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ABSTRACT

A program of experimental research has established a relationship between associative reaction time (RT--the time between the presentation of a verbal unit and the first association produced) and performance in verbal learning. Initial studies established that the RT value of verbal units used as response terms has a significant facilitative effect on performance in paired-associate learning (PAL), i.e., within levels of equated meaningfulness (M), response-term units with short-latency (LL) RT values. It was hypothesized that RT and M play different roles in the PAL process. On the basis of the notion of different roles, Ley and Locascio proposed a modification of the two-state analysis of PAL in which the response-learning stage was viewed as consisting of two processes: recognition and recall. Directed by this proposed model, Ley and Locascio designed a study in which a familiarization technique designed to strengthen the recognition response potential of verbal response units was introduced prior to a PAL task. Although the results of the research supported the hypothesis that recall of verbal units was related to making associations to the units during study, it was still unclear as to what the underlying mechanism is by which associations aid in the recall process. A number of questions still remain to be answered in the area of associations and RT. (CK)

Associative Reaction Time in Language Acquisition

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Over the past several years an ongoing program of experimental research has established a relationship between associative reaction time (RT--the time elapsing between the presentation of a verbal unit and the first association produced) and performance in verbal learning. Developing concurrently with this research has been the rudiments of a theory of verbal learning which has implications for language acquisition in general.

Initial studies in this research program established that the RT value of verbal units used as response terms has a significant facilitative effect on performance in paired-associate learning (PAL) (Ley, 1968; Ley & Anderson, 1969; Ley & Locascio, 1970a), i.e., within levels of equated meaningfulness (M), response-term units with short-latency (SL) RT values are learned in fewer trials than units with long-latency (LL) RT values. This relationship between RT and performance is not found however when the verbal units used as stimulus terms in the PAL task (Ley & Locascio, 1970b). However, if a backward recall task is introduced following the standard forward-anticipation PAL task, and the verbal-unit stimulus terms become the response terms to be recalled, again RT is found to be related to performance, i.e., the SL verbal units are recalled more frequently than the LL units (Ley & Locascio, 1970b).

The results of these early studies showed then that RT is related to performance only when the verbal units are used as response terms that S must recall. Meaningfulness, on the other hand,

was found to be related to performance in PAL whether the verbal units were used as response terms (Ley, 1968; Ley & Anderson, 1969; Ley & Locascio, 1970a), or as stimulus terms (Ley & Locascio, 1970b). This observed descrepancy between the effects of RT and M of stimulus terms on PAL, in spite of the relatively high correlation between RT and M (Ley & Locascio, 1970a) and in view of the fact that both RT and M of response terms affect performance, suggested the hypothesis that RT and M play different roles in the PAL process.

On the basis of the notion of different roles, Ley & Locascio (1970b) proposed a modification of the two-stage analysis of PAL (e.g., Underwood & Schulz, 1960) in which the response-learning stage was viewed as consisting of two processes: recognition and recall. Associative reaction time was posited as the variable underlying the recall process in PAL, a formulation consistent with the evidence that RT has an effect only on the terms which must be recalled in PAL; and meaningfulness was posited as the variable underlying recognition. Since recognition of both stimulus and response terms is necessary in PAL, M of both terms affects performance.

This proposed modification is consistent with several current theories concerning the function of M. The greater the M of a verbal unit, the more readily that unit can be pronounced (Underwood & Schulz, 1960), or recognized (Goss, 1963), or perceptually encoded (Martin, 1968); and thus the sooner that unit can serve as a functional stimulus (or response) unit in the association stage of PAL.

Directed by this proposed two-stage model of PAL, in which RT is posited as underlying a process other than recognition, Ley and

Locascio (1970c) designed a study in which a familiarization technique designed to strengthen the recognition response potential of verbal response units was introduced prior to a PAL task. Consistent with the predictions from the proposal of different roles, the familiarization treatment was found to interact with M, but not with RT, i.e., the effect of familiarization trials was limited to facilitation of the learning of low-M response pairs.

Although the results of the foregoing research had all been consistent with the proposed modified two-stage analysis, the relationship between RT and recallability had not been directly studied, i.e., does RT, as an index of the speed with which associations to discrete stimuli are elicited, have an effect on recall performance in general, or is the effect and artifact of the PAL task, the only task in which the effect of RT had been tested? If the effect of RT is on recall performance in general, then it would be expected that in a free-recall task, RT, within levels of M, would have a facilitative effect on recall performance, i.e., short-latency RT verbal units would be recalled more frequently than long-latency RT units. Further, if RT, as an index of the facility with which associations are made to stimuli, is related to recallability, it follows that making associations to stimuli is important in recall. If this relationship between associations to stimuli and ability to recall exists, then recall performance should be a function of the opportunity S has to make associations to stimuli during study. Both of these hypotheses were confirmed in a study by Locascio & Ley (1971), i.e., in a free recall task, short-latency units were recalled more frequently than long-latency units when Ss were instructed before the study trial to either

silently rehearse or to pronounce and repeat aloud, whereas no difference between short- and long- latency units was observed when Ss were instructed to make single free associations to the units or multiple associations to the units and Ss who studied via the silent rehearsal and associations modes recalled significantly more verbal units than Ss who studied via the repeated pronunciations mode.

Although the results of the research at this point clearly supported the hypothesis that recall of verbal units was related to making associations to the units during study, it was still unclear as to what the underlying mechanism is by which associations aid in the recall process. An hypothesis to account for this mechanism had been suggested from informal observations during the recall period of the free-recall study. Many times Ss in the groups who had been instructed to study by making associations would say aloud these associations during the recall period. Then Ss would appear to use these associations responses as stimuli for eliciting the verbal unit which was to be recalled. These Ss appeared in essence, to be cueing themselves with their own associations. Our next experiment (Ley & Locascio, 1971) was designed, therefore, to test the hypothesis that beingcued by one's associations results in better recall performance than not being cued. The results of this study showed that cueing Ss with their own associations had a facilitative effect on recall performance; and these results suggested the hypothesis that the associations serve as retrieval cues for recall.

If as these results suggest, the association response is functioning as a stimulus for retrieval of the verbal unit from

memory during the recall period, then what accounts for the ready availability of this association response? For in order for the association to serve as a retrieval cue, it would itself have to be available during the recall period. This problem was addressed in a recent study (Locascio & Ley, 1972) in which Ss rated the meaningfulness (M) of 319 CVCVC words and paralogs and the most frequent association response which had been made to these verbal units in a previous study. For 270 of these pairs, Ss rated the association higher in M than the stimulus verbal unit, for 37 pairs there was no difference between the ratings, and for only 12 pairs was the CVCVC verbal unit rated higher in M than its associate, and all 12 of these CVCVC were of very high M. These results suggest that the associations made to verbal units are likely to be of higher M than the verbal unit to which they were made, and high M terms are more likely to be available during the recall period.

Although research in the area of associations and RT has to date raised more questions than it has answers, there are already emerging some interesting implications for language acquisition, and perhaps education in general. To begin with, our research suggests that one must make associations to verbal material during learning in order that the material can be later recalled, and that some procedures such as repeatedly saying the material aloud interferes with the association process, and therefore can have a detrimental effect on learning. Additionally, our work has shown that associations cannot be made to all verbal materials at the same rate, and suggests that the proper amount of time for study might possibly be defined as the time it takes one to make

an association response to the verbal material being studied. This, of course, suggests the notion that verbal material that cannot elicit an association from an individual cannot be learned by that individual, a notion which is consistent with the idea of existing cognitive structures being necessary for assimilation of new material. Additionally, this notion of associations being necessary suggests that one should be able to predict learning of verbal material or perhaps even reading comprehension on the basis of the associative reaction times of individuals to key verbal stimuli from the material to be learned. These questions and a host of others remain to be investigated.

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