arousal when exposed to the very loud speech. The females gave only slight indications of increased negative arousal with increased speech loudness. Whether this represents a genuine effect or simply a tendency for females to give more socially desirable responses cannot be determined from the available data.

The mood and evaluation ratings also provided evidence that credibility of the speaker was successfully varied. Ss rated themselves as more *helpless* when listening to the high-credible speaker. This effect might be interpreted to mean that they felt more vulnerable to his arguments. Also, Ss felt more *restless* when listening to the high-credible speaker. Further evidence was provided by the trend toward perceiving the high-credible source as giving more reasonable arguments and as easier to understand.

Since arousal and credibility both appeared to have been successfully manipulated, it was surprising that credibility had no effect on persuasion. A similar failure of the credibility manipulation was obtained by Hendrick & Borden (1970) using a similar issue. Such a failure is puzzling since the effect of credibility is one of the best established results in attitude research. The failure may be due to the factual issue that was used. Insko (1967) noted that a few studies have not found attitude change as a function of variation in credibility. Insko suggested that the influence of source credibility may be inversely proportional to the logical soundness of the communication. If a communication is very logical and well supported by evidence, variation in credibility may not make much difference. This interesting possibility remains to be tested.

The attitude results for females were consistent with the results for females obtained by Hendrick & Borden (1970). In both experiments, females were less persuaded under high arousal than under low arousal. The nature of these sex differences is unclear, but they do not support the hypothesis of a positive relation between arousal and persuasion. In fact, the results for females provide strong support for Janis & Feshbach's (1953) finding of an inverse relation between fear and persuasion. Most recent research has strongly questioned Janis and Feshbach's results (McGuire, 1966).

The pattern of results for the mood ratings and the attitude data considered jointly suggests an interesting interpretation of the attitude data. Inspection of the eight means in Table 2 reveals that six of the means are quite similar. Males in all four conditions and females in the two moderate-volume

conditions were all persuaded to about the same extent. Females in the two high-volume conditions showed a relative resistance to persuasion since their means were higher. Listening to the speech under intense sound may have created a state of cognitive dissonance (Festinger, 1957) in the Ss. The males resolved their dissonance by becoming hostile. With dissonance thus reduced, they were just as vulnerable to persuasion as males in the moderate-volume conditions. However, females apparently did not reduce much of their dissonance by hostility. Instead, females in the intense-sound conditions reduced dissonance by resisting the communication, thereby being persuaded less than females in the moderate-sound conditions.

The most unusual result of the experiment was the outcome for recall. The interaction between credibility and volume was not expected and is not easily explained. The results are unusual because no previous experiments have found credibility of the source to affect learning of the communication. McCroskey (1968) noted this lack of a relation between source credibility and learning, but still felt intuitively that a high credibility source should command greater comprehension. The pattern of the recall means shown in Table 1 reveals a more complicated story, however. Under high sound intensity, listening to the high-credible source did indeed result in better learning than listening to the low-credible source.

However, under moderate sound intensity (most comparable to everyday listening conditions), listening to the low-credible source resulted in better learning than listening to the high-credible source. An explanation for these learning effects must await future research.

REFERENCES

- FESTINGER, L. *A theory of cognitive dissonance*. Evanston, Ill: Row, Peterson, 1957.
- HELMREICH, R., KUIKEN, D., & COLLINS, B. Effects of stress and birth order on attitude change. *Journal of Personality*, 1968, 36, 466-473.
- HENDRICK, C., & BORDEN, R. Effects of extraneous fear arousal and birth order on attitude change. *Psychonomic Science*, 1970, 18, 225-226.
- INSKO, C. A. *Theories of attitude change*. New York: Appleton-Century-Crofts, 1967.
- JANIS, I., & FESHBACH, S. Effects of fear-arousing communications. *Journal of Abnormal & Social Psychology*, 1953, 48, 78-92.
- McCROSKEY, J. C. *An introduction to rhetorical communication*. Englewood Cliffs, N.J: Prentice-Hall, 1968.
- McGUIRE, W. J. Inducing resistance to persuasion. In L. Berkowitz (Ed.), *Advances in experimental social psychology*. Vol. 1. New York: Academic Press, 1964. Pp. 191-229.
- McGUIRE, W. J. Attitudes and opinions. *Annual Review of Psychology*, 1966, 17, 475-514.
- SIGALL, H., & HELMREICH, R. Opinion change as a function of stress and communicator credibility. *Journal of Experimental Social Psychology*, 1969, 5, 70-78.

NOTE

1. Hendrick, C. Fear arousal and attitude change: A general hypothesis. Unpublished manuscript, Kent State University, 1968.

Variable length consonant stimuli in a "Peterson & Peterson" short-term memory paradigm

B. JAMES STARR,* Howard University, Washington, D.C. 20001

GILBERT J. HARRIS, New York State Institute for Research in
Mental Retardation, Staten Island, N.Y. 10314

and

ROBERT ARONOFF, State University of New York at Buffalo, Buffalo, N.Y. 14226

The effects of stimulus length, interpolated task interval, and rehearsal upon recall in a "Peterson & Peterson" short-term memory paradigm were tested. All three main effects, but none of the interactions attained significance. The superiority of self-initiated as opposed to E-paced rehearsal was suggested as was the increased necessity for any type of rehearsal as stimulus length increased.

The rapid forgetting that characterizes

*Thanks are due to Dr. Roy Lachman and Dr. Hayne Reese for helpful suggestions regarding the design of the present study.

short-term memory may be strikingly demonstrated utilizing an experimental paradigm developed by Peterson & Peterson (1959). S was presented with a

Table 1
Mean Number of 3-, 5-, and 7-Consonant Stimuli Correctly Recalled (Parenthetical Figures Refer to Percentage Correctly Recalled)

Interpolated Task Duration	Stimulus Length		
	3 Consonants	5 Consonants	7 Consonants
Paced Vocal (N = 12)			
3 Sec	7.50 (93.75)	3.66 (45.75)	0.42 (00.53)
9 Sec	5.75 (71.88)	2.00 (25.00)	0.33 (00.41)
18 Sec	4.17 (52.13)	1.83 (22.88)	0.17 (00.21)
No Instruction (N = 12)			
3 Sec	7.25 (90.63)	4.00 (50.00)	1.33 (16.63)
9 Sec	6.25 (78.13)	3.00 (37.50)	1.08 (13.50)
18 Sec	5.92 (74.00)	2.33 (29.13)	0.42 (00.53)
No Rehearsal (N = 12)			
3 Sec	6.25 (78.13)	1.92 (24.00)	0.08 (00.10)
9 Sec	4.17 (52.13)	0.92 (01.15)	0.17 (00.21)
18 Sec	3.83 (47.88)	0.58 (00.73)	0.00 (00.00)

consonant trigram to be remembered. Before being asked to recall it, however, he performed a well-defined task (counting backward by threes or fours) in order to prevent rehearsal. Less than perfect recall obtained with as little as 3 sec of such interpolated activity. Increasing its duration to 18 sec further decreased the probability of correct recall of the trigram. In a second experiment, Peterson & Peterson (1959) showed that paced, but not unpaced rehearsal prior to the interpolated activity increased the probability of correct recall. Melton (1963) has shown that correct recall decreases as the number of consonants in the syllable to be remembered increases. The present study sought to explore the interaction between rehearsal condition and stimulus length in the Peterson & Peterson paradigm.

METHOD

The Ss were 36 introductory psychology students at the State University of New York at Buffalo fulfilling a course requirement.

A 3 by 3 by 3 mixed experimental design was employed. Stimulus length (3, 5, and 7 consonants/stimulus) and interpolated task duration (3, 9, and 18 sec) were manipulated within Ss while rehearsal (paced vocal, no instruction, and no rehearsal) was varied between Ss. Each S was given eight trials for each of the nine possible pairings of stimulus length and interpolated task duration. The 72 resulting trials were randomized for each S with each of the nine appearing once in each of eight blocks.

Each stimulus contained letters that were auditorily distinct from one another (Conrad, 1964) and that never or rarely appeared contiguously in written English (Mayzner & Tresselt, 1965). Obvious abbreviations were excluded. Three series of 24 stimuli each (3, 5, and 7 consonants/stimulus) comprised the 72 stimuli.

Each S was tested individually. E read the first stimulus, consonant by consonant, in time with a metronome set to beat two times per second. Depending upon rehearsal condition, S was either instructed to rehearse the stimulus in time with the metronome (paced vocal) or instructed that there would be a short interval (no instruction). The duration of the rehearsal interval was 5, 8, or 11 sec, depending on stimulus length. Time intervals were selected as sufficient for three repetitions of the stimulus. After the allotted rehearsal time (or directly after stimulus presentation for the no-rehearsal group), E read a three-digit number that S was to use in the interpolated activity. Half the Ss in each group counted backward by threes, the other half by fours, in time with the metronome. Upon expiration of the interpolated task duration for that trial, a light signaled S to recall the stimulus verbally. A 15-sec intertrial interval was employed to minimize proactive inhibition (Peterson, 1963). A response was considered correct only if it was recalled exactly as presented.

RESULTS

Mean number of correctly recalled stimuli for all experimental conditions, collapsed across the eight trials for each, is shown in Table 1. The heterogeneity of the distributions of the criterion measures necessitated the exclusion of the effects of the seven-consonant stimuli from the analysis of variance performed.

A chi-square test ($\chi^2 = 12.10$, $df = 2$, $p < .01$) on the data for the seven-consonant stimuli (collapsed across interpolated task interval) indicated that individual recall was better in the silent rehearsal condition than in either of the other conditions.

Although no interaction effects attained significance in the analysis of the three- and five-consonant stimuli, all three main effects were significant: Rehearsal condition, $F(2,33) = 5.80$, $p < .01$

indicated superior performance for both rehearsal groups as opposed to the no-rehearsal condition; stimulus length, $F(1,33) = 304.96$, $p < .001$ showed a sharp decrease in performance for the five-consonant stimuli; interpolated task duration, $F(2,66) = 58.63$, $p < .001$ indicated that performance decreased as the duration increased.

DISCUSSION

The present results for the three-consonant stimuli are consistent with those reported by Peterson & Peterson (1959). Although it failed to reach statistical significance, the superiority of the no-instruction rehearsal condition over the paced vocal-rehearsal condition is contrary to the trend reported in the earlier study. This suggests that self-initiated rehearsal is more efficient than E-paced rehearsal. This interpretation is further supported by the analysis of the seven-consonant stimuli.

Increased stimulus length did decrease performance, although it did not interact with rehearsal condition. The lack of such an interaction may be an artifactual "basement effect." Namely, with five-consonant stimuli and no rehearsal, very few items were recalled correctly. Further, with seven-consonant stimuli and no rehearsal, virtually no correct responses were obtained. This suggests that rehearsal becomes more important in short-term memory as the amount of information to be remembered increases.

Clearly, Brown's (1958) idea that rehearsal merely delays the onset of trace decay is not supported. Such a notion would predict equal rates of forgetting for the three rehearsal conditions, given equal interpolated task durations. However, the question of whether rehearsal strengthens the trace or wards off interference or both is left unanswered by the present results.

REFERENCES

- BROWN, J. Some tests of the decay theory of immediate memory. *Quarterly Journal of Experimental Psychology*. 1958. 10. 12-21.
- CONRAD, R. Acoustic confusions in immediate memory. *British Journal of Psychology*. 1964. 55, 75-84.
- MAYZNER, M. S., & TRESSELT, M. E. Tables of single letter and digram frequency counts for various word-length and letter-position combinations. *Psychonomic Monograph Supplement*, 1965, 1(2, Whole No. 2), 13-32.
- MELTON, A. W. Implications of short-term memory for a general theory of memory. *Journal of Verbal Learning & Verbal Behavior*, 1963, 2, 1-21.
- PETERSON, L. R. Immediate memory: Data and theory. In C. N. Cofer (Ed.), *Verbal behavior and learning: Problems and processes*. New York: McGraw-Hill, 1963. Pp. 336-353.
- PETERSON, L. R., & PETERSON, M. J. Short-term retention of individual verb. items. *Journal of Experimental Psychology* 1959, 58. 193-198.