slots in each segment were filled by critical items which were distributed in such a way that no repeated item ever followed itself. No other constraint was imposed. The remaining five slots in a segment were occupied by once-presented filler items.

Assignment of words. Words were assigned to particular functions in a list in the following manner. From each list of 48 words a group of 20 critical words was selected, as was a group of 8 words to serve as buffers. The remaining 20 words then served as the filler items. The words serving as buffers and fillers were then allocated on a random basis to appropriate positions in the 70-slot list. The 20 words which were to serve as critical items in the list were then further subdivided into five groups of four items each. Within a single form of a list these groups of four words were assigned to serve at the four critical frequencies (1–4) and the fifth group served as the critical, never-presented items that were tested on the subsequent frequency estimation task. In order to ensure that the frequency estimates provided by the subjects were not tied to special characteristics of unique words chosen to serve at particular experimental frequencies, five forms of each list were devised so that across all forms each group of four items served at each of the experimental frequency levels (0–5).

This counterbalancing procedure produced five forms for each of the two lists, comprising a total of ten unique sets of materials. Each set of materials was used twice at each combination of the age and instructional conditions, requiring the participation of 20 subjects per condition

Frequency estimation test lists. Two forms of the frequency test were constructed, one for each of the two lists. Each test list included all of the 48 words in the presentation list pool of items plus ten additional items randomly selected from the alternative list to serve as never-presented distractors. The words were listed in an arbitrary order, each with a blank space for the subject to record his or her response.

Results

Estimates of Frequency of Occurrence

Subjects gave estimates for four items at each frequency level. The measure of central tendency used in the analysis was each subject's median estimate at each frequency level. The means of the medians may be seen in Table 1.

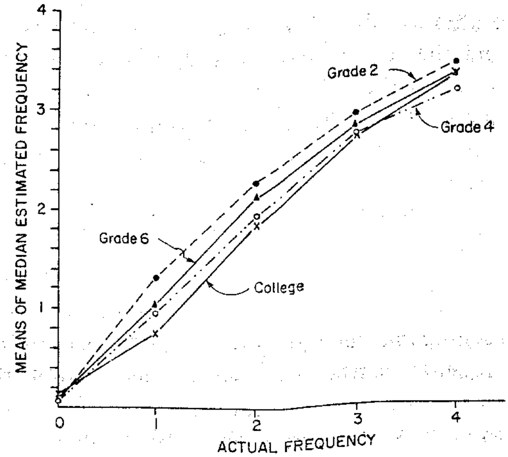

FIG. 1. Estimated frequency of occurrence as a function of actual frequency of occurrence.

TABLE 1
MEANS OF THE MEDIAN FREQUENCY ESTIMATES

Grade	Informed conditions						Uninformed conditions					
	Frequency of occurrence						Frequency of occurrence					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Second	.10	1.45	2.55	2.88	3.50	2.10	.02	1.18	1.95	2.90	3.32	1.88
Fourth	.05	.95	2.05	2.88	3.40	1.80	.08	.95	1.82	2.52	2.85	1.64
Sixth	.08	1.25	2.28	2.95	3.50	2.01	.05	.88	2.02	2.68	3.12	1.75
College	.10	.72	1.88	2.72	3.32	1.75	.10	.78	1.80	2.70	3.32	1.74
Mean	.08	1.09	2.19	2.86	3.43		.06	.94	1.90	2.70	3.16	

The data were analyzed using a 2 (instructions) ×4 (grade levels) ×5 (frequency of occurrence) analysis of variance with repeated measures on the last factor. All significant results are so at or beyond the .05 level. The by now familiar observation that estimates of frequency increase as actual frequency increases was of course replicated, $F(4, 608) = 624.37$, $MS_e = .44$. Knowledge of the forthcoming frequency test resulted in higher frequency estimates than did lack of knowledge (1.93 vs 1.75), $F(1, 152) = 7.82$, $MS_e = .80$.

The most important question in this study concerns the development of the ability to discriminate among events occurring at different frequencies. That no such developmental trend was present may most easily be seen in Figure 1. The interaction between grade level and the frequency with which items occurred did not approach significance, $F(12, 608) = 1.12$, nor did the higher order interaction that included instructions together with grade and frequency, $F < 1$. Apparently, the discrimination among items at these experimental frequencies is equivalent across the wide range of ages represented in this experiment.

There were, however, significant differences present in the average estimates given by students at different grade levels, $F(3, 152) = 3.22$. It is probably not reasonable to interpret these differences as reflecting a developmental trend in frequency discrimination or sensitivity. For one thing, it is the second and sixth graders who, on the one hand, assign similar estimates ($M = 1.99$ and 1.88, respectively) and the fourth graders and college students who, on the other hand, assign similar estimates ($M = 1.76$ and 1.74, respectively). For another, the size of the estimates are more likely to reflect decision criteria subjects use in assigning frequencies than anything else.

A final point may be made regarding the developmental issue here: Younger students are no more able to make use of instructions concerning the true nature of the test than are older students; neither the two way interaction between instructions and grade level nor the three way interaction that also included frequency approached significance. This is quite different from the typical findings in other tasks where, for example, instructions to mediate or elaborate (Rohwer, 1973) or to rehearse in a particular manner (Liberty & Ornstein, 1973) are more helpful to younger than to older children and adults, presumably because the latter are already employing efficient learning strategies.

Accuracy of Frequency Judgments

Two dependent measures were used in order to assess the accuracy of the judgments assigned. The most obvious of these was the absolute number of items whose frequency estimates were correct. Because this measure sacrifices a good deal of information, a deviation measure (Rose & Rowe, 1976) was also used. The unsigned difference between each estimate and the actual frequency was calculated. The mean of these unsigned deviations was obtained for each subject at each experimental frequency level and entered into the analysis of variance plan used earlier on the estimated scores. Only the results of the deviation analyses will be reported as there were minimal differences between the two sets of analyses. Mean deviation scores may be seen in Table 2.

TABLE 2

MEANS OF THE MEAN UNSIGNED DEVIATION SCORES

Grade	Informed conditions: Frequency of occurrence						Uninformed conditions: Frequency of occurrence					
	0	1	2	3	4	Mean	0	1	2	3	4	Mean
Second	.20	.72	.86	.95	.95	.74	.10	.60	.80	1.05	1.49	.81
Fourth	.16	.51	.74	.76	1.02	.64	.15	.58	.91	1.31	1.55	.90
Sixth	.19	.64	.74	.66	.79	.60	.10	.52	.84	.84	1.16	.69
College	.19	.39	.76	.82	1.05	.64	.22	.41	1.08	1.34	1.31	.87
Mean	.18	.56	.78	.80	.95		.14	.53	.91	1.13	1.39	

Subjects produced more accurate estimates for the infrequent items than for the frequent items, $F(4, 608) = 128.57$, $MS_e = .19$. Instructing subjects about the frequency test prior to the presentation of the materials resulted in increased accuracy but only at higher frequencies of occurrence, $F(4, 608) = 9.49$. For items occurring at the lower frequencies, there was no accuracy difference between informed and uninformed subjects.

As in the case of the size of the frequency estimates, the grade levels of our subjects had little impact upon the accuracy scores, $F(3, 152) = 2.10$, $p > .10$. Students at the different grade levels received no differential benefit from task-specific instructions, $F(3, 152) = 1.36$. There was, however, a significant interaction between grades and frequency of occurrence, $F(12, 608) = 2.00$. The nature of this effect however does not lead one to the conclusion that there is a developmental trend towards an increasing ability to accurately assign estimates of occurrence to events that differ in frequency. The interaction is largely produced by sixth-grade students who showed less average deviation from true frequency for items occurring three and four times than did students at the other grade levels. At the lower frequencies, all grades showed similar deviations. It should be pointed out that it is this particular effect that represents the only difference between the two accuracy measures, deviation scores and number correct. In the case of the latter analysis this interaction was not significant.

Discussion

The results of this study are quite straightforward: Sensitivity to differences in the frequency with which events occur, whether assessed by the accuracy of estimates or by the size of the estimates, appears to be present across the wide range of ages represented by students from elementary school to college. Sensitivity to frequency differences does not diminish when instructions concerning the task are given only after the materials have already been presented. And this is as true of second-grade children as it is of college students. The only impact of appropriate instructions given prior to the presentation of the materials is on the accuracy of the judgments and that difference is present only for higher frequency events and is true for all ages in this study. Thus, second graders are as prepared to process frequency differences among events as are college students, a rather remarkable finding considered against the background of the wide range of memory processes on which second graders are not so well prepared as are college students.

The ability to tag frequency apparently should join the very limited set of cognitive skills that show no developmental trends, although mention should be made here of another study designed to consider the development of frequency judgments for lists of pictures versus lists of words (Ghatala & Levin, 1973) whose conclusion is that there are developmental trends. However, the study reports a complex and contradictory pattern of results for both absolute and relative frequency judgment tasks. These differences may be accounted for by a number of methodological problems, including the use of a single, unique pool of items in the critical frequency slots and an analysis plan based on judgments made of items appearing once versus judgments made on items appearing multiple and varying numbers of times.

In addition to frequency sensitivity, the cognitive skills which show limited development are restricted to judgments of relative recency (cf. Brown, 1975, pp. 140–142) and perhaps to recognition memory (Brown & Campione, 1972; Brown & Scott, 1971; Corsini, Jacobus, & Leonard, 1969). Brown (1975) has argued that these two show no developmental trends as they are "episodic" and "non-strategic" skills. While this may or may not prove to be a useful conceptualization, the present experiment adds one more memory skill to those that show limited development with age. It might be noted that if, as Underwood (1971) proposed, the ability to tag frequency underlies recognition memory then the developmental trends for the two tasks, whatever they are, should be identical.

Sensitivity to the frequency with which events occur is clearly in a domain of cognitive skills that is quite different from the kinds of skills such as elaborative devices and rehearsal strategies which influence learning speed and immediate recall. The next experiment further highlights the rather unusual nature of frequency sensitivity.

Experiment 2

This experiment asked the quite direct question of whether or not the ability to discriminate among events occurring at different frequencies improves with practice. Considered against the background of the fact that subjects who know that they will be asked to frequency estimate are not more sensitive than those who believe something else is required of them, one might suppose that practice should not improve this sensitivity. Considered against the background of the developmental evidence reported in Experiment 1, one might also arrive at the same supposition: If second graders are as sensitive to frequency differences as college students, why should practice (especially on one laboratory list) improve the performance of an adult?

Nevertheless, outside the domain of Experiment 1, there exists a large body of literature on human learning that has demonstrated the facility with which college students improve their cognitive skills, typically after just one exposure to a task (cf. Postman, 1969). Considered against this far more representative background, one would expect improvement in frequency judgments, especially if subjects were provided with feedback regarding the accuracy of their earlier performance.

Method

Design

Subjects were asked to give frequency judgments after viewing each of two successive lists. Within those lists, items occurred at frequencies of 0, 1, 2, 3, and 4. Immediately after completing the judgments on the first list, half of the subjects were given access to information which would enable them to compare the true frequencies with their own judgments. The remaining subjects were given no such feedback. The design was thus a 2 (lists) ×2 (feedback versus none) ×5 (frequency of occurrence) factorial, with repeated measures on the first and last factors.

Materials and Procedure

The materials used in this study were, with one exception, those used in the first study. The exception occurred in the frequency-estimation test lists where for each presentation list 10 items were required to serve as never-presented distractors. In the first experiment these 10 items came from the pool of 48 items on the alternate list. Because in this study, each subject saw both lists, a new set of 20 foils had to be selected, 10 to serve for each list. These were selected using the same criteria as were used in the selection of the original 96 items.

For each of the two lists there were five unique forms produced by the counterbalancing of items occupying the critical positions. Five sets of experimental materials were produced by pairing together one form of each of the two lists. Each set was used equally often for each experimental condition with the sequence of the two lists counterbalanced across subjects.

All subjects were tested individually. They were instructed, prior to the presentation of the first list that they would be asked to judge the frequency with which items occurred immediately after seeing a list of familiar words. The words were presented one at a time using a slide projector, with items exposed for 3 seconds. At the end of presentation subjects were handed a mimeographed sheet of the words on the list and were asked to make a frequency judgment for each item. They were instructed to assign a frequency of zero to words they had never seen. No upper limit on frequency estimates was suggested. Subjects had 2 minutes to make their judgments. Half the subjects were then given 1 minute to look over a feedback sheet that contained items arranged in exactly the same order as they were on the judgment test. Recorded alongside of each item was its actual frequency of occurrence. Subjects could then compare their own estimates for each item with its actual frequency of occurrence. They were told that this feedback might help them to make judgments on the next list. One minute was selected as the time for the provision of feedback on the basis of unpaced pilot subjects who took about this amount of time to look over the answer sheet.

Subjects in the nonfeedback condition spent the 1-minute interval waiting for the experimenter to get ready to present the next list. They were allowed to continue looking over their initial response sheet although they, like the feedback subjects, could not change their answers.

Subjects

The subjects were Temple University undergraduates enrolled in the introductory psychology course. There were 20 subjects per condition. None had ever previously served in an experiment that required frequency estimation as a response.

Results and Discussion

The first dependent measure to be considered is the median estimate assigned by each subject to items at the critical frequencies. As can be seen in Table 3, subjects showed the usual increase in estimates with increases in actual frequency of occurrence, $F(4, 152) = 273.30$, $MS_e = .41$. While the size of the estimates declined slightly from the first to the second list, this difference was not significant, $F(1, 38) = 3.20$, $MS_e = .49$, $p > .05$. This same decline in estimated frequency of occurrence, coupled with no change in the slope of the estimating function has been reported elsewhere (e.g., Reichardt, Shaughnessy, & Zimmerman, 1973).

The provision of information regarding the performance of each subject in the feedback condition did not affect the size of the estimates given by these subjects as compared to those given by subjects not provided with feedback. None of the critical interactions including the feedback variable approached significance.

Feedback, then, had little effect on performance on the second list as judged by the relationship between the estimates assigned and the actual frequencies. It is of special interest in this study to consider the impact of feedback on the accuracy of the judgments. As in the first experiment, two accuracy measures were used: the absolute number correct at each frequency and the mean of the unsigned deviations at each frequency. The deviation measures will be discussed (see Table 4) although both measures revealed only one significant effect: As actual frequency increased, the accuracy of the estimates given declined, $F(4, 152) = 58.46$, $MS_e = .19$. On neither measure did performance improve from the first to the second list and the provision of information regarding accuracy of estimates given on the first list did not influence performance on the second list.

Thus, the only change in frequency sensitivity that resulted from practice was in the slightly lower estimates given on the second list. The slope of the estimation function remained the same, as did the accuracy of the judgments.

TABLE 3

MEANS OF THE MEDIAN FREQUENCY ESTIMATES

Condition	List	Frequency of occurrence 0	1	2	3	4	Mean
Feedback	One	.12	.92	2.00	2.82	3.35	1.84
Feedback	Two	.12	.82	1.92	2.40	3.00	1.65
Mean		.12	.87	1.96	2.61	3.18	
No feedback	One	.12	.98	1.78	2.40	3.25	1.71
No feedback	Two	.22	1.05	1.78	2.38	2.78	1.64
Mean		.17	1.02	1.78	2.39	3.01	

TABLE 4

MEANS OF THE MEAN UNSIGNED DEVIATION SCORES

Condition	List	Frequency of Occurrence					
		0	1	2	3	4	Mean
Feedback	One	.14	.32	.81	.84	1.18	.66
Feedback	Two	.19	.44	.75	1.05	1.09	.70
Mean		.16	.38	.78	.94	1.14	
No feedback	One	.26	.40	.78	.95	.96	.67
No feedback	Two	.26	.42	.91	.99	1.15	.75
Mean		.26	.41	.84	.97	1.06	

GENERAL DISCUSSION

Earlier research has already shown that humans have the ability to mark or tag frequency of occurrence (Hintzman. 1969). The range of real-world events whose occurrence information people note includes items abstracted from the flow of information, such as single letters and pairs of letters. Presumably then, people are also marking with frequency tags information that is of more vital significance to them. In light of this evidence it is perhaps not surprising that frequency performance is not especially improved when subjects are alerted that that is the task required of them in an experimental situation (Experiment 1; Flexser & Bower, 1975; Howell, 1973).

There is also some laboratory evidence that separate frequency counts are kept of events that are seemingly highly similar. So, for example, persons can make fine-grained distinctions between the frequency of verbatim repetitions of a sentence and of repetitions that retain the gist of a sentence (Gude & Zechmeister, 1969). They can also distinguish, although not perfectly, between the frequency of overt occurrences of events and of their own reflections (images, thoughts) on those events (Johnson, Taylor, & Raye, 1977).

The two studies reported here contribute to the literature on this remarkable memory skill. The ability to frequency count does not show a developmental trend across the range of ages from second grade to college. At none of these age levels is this ability affected by explicit instructions regarding the forthcoming task. While it would be useful to extend the age range over which this skill is assessed, it is nonetheless remarkable that there is no evidence of an increasing ability to tag frequency—either in terms of the relative size of the estimates or in terms of the accuracy of the estimates. Young children are as prepared to process frequency information as are young adults. Hence, it is not surprising that practice at frequency counting does not improve the performance of young adults. Indeed specific feedback on a prior list does not affect the accuracy of judgments made on a subsequent list.

That there are no instructional differences in sensitivity to frequency differences suggests that frequency counting or tagging is something which the organism engages in as an essential component of his processing of the world; or in the case of this study, in the processing of a list of words. That sensitivity to frequency appears to be as high for young children as it is for college students and that training does not improve the performance of college students suggests that this kind of processing is an automatic or an essential aspect of information consumption at least as early as grade school. Indeed, the suggestion has been made that frequency tagging may be invulnerable to certain state alterations, e.g., alcohol-induced intoxication (Johnson, in press).

While there is now considerable evidence concerning the sensitivity of humans and perhaps of some animals (cf. Herrnstein & Hineline, 1966) to the frequency of events, it becomes important to consider at least briefly the significance of this information to an organism. People may rely in part upon frequency information in order to decide the likelihood that some piece of plausible information is in fact true (cf. Hasher et al., 1977). They may use their knowledge of the frequency of bigrams to help solve anagrams (Fink & Weisberg, Note 1), or, to play Scrabble. Frequency information may be an important determinant (albeit not a sufficient one) in the formation of typicality constructs of categories in the real world (Rosch, Simpson, & Miller, 1976). Frequency information is useful in forming expectancies or predictions concerning the likelihood of certain events (cf. Estes, 1976). It may also constitute a portion of the information used by animals in allocating their eating behavior (cf. Collier & Kaufman, Note 2). And, it may well be the major source of information used in distinguishing old events from new ones (Underwood, 1971).

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