DOCUMENT RESUME

ED 096 616 CS 001 326

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TITLE Extraversion-Introversion and Verbal Learning.
PUB DATE Sep 74
NOTE 24p.; Paper presented at the Annual Meeting of the American Psychological Association (82nd, New Orleans, Louisiana, August 30-September 3, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Educational Research; *Learning Theories; *Literature Reviews; *Paired Associate Learning; *Personality Studies; Serial Learning; *Verbal Learning
IDENTIFIERS *Extraversion; Introversion

ABSTRACT

The data from verbal learning studies have been partially instrumental in the development of the theory of extraversion-introversion (E-I) relative to levels of cortical arousal. In most of the studies relating E-I to verbal learning, the approach was to determine if there was an overall superiority for one of the personality groups. Differences in performance, even when obtained, do not prove that there are differences in learning rates. A stage analysis of paired-associate learning is one step in the direction of trying to localize the effects of E-I. Many researchers interested in the relationship of personality variables to verbal learning tasks are in essential agreement concerning the research strategy to be pursued. The shift is away from tasks such as paired-associate and serial learning toward the free recall tasks and recognition tasks. These tasks provide tools to answer much more specific questions. The specific questions being asked include the relationship of anxiety, extraversion, neuroticism, and ego-involvement to clustering, filtering, categorizing, pigeon-holing, detection sensitivity, and decision criteria. Relationships of this type wil likely prove to be more valuable to our understanding of these personality dimensions. (Author/WR)

Extraversion-Introversion and Verbal Learning

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Presentation in a Symposium: Personality Variables in Verbal Learning and Verbal Behavior Research

American Psychological Association 82nd Annual Convention
New Orleans, 1974

The purpose of this paper is to examine the relationship of the personality dimension extraversion-introversion (E) to performance on verbal learning tasks in human subjects. A secondary emphasis will be given to the neutrocism (N) dimension since this personality dimension is theoretically related and has been investigated in many of the studies dealing with E. Before reviewing the major studies and findings it should be valuable to briefly review the status of the E and N dimensions.

As long as there has been anything which can be called personality theory attention has been given to the E and N dimensions. The E dimension was given a big boost by the dominance and importance Carl Jung ascribed to this personality characteristic. Hans Eysenck, however, must be credited with the contemporary interest in this dimension. During the 1940 and 50s Eysenck approached the analysis of personality from a quantitative and factor analytic perspective. His early work dealt with descriptions of individual differences in personality traits and the results of his studies supported the notion that there are two major personality dimensions -- E and N. Many other researchers who also have used the factor analysis tool (e.g. Cattell and Guilford) are in essential agreement that the E and N dimensions are dominant. They part company however in their emphasis as to the significance of finding those dimensions as first order factors. It is Eysenck's bias that it is more valuable to

relate differences on these dimensions to other aspects of behavior and develop explanations of these basic dimensions rather than proliferate dimensions which account for less and less of the individual differences of personality dimensions.

After studying the relationship of E to conditioning, perception and learning tasks, Eysenck proposed a theoretical model based on inhibition-excitation. This model was directly related to the work of a number of experimental psychologists but most importantly the work of Pavlov and Hull. The research which derived from the theory was never entirely supportive. Some of the data were easily accommodated by the theory but in major areas such as classical conditioning and pursuit rotor performance the data were at best equivocal. In the late 1960s Eysenck reformulated the theory and modified the emphasis on excitation-inhibition in several critical ways. The most recent formulation of the theory now emphasizes brain activity and specifically cortical arousal as the major physiological basis for differences in E.

Both personality dimensions E and N both relate to the level of emotion and arousal in an organism. Differences in E are postulated to be associated with differential thresholds in various parts of the ascending reticular activating system. It is theorized that introverts differ from extraverts in their level of cortical arousal because of their differential reaction to internal and external sources of stimulation. Introversion is associated with lower tresholds of excitation ascending reticular activating system which results in an amplification of stimulus inputs. Conversely extraversion having a higher threshold for activation of the ascending reticular activating system results in lower levels of cortical arousal when amount of stimulation is equal for individuals on the two extremes of the dimension.

Extraversion is a personality dimension which is characteristically thought to be normally distributed rather than a bimodally distributed trait. Most individuals would thus be characterized as ambiverts. Most of the research has concentrated on studying differences in individuals scoring at the extremes of this dimension. The most common method of measuring E presently is by the use of the Eysenck Personality Inventory. This 56 item paper and pencil test is a modification of the earlier Maudsley Personality Inventory and has scales for E and N. Many other paper and pencil personality tests have measures of E and anxiety which are highly correlated with the E.P.I. measures. A number of other approaches have also been used including self-ratings, a lemon-drop test and clinical judgments to measure E and N. These have been well documented in the literature and tend to substantiate that E and N are traits which can easily and reliably be measured with objective personality tests.

The behavior patterns of extraverts can be expected to differ in order to compensate for their different levels of cortical arousal and the sensory stimulation needed to maintain an optimal level. It is hypothesized that the extravert learns a whole series of behaviors which are adaptive to his condition and facilitate the maintenance of an optimal level of arousal. For example, it is hypothesized that extraverts should take more stimulant drugs (e.g. nicotics, coffiene), change tasks readily, seek noisy and social environments, provide internal stimulation through changes in body position, etc. Conversely, the introvert is more of a loner, seek environments with minimal distractions, avoid stimulants, etc. Since the types of items on the E.P.I. identify extraverts and introverts on items similar to these different behavior patterns, one cannot infer this as verification but as a group, the differences described above have been found in a number of studies.

Before providing the details of the theoretical model which has generated the research in verbal learning, I think a few words need to be said about the N dimension and its relationship to cortical arousal. First of all N is closely associated with the more familiar dimension of anxiety and is related to a predisposition of becoming neurotic. Neuroticism is also a normally distributed dimension with stable and labile being the extremes. According to Eysenck differences in the behavior associated with the extremes on the N dimension are identified with differential thresholds of arousal in the v[illegible]ral brain, i.e. the hippocampus, amygdala, cingular system, and hypothal[illegible]s. Thus the N dimension is most closely associated with emotional responsiveness or exitation. Considering the differences between E and N, Eysenck has agreed that cortical arousal can be produced along two quite distinct and separate pathways. Cortical arousal can be produced by internal or external sources of stimulation or such cognitive activities as problem solving without necessarily involving the visceral brain at all. Cortical arousal, however, can also be produced by emotion, in which case the reticular formation is involved through the ascending and descending pathways connecting it with the hypothalmus. Thus, Eysenck postulates that there is a degree of partial independence between autonomic activation and cortical arousal; activation always leads to arousal, but arousal very frequently arises from types of stimulation that do not involve activation. There is also a difference in the active vs. reactiveness of these dimensions. Extraversion is thought to have a continued effect such that under the same level of stimulation the introverts is characterized as having a higher level of cortical arousal. This is not always the case with N. High N individuals and low N

individuals (with E a constant) may or may not be different in levels of activation and thus arousal is partially dependent on the emotional cues present in the environment. High N individuals react to emotional cues and thus have a heightened cortical arousal level, however, when these cues are absent there are no differences between the high N and low N individuals in terms of activation or cortical arousal.

The Theory of E Related to Verbal Learning

In accord with the earlier theoretical model Eysenck (1957) hypothesized that since extraverts build up reactive inhibition more quickly than introverts that they should have higher reminiscence scores on pursuit rotor learning tasks. The evidence has supported this hypothesis but a complication developed. Contrary to the prediction from the Hull-Kimble inhibition theory, Eysenck (1962) showed that instead of having lower pre-rest scores extraverts differed from introverts by having higher post-rest scores. The failure of inhibition theory led Eysenck (1965) to propose a three-factor theory of reminiscence, retaining the concepts of reaction and conditioned inhibition to account for certain phenomena associated with reminiscence and performance, and incorporating some principles from the memory consolidation theory of Walker (1958). According to Walker's theory of consolidation, an associative event sets up a perseverative trace in the nervous system which persists for some time. In this active phase, during which permanent memory is laid down, there is a degree of temporary inhibition of recall that serves to protect the consolidating trace against disruption. High arousal at the time of the associative event is postulated to result in a more intensely active trace process, which leads to superior ultimate memory, but also to a greater temporary inhibition against immediate recall. Support for this theory as it applies to verbal learning has been provided in numerous experiments

(e.g. Kleinsmith & Kaplan, 1963, 1964, Walker & Tarte, 1963) demonstrating the predicted interaction between level of arousal and time of recall in determining paired-associate learning.

Eysenck has not abandoned his old theory but has argued that reminiscence is due primarily to consolidation or to inhibition depending on certain characteristics of the task in question. Reminiscence on tasks that involve a great deal of new learning, or subject to drive-level manipulation, is hypothesized to reflect primarily the process of consolidation. Conversely, tasks that are not heavily dependent on new learning, and in which drive level is less implicated, reminiscence is hypothesized to result largely from the dissipation of reactive inhibition. Verbal learning and pursuit rotor tasks are examples of the former, while reaction time and vigilance are examples of the latter.

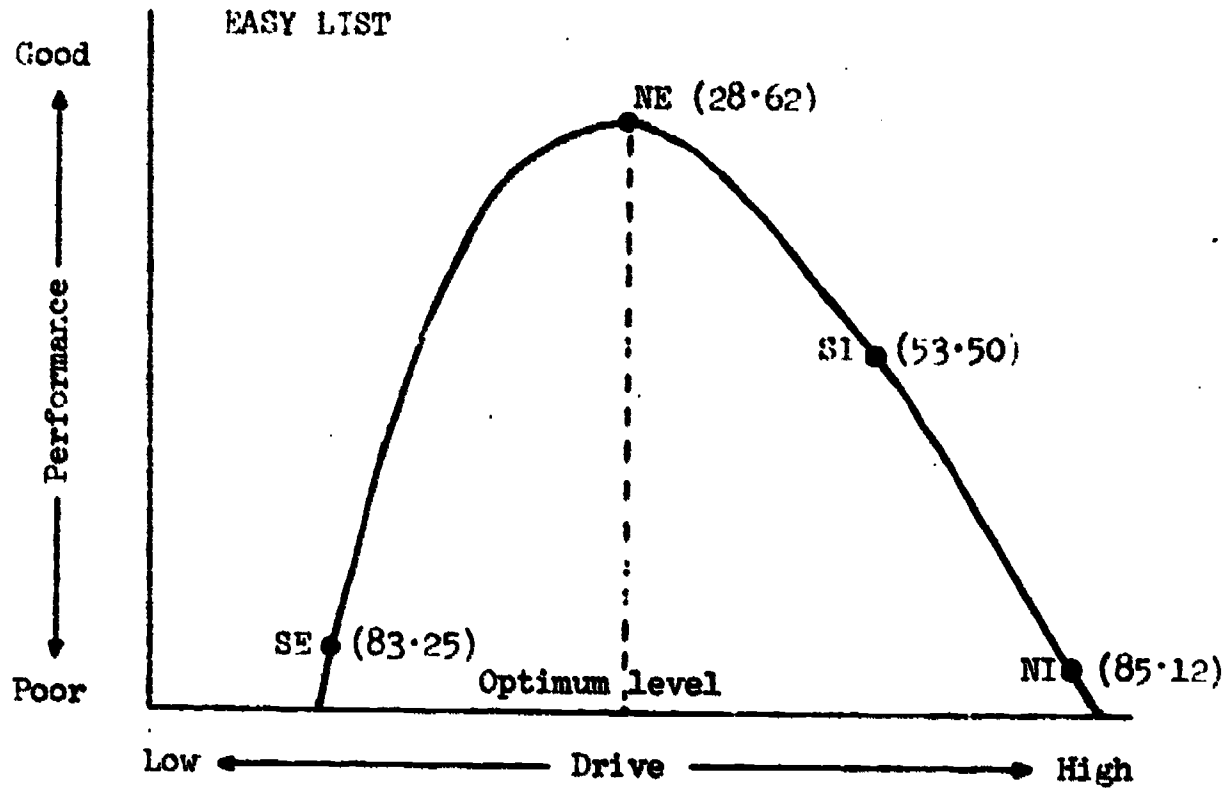
The Research on E Related to Verbal Learning

Prior to 1967 a number of studies using verbal learning tasks were completed which did not support the theory that introverts should be superior to extraverts because they built up reactive inhibition more gradually. Although the results were often not dramatic, studies by Jensen (1962; 1964), Shangmugan and Santhanan (1964), and Howarth (1963) supported the conclusion that extroversion is associated with superior learning and memory especially when the interval between learning and recall is short. These studies supported a need to modify the inhibition theory although as previously mentioned the impetus came from the work on the pursuit rotor task.

Eysenck and I (1967) designed a study to explore the relationship of E and N and the superiority of E using a paired-associate (P-A) task. This study was based on the hypothesis that the four personality groups (E HN; E LN; I HN; I LN) can be arranged along a continuum of arousal,

from the lowest (E LN) to the highest (I HN), with the other two intermediate. This prediction assumes that the P-A task, the laboratory environment and being tested activates "neuroticism" in individuals so predisposed. Thus the high neuroticism-introverts is cortically aroused on both counts: neuroticism and introversion. On the basis of the Yerkes-Dodson Law it was predicted that for a difficult P-A task the optimum point on the inverted-U shape should shift towards the low arousal end of the continuum. An easy and difficult P-A task was constructed manipulating letter repetition to increase task complexity and difficutly. Sixteen Ss of each of the four personality groups were assigned to either the "easy" or "difficult" list. The results indicated that extraverts performed significantly better than introverts on both tasks. Of additional interest, however, was the fact that the second order interaction (EX NX Difficulty) was also found to be significant. This data shown in Fig 1 indicates high neuroticism-extraverts are superior to low neuroticism-extraverts on the easy list, while the reverse is true on the difficult list. Similarly, high neuroticism-introverts learn faster on the difficult task and slower on the easy task than low-neuroticism introverts.

After finding that at least the theory was correct with respect to immediate recall it was necessary to extend this work and substantiate the remaining portion of the theory. That is, introverts are hypothesized to be at a disadvantage with immediate recall but when time is allowed for consolidation to occur their performance should increase and show the reminiscence effects demonstrated by other investigators with stimulus-produced states of arousal. (Kleinsmith & Kaplan 1963, 1964 et al.) In this study (McLaughlin, 1968) I varied the recall intervals, using immediate recall and intervals of 1, 2 or 7 days. Seventy-five Ss were tested



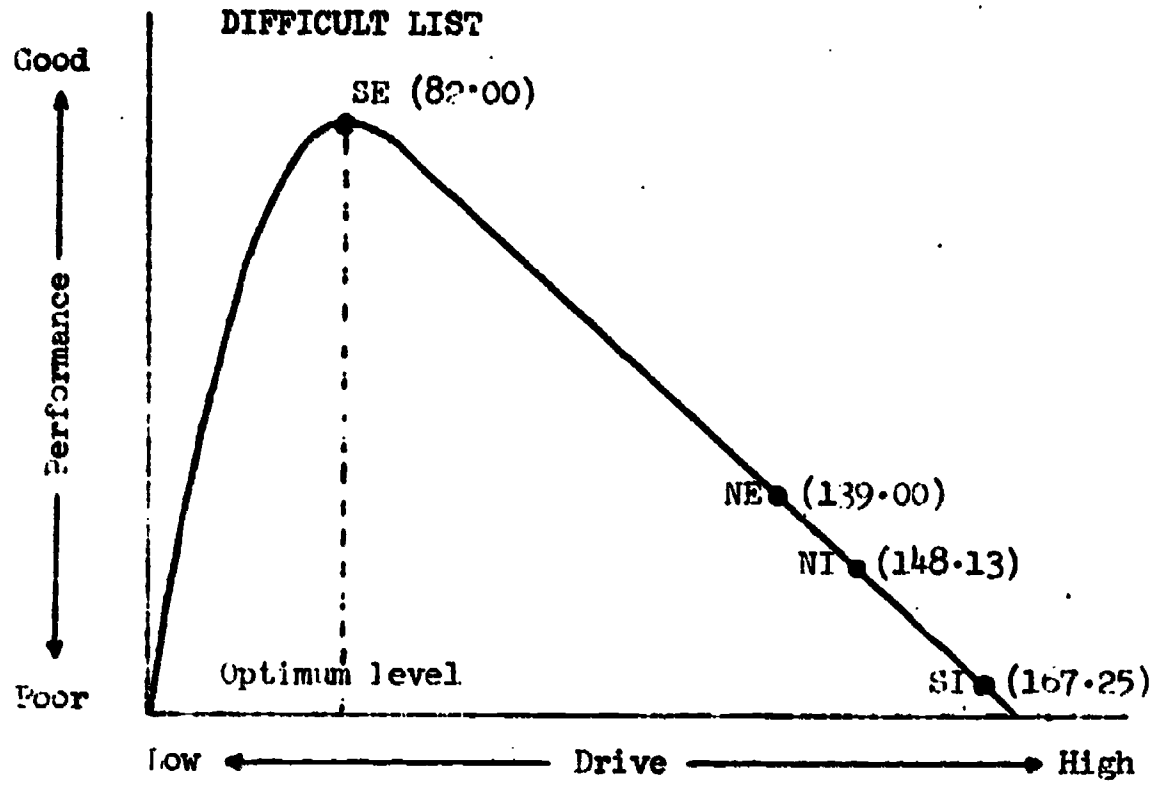


FIG. 1 The relationship of number of errors to criterion and the hypothesized level of arousal for the easy and difficult lists. (Belanchlin & Eysenck, 1967)

after having been selected on the basis of the E.P.I. from a larger group of 141 and assigned to one of the four personality groups (HN E, LN E, HN I, LN I). The list to be learned consisted of 12 pairs with 3-letter words as stimuli and 40 percent association value nonsense syllables as responses The list was presented on a memory drum at a 2-2 sec rate with a 6 sec intertrial interval to a criterion of 10/12 correct responses for a maximum of 36 trials. The recall task consisted of three parts: (a) blank sheet to write down anything which was remembered (free stimulus and/or response recall), (b) a sheet which listed the stimulus items with blanks for the responses, and (c) a multiple choice test which had each of the stimulus items and four possible response items. Extraverts were found to be superior in learning the task. These data were further analyzed into a response learning, associative and integration stage. Response learning was defined as the mean number of correct responses until each response was given correctly. The associative stage was defined as the mean number of trials between the trial on which the response was first given until it was first given to the appropriate stimulus. The integration stage was defined as the mean number of trials between the trial in which the response was first given to the appropriate stimulus until the response was last given incorrectly.

The differences in mean number of trials to complete the response learning stage yielded no significant differences. In the associative stage, the difference of greater trials for the extroverts was significant by an analysis of variance test ($p < .05$). Similarly, the analysis of the integration stage yielded significant differences ($p < .05$), but this stage was completed faster by the extroverts.

The recall data were analyzed for differences between the number of stimulus and/or response members recalled, the number of responses

recalled when the stimuli were presented and the number of responses recognized in the multiple-choice test. In five separate analyses of variance the only variable found to have an effect was Days. Thus, the retention data failed to show any differential effects attributable to personality as had been hypothesized.

Independently a similar study was reported by Howarth and Eysenck (1968) extending the findings of the McLaughlin and Eysenck (1967) study. In this study by Howarth and Eysenck 110 Ss were selected from over 600 students on the basis of their E.P.I. scores as being either extraverted or introverted and having low N scores. Seven pairs of CVC nonsense syllables were presented by a projector at a 3 sec. rate with an 18 sec. intertrial interval that was occupied by color-naming. Ss were tested at intervals of either 0, 1, 5, 30 min. or 24 hr. The extraverts required a mean of 15,85 trials to criterion, the introverts 18.29 but this was not statistically significant. The results of the recall data are shown in Fig. 2. These results strongly support the theory that the extraverts are only at an initial superiority but as time increase a dramatic change occurs. The introverts even when tested immediately can recall only half of the items and at each time intraval the reminiscence continues to increase. Of course this completely contradicts the forgetting curve but it is data similar to this which was obtained by Kleinsmith and Kaplan (1963, 1964), Walker and Tarte (1963) and McLean (1969). For comparison sake the data from my 1968 study are shown in Fig. 3. Obviously one study strongly supports the theory the others not -- an unfortunate situation but hardly unique.

A study by Howarth (1969) that was concerned with the role of interference in P-A learning found that although no differences were found in the rate of learning for extraverts and introverts on a five pair list when

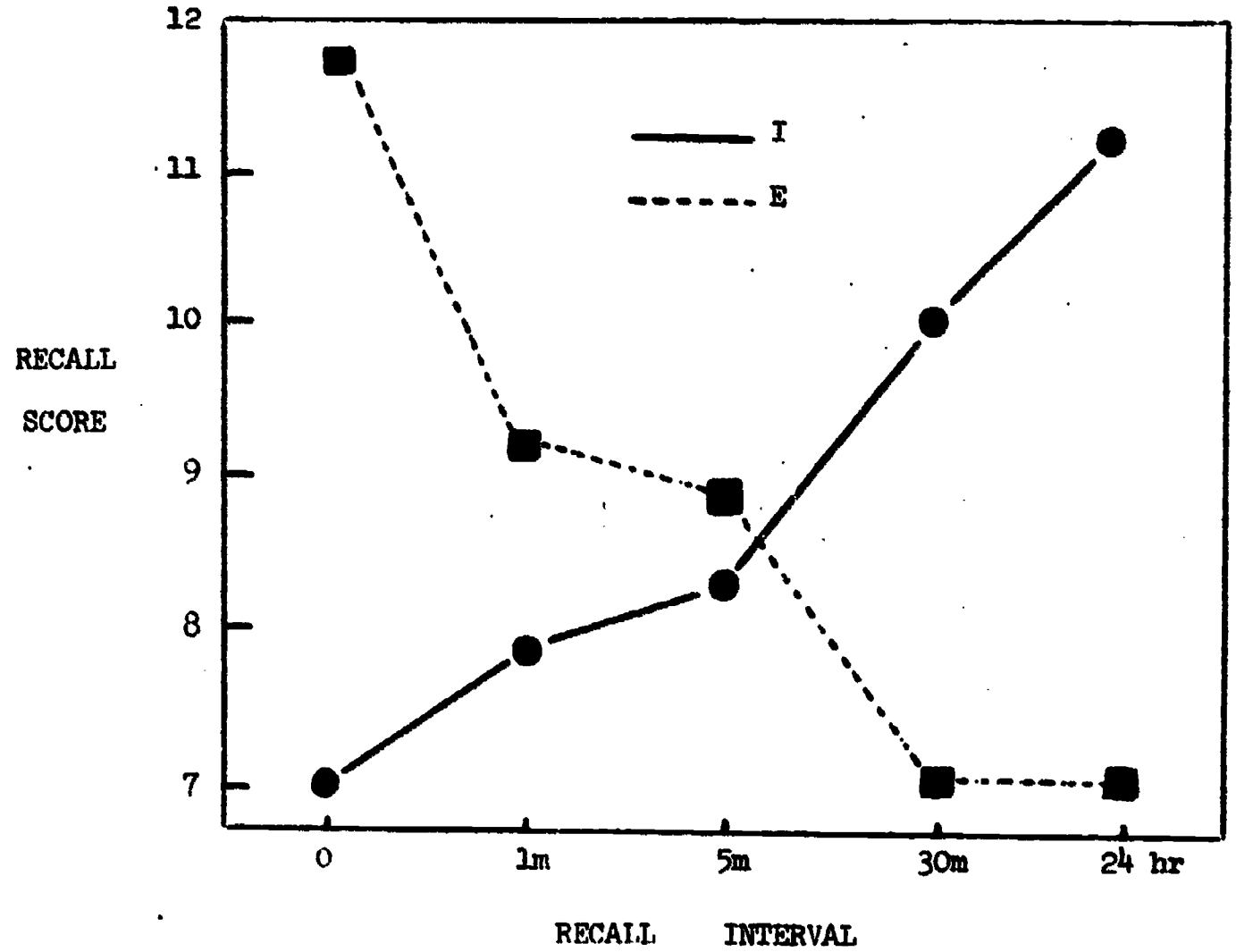


FIG. 2. Mean recall scores of extraverts and introverts at the recall interval stated. Maximum recall score possible was 14. Each point is the mean score of 11 Ss. (Howarth & Eysenck, 1968)

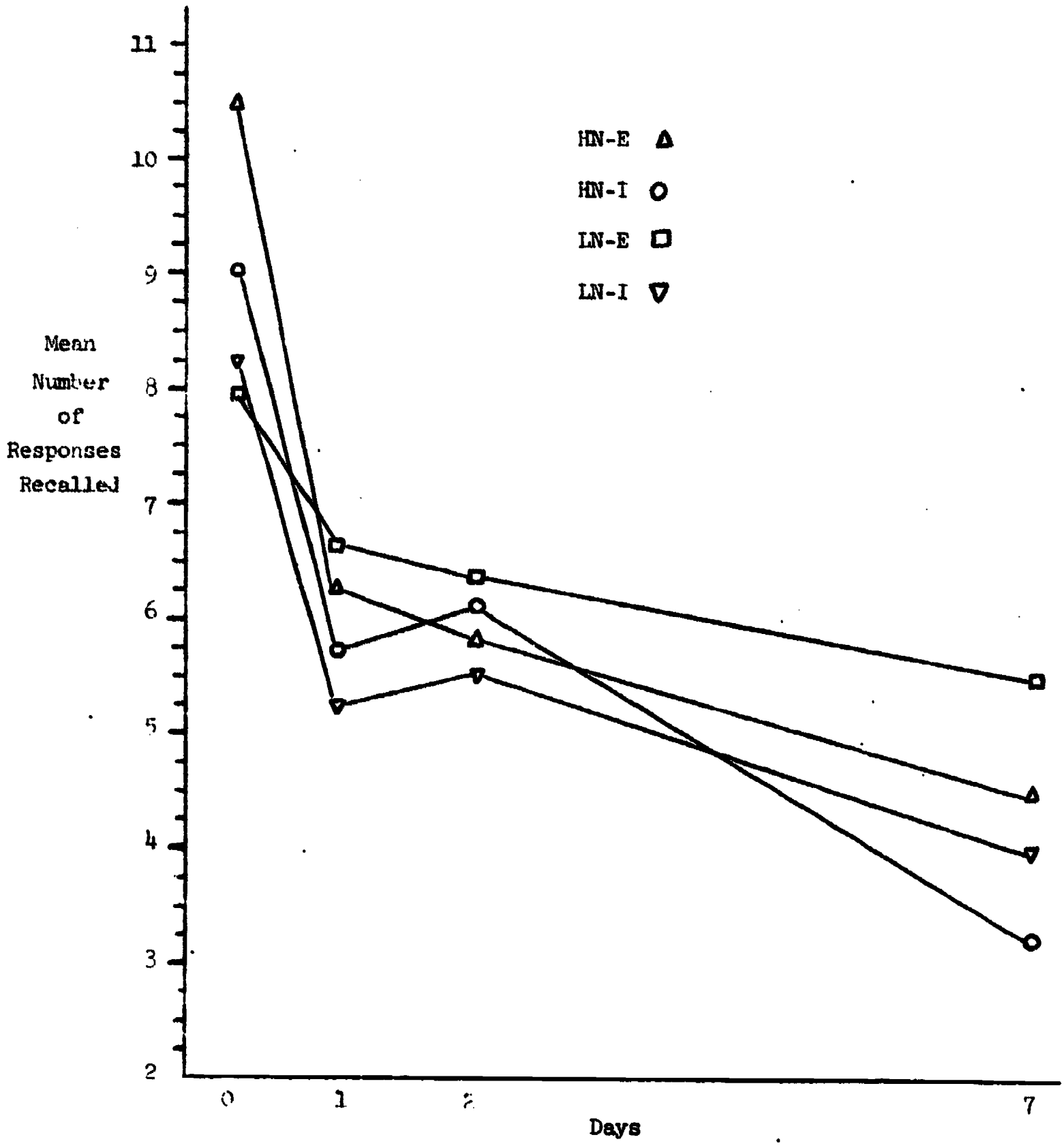


FIG. 3. Mean number of correct responses recalled for each of the four personality groups. (McLaughlin, 1968)

the items were repaired a second and third time, extraversion was ultimately associated with superior learning. From what is known about the A-B, A-Br transfer paradigm, however, it might have been expected the introverts should be ultimately successful. That is, introverts having poorer recall from list 1 should do better on list 2 as associations learned in list 1 are less available for interference. Time, however, is of the essence because as time increases the associations learned in list 1 should be more and more available to the introverts and less and less for the extraverts. Since it only took an average of 2.5 min. to learn a list it still should appear to favor the introverts.

Bone (1971) reported a study which was basically on extension of the McLaughlin and Eysenck (1967) study. This study compared introverts and extraverts on a list containing re-paired primary associates (A-Br) and a list containing unrelated words. The findings of this study basically supported the data of McLaughlin and Eysenck in showing a superiority for extraverts. Bone, however, did not find a significant superiority for the "easy" list. Since "easy" was used as a relative term by McLaughlin and Eysenck, no great significance should be attached to this inconsistency.

Continuing with the hypothesis that there is an arousal continuum ranging from high arousal (HN I) intermediate arousal (HN E and LN I) to low arousal (LN E), Schwartz (1974) investigated the role of phonetically vs. semantically related items with a P-A task. Ss high on arousal performed best when response words were semantically similar to one another, whereas Ss low on arousal performed best when response words were phonetically similar. The rationale for this study was based on studies which showed conflicting results of arousal -- sometimes facilitating and sometimes debilitating recall. It is likely that variables other than the

type or nature of the items will result in a similar conclusion.

Considering the way Eysenck's theory is stated it is hard to understand why so much emphasis was placed on the P-A task. The theory is basically stated to predict differences in memory at periods beginning immediately after the end of the task. Rate of learning is of course affected by ability to store information in memory but the P-A task is not well designed to provide a critical test of the hypothesis. At the time this research was begun the P-A task was paramount in verbal learning but not because it was a tool for studying memory processes but because it could reveal a great deal about the learning process. Several difficulties emerged which led me to conclude that other tasks would ultimately prove more valuable for this type of research. First, the task is an alternation between learning and recall with S tested every trial after having an opportunity to learn the association. A recall trial given one trial after criterion should normally be expected to yield the same level of performance as the criterion if tested immediately. The results from the Howarth and Eysenck (1968) study are puzzling in this respect. In their study however the measure of memory changed from pronouncing the nonsense syllables to writing them down. Also, it has been repeatedly shown, and in fact usually is part of the instructions, that the stimuli do not have to be "learned". The stimuli only have to serve as reliable cues for the occurrence of the correct response. Second, the P-A task does not lend itself to short recall intervals. Normally the associations are sufficiently difficult to learn and they are not easily forgotten. Some pairs learned early are followed by trials for overlearning until all pairs are learned to a criterion. The degree of overlearning of some pairs is a uncontrolled variable in these studies. Having Ss return to the laboratory after delays of a day

or more is extremely difficult. Ss in my 1968 study frequently indicated that they practiced the pairs, wrote them down, had others try to learn them or even anticipated the nature of the study despite a clever ploy. These Ss of course have to be excluded from the data analysis. Third, the very complexity of the task - learning associations - is a disadvantage at this point for determining the nature and extent of a relationship between personality and verbal learning. Fourth and lastly, the P-A task does not lend itself readily to group testing, a liability if other tasks prove adequate.

Several studies (Jensen, 1962; Howarth, 1969) have used the serial learning task but that task has many of the same disadvantages found with the P-A task. Recently in our laboratory we have been exploring the usefulness of the free recall task. Other psychologists interested in memory phenomena as opposed to the learning process per se have been recently giving a great deal of attention to this task. A typical study using the free recall task was done by Alcott (1968) as a master's thesis. The main portion of the study consisted of presenting 107 general psychology students with four successive sets of words for a fixed duration followed by a recall period. The items in each of the four lists were distinctly different (ex. United States cities, adverbs, verbs and adjectives, and animals). The recall period on the first three lists was immediate for all Ss. On list 4, Ss were tested after either 0, 1, 5, 15 or 30 min. The delays were filled with activities, but the activities were unrelated to learning lists of words (ex. estimating lengths of lines on a screen, number of dots on a projected slide). An analysis of variance of the number of items recalled on the four lists and E.P.I. scores found no significant differences. Also, no differential effect was found for the five different retention intervals relative to either E or N separately

or together. This first study using the free recall task was a well designed and executed study but it produced no support for the theory.

A second study was done by using a task developed by Tulving which produces a retrograde amnesia-like effect using the free recall task with human Ss. Tulving (1969), studying a free recall task, presented Ss with a 15-item list of common words with an item having a high probability of recall inserted in Position 2, 8, or 14. He found a large decrement in a S's ability to recall the item prior to the high-probability item. This effect he compared to the retrograde amnesia produced in animals by electroconvulsive shock. Retrograde amnesia is thought to be the result of the disruption of consolidation processes. This phenomenon, demonstrated in a free recall task, provides a means of testing the hypothesis that extraverts and introverts differ in amount of time required for consolidation. Extraverts who are theorized to complete consolidation rapidly, should show less of an amnesic reaction to a high-probability item than introverts. A study by McLaughlin and Kary (1972) was an attempt to test this hypothesis. To achieve a closer parallel to the electroconvulsive shock used to induce retrograde amnesia effectively in animals, the effect of a brief intense burst of white noise was assessed to determine if it could produce an equivalent or greater amount of retrograde amnesia than the high-probability item. A recognition measure was used in addition to the more common recall measure to provide a more sensitive index of the strength of the phenomenon.

A series of 40 free recall lists with 12 items were presented to each of the 80 Ss with either a proper name or a burst of white noise in Position 3, 6, or 10. Forty extraverts and 40 introverts were compared for either recall or recognition of the items. A retrograde amnesia-like effect was found for the item prior to the proper name, but introverts did not show a

greater effect as hypothesized. Personality differences, however, were found on the recognition task. Error scores for the extraverts indicated a greater willingness to "guess" when they thought they might possibly be correct. For all lists combined the extraverts made significantly more errors. Thus, the extraverts did better on the recognition task, but only at the expense of making more errors. A finding related to this was the differential learning rate of the response learning stage in one of my earlier studies (McLaughlin, 1968). The faster response learning might be indicative of a greater willingness to guess correct responses rather than a direct measure of rate of learning. In order to examine the possibility a study was designed using the model derived from signal detection theory (Kary and McLaughlin, 1974). Signal detection theory was originally designed to deal with problems in psychophysics but has recently been extended to the study of memory (Murdock, 1965; and Norman & Wickelgren, 1965). The theory of signal detection makes an explicit distinction between and the separation of (1) the observer as a sensor, i.e. his sensitivity, and (2) the observer as a decision maker, i.e., the effect of his values and expectations on his responses. These two aspects are confounded in performance but signal detection methodology makes it possible to partial out the contribution of each of these components.

A study using this signal detection approach has recently been completed but the results have not yet been published (Kary & McLaughlin, 1974). A free recall task of 50 common words was presented one word at a time on a screen to the Ss in small groups. After this learning period a series of 100 words were presented, 50 old items and 50 new items. The S was instructed to make a decision as to whether it was old, or new and the degree of confidence in his decision. The S could indicate he had no

ides by deciding uncertain, or make a decision and rate it either (1) not very sure but think so, (2) pretty sure or (3) very sure. In the experiment 80 Ss, 40 extraverts and 40 introverts were tested as described, in addition 20 extraverts and 20 introverts were tested under a monetary incentive the Ss were instructed that correct answers rated 3 would gain the 5¢, 2-3¢ and 1-1¢. Incorrect answers resulted in the same rate of loss. The Ss were also told only the top ten percent based on money earned would be paid.

In relationship to the E-I theory, the study was designed to determine if E-I differences could be obtained and whether these differences would be largely, if not entirely accounted for by differences in criteria used rather than sensitivity. The studies preceding this type of approach indicated extraverts would use a lower criteria thus use more extreme ratings and make more correct responses but at the expense of greater false alarms. The theory however would predict sensitivity differences based on the higher arousal of introverts. Although this study is not designed to determine the effect of time -- allowing for differential amounts of consolidation -- the type of task is closer to the original task used by the Michigan group (Walker, Kleinsmith, Kaplan & Tarte) rather than the paired-associate task which was used to test the theory on E-I differences.

The data for correct responses is shown in Table 1. A hit is a correct recognition of an original item while a correct rejection is a correct rejection of a new item. An analysis of these data found no differences for hits for either personality or the money condition. On the correct rejections the introverts were superior to extraverts across the money-no money condition ($p < .05$). The data for errors is in Table 2.

Table 1

Mean (in %) Number of Correct Responses (Hits and Correct Rejections for E and I in the Money and No Money Conditions

	Money		No Money	
	E	I	E	I
Hits	76.60	77.40	76.27	76.00
Correct Rejections	72.25	78.85	69.15	72.05
Mean	74.42	78.12	72.12	74.02

Table 2

Mean (in %) Number of Errors (False Alarms and Misses)

for E and I in the Money and No Money Conditions

	Money		No Money	
	E	I	E	I
False Alarms	17.90	16.60	23.30	19.95
Misses	19.45	18.70	18.65	19.90
Mean	18.67	17.65	20.97	19.92

A false alarm is reporting a new item as having been an original item but reporting it as a new item. The only significant differences found here were with the false alarm data. The Ss in the money condition made fewer false alarms (errors) than the no money condition. In the no money condition the extraverts made significantly ($p < .05$) more false alarms. For each response other than uncertain the S made a confidence rating. An analysis of these ratings indicated that in the no money condition the extraverts more frequently used the 3 rating (very sure). The extraverts had a mean of 50.50, introverts 43.70 which was a significant difference ($p < .05$). For the money data the means were 58.05-E and 60.65-I. No significant differences were found for the use of the 2, 1 or uncertain categories related to personality. For each S, the values of d', an index of his detection capacity, and of B, which reflects his decision criterion or "level of caution" were computed. For each of these measures there were no differences found for the effect of personality as a variable either in the money or no money condition.

This study is using a methodology which should ultimately be able to prove its utility but only after performance differences on the task can be established. The data on the rate of false alarms and the more frequent use of the 3-rating for extraverts partially support the conclusion that in verbal learning tasks, extraverts take risks more readily, are more confident, have lower criteria for detection and are more willing to guess than introverts. Verbal learning tasks which can not partial out the contribution of this criterion difference are difficult to interpret theoretically.

Conclusions

The data from verbal learning studies have been partially instrumental for the development of the theory of E-I relative to levels of

cortical arousal. Only a couple of studies have been specifically designed to test the prediction concerning differential consolidation rates. That data is not entirely supportive. Until the differential effects of E-I on immediate recall can be ascertained and described the effects of delay intervals is of secondary importance. In most of the studies relating E-I to verbal learning, the approach was to determine if there was an overall superiority for one of the personality groups. Differences in performance, however, even when obtained do not prove that there are differences in learning rates. A stage analysis of paired-associate learning is one step in the direction of trying to localize the effects of E-I. Stage analysis itself has a number of limitations and the limitations of the paired-associate task for this type of research has already been described.

Many researchers interested in the relationship of personality variables to verbal learning tasks are in essential agreement concerning the research strategy to be pursued. The shift is definitely moving away from tasks such as paired-associate and serial learning toward the free recall tasks and recognition task. These tasks provide tools to answer much more specific questions. The specific questions being asked include the relationship of anxiety, extraversion, neuroticism and ego-involvement to clustering, filtering, categorizing, pigeon-holing, detection sensitivity and decision criteria. Relationships of this type will likely prove to be far more valuable to our understanding of these personality dimensions. This new outlook has also given a renewed inpetus to the use of verbal learning tasks as a tool for investigating individual dif-

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