

PERSONALITY AND SECOND LANGUAGE LEARNING

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(Received 22 February 1993)

Summary—Relationships between personality differences and differences in language learning ability were studied by first administering the Eysenck Personality Questionnaire (EPQ) to 41 tertiary level students learning French as a second language. Subsequently, it was possible to examine relationships between scores on the EPQ scales and marks obtained in the French oral and written examinations. One major finding was that the personality dimension of Neuroticism accounted for 23% of the variance of French oral examination marks: a value which approaches the predictive power of the written French test. A second important finding was that individuals with high neuroticism and high extraversion scores did better on the oral test than on the written test when compared with individuals having high neuroticism and low extraversion scores who did better on the written test than on the oral test. These and corresponding factor analysis results conform to theoretical expectations and indicate that a “two-factor” model is necessary to explain observed relationships. One factor is attributed to differences in cerebral “arousal” that cause differences in neuroticism as well as determining differences in general learning ability. A second factor is attributed to differences in cerebral “arousability” that cause the psychological contrast between melancholic and choleric personality types. This includes differential performance on oral and written measures of language learning.

INTRODUCTION

In an important review, Brown (1973) identified a trend towards the search for interdisciplinary solutions to language learning problems. Brown also suggested a key role for psychology and went on to state that there was an increasing awareness of the necessity to examine human personality as a means of finding answers to perplexing problems in language learning.

According to this author, one of the greatest difficulties in striving for such a goal was the inadequacy of existing methods for the description and measurement of personality differences. In the language learning literature, terms used to describe personality differences were too loose and ill-defined. In the psychological domain, it was suggested, standardized tests permitted operational definitions but questions still existed concerning the validity of such measures.

In a later review, Scovel (1978) also drew attention to the validity problem and to the lack of any consensus concerning dimensions of personality variation. In particular, Scovel noted that “although studies of the relationship between affective factors and language learning abound in the literature, the evidence to support such a relationship is difficult to interpret. Much of the problem resides in the fact that a wide range of variables are lumped together under the rubric ‘affect’.”

These sentiments were echoed in a 1983 article by Bailey. She claimed that affective factors are generally assumed to influence second language acquisition, but noted yet again that the tasks of defining, manipulating and quantifying affective factors pose serious problems for researchers. Notably, these concerns have encouraged some investigators to think in terms of very narrow and highly specific concepts such as “classroom anxiety”, “French class anxiety” or “foreign language anxiety” (MacIntyre & Gardner, 1989, 1991). This makes it easier to demonstrate the validity of corresponding measures and allows investigators to avoid some of the more intractable research questions. Unfortunately, reality does not become any less complex just because we choose to examine it in a highly selective manner. Consequently the conclusions to be drawn from such studies are likely to be very limited and superficial or else highly speculative and prone to error.

It is true, of course, that many different personality scales of uncertain reliability and validity were devised in the past but there has been a growing consensus among psychometricians concerning the general relevance and validity of a small number of major dimensions. Dimensions that can be labelled introversion–extraversion (E) and neuroticism–stability (N) emerge consistently

in all of the best-known modern psychometric systems of personality description. Moreover, it has been repeatedly demonstrated by independent groups of researchers that the scales of the Eysenck Personality Questionnaire (EPQ) provide the best description of these core dimensions and of all that can be reliably measured in the domain of temperament and non-cognitive personality differences (Eysenck & Eysenck, 1985, pp. 118–158). The validity of the EPQ scales has been more extensively researched than that of any comparable system of personality description and measurement and the test–retest reliability coefficients for E and N are very high and of the order of 0.9 (Eysenck & Eysenck, 1975).

In seeking to understand how these personality differences might relate to language acquisition one must refer first to the emphasis on “affect” in reviews of the language learning literature. Studies of “anxiety” are particularly suggestive since individuals with high N scores are more than usually prone to anxiety and they usually obtain high scores on measures such as Taylor’s Manifest Anxiety Scale (MAS). More specifically, Eysenck (1973, p. 401) notes that “many investigations have shown that [the MAS] correlates in the neighbourhood of 0.6 to 0.7 with neuroticism, and 0.3 to 0.4 with introversion . . .”

Anxiety and learning

Both positive and negative effects of “anxiety” on second language learning have been reported (Chastain, 1975; Swain & Burnaby, 1976; Kleinmann, 1977; Madsen, 1982; Ely, 1986). Scovel (1978) pointed out that this apparent inconsistency can be explained if account is taken of factors that contribute to the subjective level of difficulty of the measures employed to assess language learning. Reference is made to findings which suggest that anxiety is likely to have a negative influence when tests are more difficult and also during the early stages of learning or when individuals are less proficient. These conclusions concerning the negative correlates of anxiety are echoed in a recent article by MacIntyre and Gardner (1991) but strangely, in what purports to be a comprehensive review, there is little more than a single paragraph on positive or facilitative effects. Since this is so, it is not surprising that the theory proposed by these authors fails to mention positive effects: a fatal omission which renders the theory untenable.

Observations concerning positive and negative effects have also been made in the personality and learning literature where anxiety again appears to influence performance of verbal learning tasks in a way that depends critically on factors such as task difficulty, stage of learning and level of proficiency. In his very extensive and detailed review of studies linking personality, learning and anxiety Eysenck (1973) describes how some of these effects were explained by the learning theories of Hull and Spence and he refers especially to a modified version of the particular model described by Spence and Spence (1966).

In this model, scores on measures of “emotional responsiveness” are associated with higher “drive” levels that increase the likelihood of both task-relevant and -irrelevant responses in a learning situation. Although the Spence and Spence model is no longer viable it did stimulate a program of systematic research and, *apart from other considerations, this research did also demonstrate that any theory of “anxiety” and learning must account for both positive and negative effects.*

Eysenck’s theory of neuroticism, extraversion and learning

While acknowledging the value of this earlier work, Eysenck makes the point that measures of anxiety such as the MAS confound the introversion and neuroticism dimensions of personality. He also observes that models of learning cannot afford to ignore “such knowledge of the process of learning and remembering as modern biology has given us”. His own model subsumes some of the ideas of Hull and Spence but refers directly to the biological bases of differences in personality and differences in learning ability by introducing the concepts of “cortical arousal” and “limbic system activation”.

Differences in cortical arousal, caused by the ascending reticular activating system (ARAS), determine introversion–extraversion differences with high arousal causing introversion and facilitating learning of “task-relevant” responses. Differences in limbic system activation determine neuroticism differences with high activation causing high neuroticism and “task-irrelevant” responses that impair learning. From these concepts there would be the very straightforward

expectation that introversion facilitates learning whereas learning is impaired by neuroticism. However, before predictions can be made from Eysenck's model two additional features must be considered.

First, arousal and activation are not wholly independent since high limbic system activation is thought to increase cortical arousal. The converse is not so since the theory holds that high cortical arousal can occur in the absence of high limbic system activation. In the present context, the postulated effect of limbic system activation on cortical arousal means that high N cannot be unambiguously associated with impaired performance of learning tasks since increased arousal facilitates learning. Equally important, it can be argued that experimental conditions can be conceived where the generation of "task-irrelevant" responses would not have a significant influence on task performance. What might be anticipated, therefore, is that under "favourable" circumstances it should be possible to observe facilitation of learning associated with high N but under "unfavourable" circumstances high N will be associated with impaired performance that will mask any learning advantage. At this point, it is not possible to define favourable in precise terms but theoretical and empirical considerations suggest that favourable circumstances would be those where task demands are low and where there is a friendly learning environment.

The second feature of Eysenck's model that must be considered is "consolidation" of the memory trace. According to Eysenck (1973, p. 402), "the process of consolidation of the memory trace is of fundamental importance in all learning, and is, in turn, influenced profoundly by the degree of cortical arousal . . . the greater the degree of arousal, the stronger, the more prolonged the consolidation process, and consequently, the greater the performance and accessibility of the memory trace so laid down."

Eysenck goes on to cite Walker (1958) and Walker and Tarte (1963) who refer specifically to the role of high arousal and suggest that "high arousal during the associative process will result in a more intensely active trace process. The more intense activity will result in greater ultimate memory [and learning] . . ." Notably, the emphasis here is on greater *ultimate* memory and learning. This is consistent with the results of studies reviewed by Eysenck and also with Eysenck's claim that *while a stronger and more prolonged consolidation process enhances the ultimate learning outcome it initially impairs performance of learning tasks.*

What this means is that where there is high arousal, whether intrinsically or extrinsically determined, there will be poor performance of learning tasks initially and it is only after consolidation has occurred that one can expect evidence of better learning. This important idea draws attention to the crucial distinction that can be made between "performance" and "learning" and suggests strongly that in any attempt to evaluate learning one must be careful to look at the ultimate outcome, after consolidation has occurred. In such circumstances, the unequivocal prediction from Eysenck's theory would be superior learning in the case of introverts with their higher levels of cortical arousal.

E and N and arousal versus arousability

A revised set of expectations is suggested if consideration is given to recent findings that provide new information about the precise manner in which Eysenck's E and N dimensions relate to cortical arousal (Robinson, 1982, 1983, 1991, to appear). This work confirms the broad thrust of Eysenck's hypothesis linking personality differences with differences in cortical arousal but some adjustments and refinements are indicated that result in a different language learning prediction for E if not for N.

A detailed description of the new findings will not be provided here but it is pertinent to point to an important distinction that must be made between cortical *arousability* and cortical *arousal*. Cortical or, preferably, cerebral arousability, refers to the intrinsic nature of neural "networks" or "circuits" in the cerebrum and to their inherent "reactivity" or "sensitivity." The term also refers to the relative functional autonomy of the cerebrum and to its capacity to sustain activity without dependence on external sources of excitation or stimulation such as the brain-stem arousal system.

In contrast, cortical or cerebral arousal refers only to the general level of activity in cerebral neural networks, however caused or generated. It is now well known that this general level of activity is strongly influenced by external agencies and especially by projections from the brain-stem

systems that generate "background" activation of cortical neurons and regulate sleep-wakefulness cycles (Magoun, 1963; Samuels, 1959).

Clearly, with high cerebral arousability one must expect a typically high level of cerebral arousal. However, given the overall inhibitory influence of the cerebrum on brain-stem processes, it follows directly that with low cerebral arousability there will be disinhibition of the brain-stem arousal system and, for this precise reason, there will again be high levels of cerebral activation, albeit that this high level of arousal is externally mediated. *Thus, both high and low cerebral arousability can result in high levels of cortical arousal and while these two variables are closely related it is clear that they are not identical and that the terms are not interchangeable.*

Robinson (1982, 1983, 1989, 1991, to appear) identifies two different aspects of cerebral arousability. One of these relates to the balance of neural excitation and inhibition in the cerebrum, and also to the reactivity or sensitivity of cerebral networks, but in the terminology of those who study the dynamic properties of systems one can refer to differences in "natural frequency". The second aspect of cerebral arousability can be described most readily in terms of the length of time neural circuits will remain active following stimulation. In physical terms and in terms of systems theory this dimension of arousability would be described as differences in "damping ratio".

Clearly, to obtain an estimate of *overall* cerebral arousability one must refer to both natural frequency and damping ratio. When this is done, it transpires that melancholics or neurotic introverts have the highest overall arousability and therefore also high arousal. In contrast, choleric or neurotic extraverts have the lowest overall arousability but, as explained above, there will again be high levels of arousal. Stable extraverts and introverts, which is to say sanguine and phlegmatic individuals, tend towards intermediate levels of overall arousability which accounts for their low N and emotional stability.

The middling arousability of the sanguine and phlegmatic types is achieved because in sanguine types low natural frequency (low arousability) is compensated by low damping ratio (high arousability). In phlegmatic types high natural frequency (high arousability) is compensated by high damping ratio (low arousability). Here the personality differences are due to the specific consequences of differences in natural frequency or differences in damping ratio, as distinct from differences in overall arousability, and the extraversion differences in these two cases are due largely to differences in natural frequency. *Thus differences in cerebral arousability are manifest as the difference between neurotic introverts and neurotic extraverts whereas differences in cerebral arousal are manifest as neuroticism differences.*

Since high levels of cerebral arousal will cause limbic system "activation" and activation of the autonomic nervous system (Samuels, 1959) it is clear that in this important respect Robinson's results confirm Eysenck's hypothesis that N differences should relate to individual differences in the degree of limbic system activation. However, there is now a more fundamental explanation for N which, in the first instance, relates to differences in cerebral arousal.

Since Eysenck's original theory linked N to both limbic system activation and cerebral arousal, albeit in a different fashion, and since arousal is still conceived as relating to learning in the manner proposed by Eysenck, we must again anticipate facilitation of learning that may be masked by impaired performance if attempts to assess learning are conducted during the consolidation period, or in otherwise unfavourable circumstances. Thus the hypothesized relation between N and language learning is not altered by new knowledge of the neurological bases of N.

The same is not true for the E dimension or at least not insofar as this dimension relates to arousability or arousal. Since this dimension is related to cerebral *arousability*, and not to cerebral *arousal* as originally hypothesized by Eysenck (1967), we lose the rationale for prediction of a general facilitation of language learning. Unfortunately, we also lose an important explanatory principle that was used very effectively in Eysenck's original formulation to relate biological and psychological differences. That is to say, many differences in the behaviours of introverts and extraverts can be understood if it is suggested that introverts avoid stimulation in order to reduce uncomfortably high levels of cortical arousal whereas extraverts seek stimulation in order to increase uncomfortably low levels of cortical arousal.

This arousal postulate explains far too much to be set aside lightly but fortunately it can be retained in a more refined and specific form. It will be recalled that low cerebral arousability, as well as high cerebral arousability, must be associated with high arousal because with low cerebral

arousability there is disinhibition of the brain-stem system that activates the cortex. An important qualification must be introduced here because disinhibition of the "stimulus-dependent" and less autonomous brain-stem arousal system is only likely to result in high levels of cortical arousal if the individuals concerned are active in a stimulating environment. Otherwise, low cerebral arousability will ensure low cerebral arousal and, as Pavlov discovered, the individuals who are most obviously influenced by environmental stimuli are also most prone to sleep when inactive in an unstimulating environment. Equally relevant and noteworthy, extraversion, probably in combination with high neuroticism, has long been associated with the kind of changeability in emotional mood and observed behaviour that must be expected if levels of cerebral arousal are hostage to fortune and much more dependent on environmental circumstances.

Clearly, the original arousal explanation for stimulus seeking and stimulus avoiding behaviours can be retained, and it is at least partly confirmed by the new knowledge of brain function. However, we still cannot claim that in *active* learning situations introverts and extraverts will differ in terms of cortical arousal. Because this is so we cannot predict any *general* difference in learning for introverts and extraverts that is due to differences in cortical arousal.

If differences in cerebral arousability do not translate into straightforward differences in cerebral arousal they do translate into differences in the relative influence of cerebral and brain-stem processes. As already noted, greater cerebral or thalamocortical arousability will result in greater inhibition of the brain-stem reticular formation. Moreover, it can be argued that the relative dominance of cerebral over subcerebral processes is another important and fundamental determinant of traits and attributes long associated with the introversion-extraversion concept. Of particular theoretical and pedagogical interest, there is a basis here for expecting differential performance on oral and written language tests.

At the psychological level, predominance of the cerebrum over the brain-stem can be related to greater involvement of conscious voluntary processes in learning and in the execution of behaviour. Relatively greater influence of brain-stem processes can be related to greater involvement of unconscious, involuntary, automatic processes, mediated by the brain-stem reticular formation, and underpinning all skilled performance. Since skilled performance is assumed to include skilled cognitive manipulation, it has been proposed that introverts should do better on tasks that require conscious access to knowledge but do not require manipulative problem solving activity whether overt or covert. The converse should apply for extraverts.

This hypothesis is supported by the results obtained in two recent studies (Robinson, 1985, 1986) and is consistent with the results of early studies by Himmelweit (1945, 1946) and with the results of some early factor analytic studies revealing a bipolar verbal-performance factor that was also loaded by introversion-extraversion measures (Burt, 1949). Although there has been one recent contrary finding (Barrett & Eysenck, 1992) these reports do provide a strong indication that groups of introverts obtain relatively higher scores on the "verbal" as compared to "performance" subtests of the Wechsler Adult Intelligence Scale (WAIS) whereas the opposite state of affairs is true for groups of extraverts.

In the context of second language learning, the same reasoning suggests that groups of extraverts should do relatively better on tests of spontaneous oral performance. Groups of introverts should do better on written tests evaluating knowledge of language that is accessible to conscious processes. There have in fact been some prior studies of introversion-extraversion and second language learning (Pritchard, 1952; Naiman, Frohlich & Stern, 1975; Naimon, Frohlich, Stern & Todesco, 1978; Chastain, 1975; Brodkey & Shore, 1976; Rossier, 1976; Busch, 1982; Ely, 1986). It turns out that a consistent finding in all but one of these reports is that measures of extraversion, or of traits usually associated with extraversion, can facilitate performance on some measures of second language acquisition. More often than not, this superiority of extraverts is related to oral rather than written performance.

Three studies actually employed the E scale of the Eysenck Personality Inventory (EPI). These are especially relevant since the EPI is an earlier version of the EPQ used in this study and the two E scales are very similar if not identical. In two of these three studies, high E scores were associated with better oral performance. Busch (1982) actually reports that while males tending to extraversion had higher oral scores there was also evidence that introverts tended to have higher scores on measures of reading and grammar. Thus, the weight of evidence is consistent with the

notion that extraverts do better on measures of oral performance. There is less evidence concerning E and written performance but the Busch study does provide some indication that extraverts may do less well than introverts.

To conclude this introduction it is noted that studies of personality and learning have so far been largely confined to the use of conditioning procedures and simple verbal learning tasks (Eysenck & Eysenck, 1985). Arguably, however, the best way to minimize the risk of confounding performance and learning, and to obtain unambiguous evidence of a relationship between personality and learning, is to consider the ultimate outcome of real-life learning situations using measures of both E and N: as distinct from measures of "anxiety" or even E and N measures considered in isolation. Language learning courses seem ideally suited for this purpose because students are confronted with a novel and complex learning task of considerable magnitude and duration. The ultimate learning outcome, following consolidation, is relatively easy to evaluate and much less likely to be confounded with performance differences that might for example, relate to differences in the operation of short-term memory and have nothing at all to do with learning.

With such a scenario, two main hypotheses are suggested by Eysenck's learning and arousal theory when account is taken of recent findings that reveal just how the E, N and P dimensions relate to actual differences in cerebral arousability and other neurological variables. First, there should be an arousal-related general language learning superiority in the case of individuals with high N scores. No specific studies of N have been found in the language learning literature but studies using conceptually and empirically related "anxiety" measures are broadly consistent with such a hypothesis. If, as in the present case, oral and written tests are used to evaluate second language acquisition it can be further suggested that the superior language learning ability of high neuroticism scorers should be most evident from results obtained using the less formal and less demanding oral tests.

From the theoretical considerations discussed here and from earlier language learning studies one would expect no general learning superiority for introverts over extraverts despite earlier expectations in the personality literature that this might be so. From the same language learning studies one would expect that groups of introverts should do better on written tests than on oral tests whereas groups of extraverts should be superior on oral tests. However, with the new knowledge concerning cerebral arousability and personality differences described earlier we know that all introverts do not differ from all extraverts in terms of cerebral arousability and in terms of the relative dominance of cerebral and brain-stem processes. In fact, it is only neurotic introverts or melancholics and neurotic extraverts or choleric that can be contrasted in this way, with the former having predominance of cerebral processes and the latter greatest influence of brain-stem processes.

This allows formulation of a more specific second hypothesis that melancholics will do better on written than on oral tests whereas the reverse will be true for choleric. In terms of the E and N dimensions, and their relations with the underlying neurological variables, this translates into the expectation that, among high N individuals, those with high E scores should do better on oral language tests than on written language tests when compared with those having low E scores.

METHOD

Subjects

Individuals participating in the project were enrolled as students in the French Studies Department of Sydney University. Forty-five third-year students volunteered to take part in the project. Four volunteers were appreciably older than the main body of students. These individuals were excluded by setting up a criterion that all Ss should be <35 years of age. The mean age of the remaining students was 21.4 years and the corresponding standard deviation was 2.4 years. The age range was 19 to 31 years but most Ss were aged between 20 and 22 years. The group was made up of 32 females and 9 males.

Procedure

The EPQ was administered to all Ss. Subsequently, after completion of the French oral and written examinations, Ss marks were obtained from the records of the French Studies Department. Written performance was evaluated by two tests. The first test concentrated on grammar and vocabulary taught during the first two terms. The second test, held at the end of the academic year, dealt with grammar and vocabulary taught during the third term. The first test employed two types of items: (1) sentences which had to be completed with the correct form of the appropriate pronoun, and (2) sentences for translation from English to French. The second test consisted entirely of English sentences for translation into French.

Oral performance was assessed continuously throughout the year. For each term two marks were awarded. One mark was awarded for class participation, especially in small-group activities. The other mark was awarded for an end-of-term test. The latter involved small groups of from 2 to 4 students. In these groups students participated in role-playing and in problem-solving activities. The presentation of short exposés also figured prominently. The principal objectives of the classroom activities and the tests were, respectively, to enable students to assimilate and then to display mastery of the various speech acts and conversational strategies being taught during the term. The criteria used to evaluate performance were: (1) fluency, (2) logical structure and discursive coherence, (3) accuracy of vocabulary, and (4) grammatical accuracy. The selection and weighting of criteria varied according to the nature of the task and the subject matter. End-of-term tests accounted for 55% of the total oral mark for the year, with classroom participation making up the remaining 45%.

RESULTS

The distribution statistics for the variables of interest are shown in Table 1. The E, N and P means and the SDs are not too dissimilar from those indicated in the EPQ manual for samples of similar age. It is noted, however, that the E and N means are somewhat higher than might be expected from the normative data. The corresponding SDs are rather smaller than would be expected.

The French oral and written examinations were scored on a scale of 0 to 100 but there is an appreciable difference in the means and SDs for the two sets of scores. The Pearson product-moment correlation for the oral and written examination marks was 0.55 which indicates that the two sets of examination marks only share 30% of common variance.

In order to test the hypothesis concerning E and differences in marks obtained for the French oral and written examinations, an additional variable (OWD) was derived by first transforming both sets of marks to *z* scores. The transformed written scores were then subtracted from the transformed oral scores and further transformed so that OWD, like other variables in this study, has a mean of 100 and a SD of 15. High OWD values indicate relative superiority of oral over written performance while the converse holds for low OWD scores. A measure of overall performance in the French examination (OWM) was also computed by simple addition of the transformed oral and written scores.

SPSS Regression was employed to carry out standard multiple regression analyses. In one analysis, French oral examination marks were entered as the dependent variable with scores on the P, E, N and L scales of the EPQ as the independent variables. Table 2 displays the correlations between the variables, the unstandardized regression coefficients (*B*) and intercept, the standardized regression coefficients (*b*), the semipartial correlations (*sr*), the squared semipartial correlation for N and the multiple regression coefficient (*R*). The multiple regression coefficient was significantly different from zero ($F = 2.86$; $df\ 4,36$; $P < 0.05$). With this simple rectilinear model, only N scores

Table 1. Sample statistics for personality and French examination variables

Sample statistics	P	N	E	French oral	French written
Mean	4.0	14.1	14.0	70	59
SD	3.1	4.8	4.1	7	15

Table 2. Standard multiple regression of personality variables on French examination oral scores

Variables	Oral(DV)	N	L	E	B	b	sr
N	0.42				0.769**	0.52	0.48*
L	0.02	0.14			-0.046	-0.02	-0.02
E	0.05	-0.14	0.04		0.137	0.08	0.08
P	0.08	-0.36	-0.13	0.20	0.575	0.25	0.25
Intercept = 55.673							
$R = 0.49^*$							

^a $sr^2 = 0.23$.

** $P < 0.01$; * $P < 0.05$.

contributed significantly to prediction of French oral examination marks ($P < 0.01$; $sr = 0.48$). It is noteworthy that N accounted uniquely for 23% of the total variance.

A similar analysis with French written examination scores as the dependent variable revealed no significant relationships. It is also noted that in the matrix of simple rectilinear product-moment correlation coefficients for all three personality variables, and for the oral and written scores, none were statistically significant and none exceeded a value of 0.14 except that noted above for N and oral scores. Correlations were also calculated for the personality variables and both OWM and OWD. None of these correlations were significant except that for N and OWM ($r = 0.32$, $df = 39$, $P < 0.05$).

As noted in the Introduction, the hypothesized relationship between E and the oral vs written difference variable, OWD, should occur in high N Ss and constitute part of the psychological contrast between melancholic and choleric individuals. Consequently, relationships between the personality variables and OWD were examined in Ss with N scores > 15 . Statistically significant correlations were found for E ($r = 0.61$, $df = 15$, $P < 0.01$) and for N ($r = 0.51$, $df = 15$, $P < 0.05$) but not for P.

Since a correlation between N and OWD had not been predicted there was reason to examine further the relationship between E and N. This was done by calculating and plotting the "running" or "moving" averages shown in Fig. 1. With this procedure, an average score is calculated for the five lowest N scores and then an average is calculated for the five corresponding E scores. Additional "ascending" averages of N are calculated by dropping out the lowest of the five raw N scores and including the next highest score not previously included in an average. Corresponding averages are calculated from the raw E scores.

The merit of the moving average procedure is that it very effectively minimizes the measurement error or "noise" associated with individual scores and thereby allows an investigator to see the exact form of any relationship between two variables. Curvilinear relationships are not always obvious in a scattergram and even very strong curvilinear relationships may be overlooked since they often give rise to small or zero-order rectilinear correlation coefficients. In Fig. 1 we can see that for high N individuals E and N are not independent. Moreover, in our sample the melancholic and choleric individuals of special interest are distinguished by N as well as by E differences. The melancholics and choleric are both high on N but the N scores of choleric are appreciably higher than those of melancholics. What this means is that E and N can be considered independent measures of the psychological differences that interest us and to an appreciable extent these scales are measuring the same thing in our high N Ss.

However, that is not the whole story. As shown by the rolling averages plotted in Fig. 2, the relationship between E and OWD is not the simple rectilinear relationship predicted at the outset. In fact there is a very obvious bump or peak near the middle of the graph. From the plot of N scores against extraversion, it is equally clear that this bump or peak can be attributed to variance of N scores that is not already accounted for by the correlation with E mentioned above. Thus when the two variables are considered separately the correlations with OWD will be attenuated.

When the E and N scores for the high N group were restandardized, and composite E + N scores calculated, these gave rise to a higher correlation than that obtained for E and N separately ($r = 0.68$, $df = 15$, $P < 0.01$). Also, as shown in Fig. 3, a plot of running averages for the E + N variable and OWD confirms that when the influence of both variables is taken into account the relationships with OWD are clearly rectilinear. This point is also made by the 0.91 value of the

correlation coefficient which provides a further indication of the strong underlying relationship between personality differences on the E and N scales and differences in oral vs written test results.

A factor analysis was performed to obtain a more global or integrated perspective on relationships between the personality and language variables. Principal components were extracted from the product-moment correlation matrix and then rotated to simple structure using Varimax. This produced three factors with eigenvalues greater than unity. The loadings of the variables on these three factors are listed in Table 3.

A principal factor analysis produced a similar solution prior to rotation. However, after rotation, the effect was to give greater emphasis to relationships between personality variables, on the one hand, and between the performance variables on the other. This change of perspective was achieved at the cost of obscuring the theoretically more interesting relationships between personality and performance variables that are indicated by the other solutions.

The first factor in Table 3 is clearly an N factor and the specific results described above indicate that there is a positive relationship between N and the general language learning ability denoted by the OWM variable. The loading of OWD on the first factor cannot be related to specific theoretical expectations but in the absence of any contrary indication it is taken to mean that the oral test is simply a better measure of an N-related general language learning ability than the written test.

Again consistent with our specific findings, the second factor is loaded substantially and positively by E and by OWD. The high loading of P does not correspond with any of our specific findings. Since it cannot be discounted easily, we assume that with the more straight-forward but less penetrating methods of statistical analysis the P and OWD relationship is confounded or obscured; much in the same way as the relationship between E and OWD is obscured or distorted in Fig. 2.

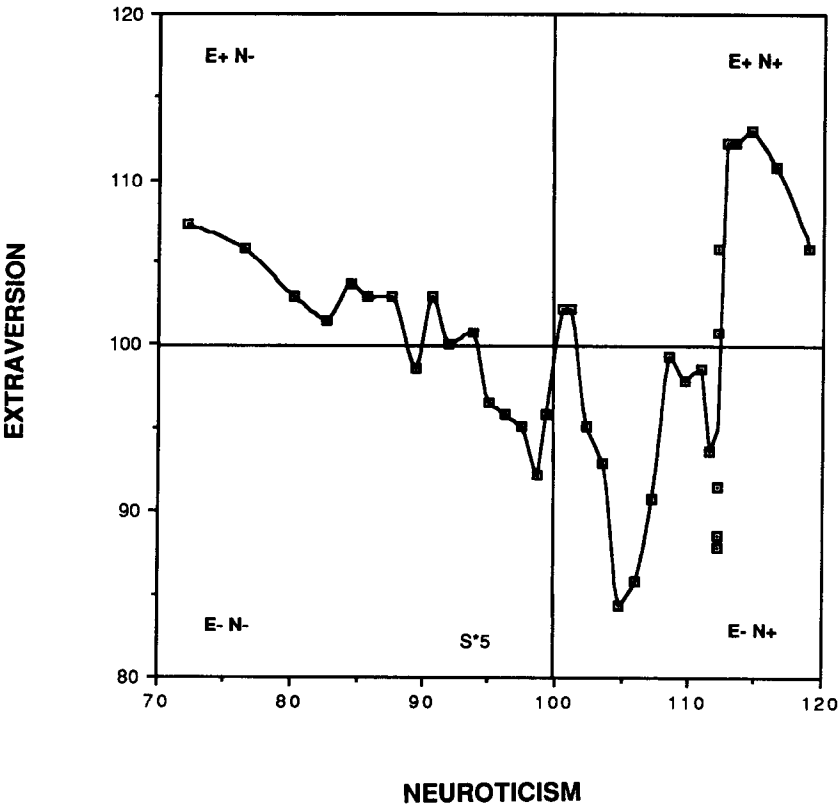


Fig. 1. Average E scores plotted against corresponding "rolling" or "moving" averages of N scores. The method for calculating the average scores is described in the text.

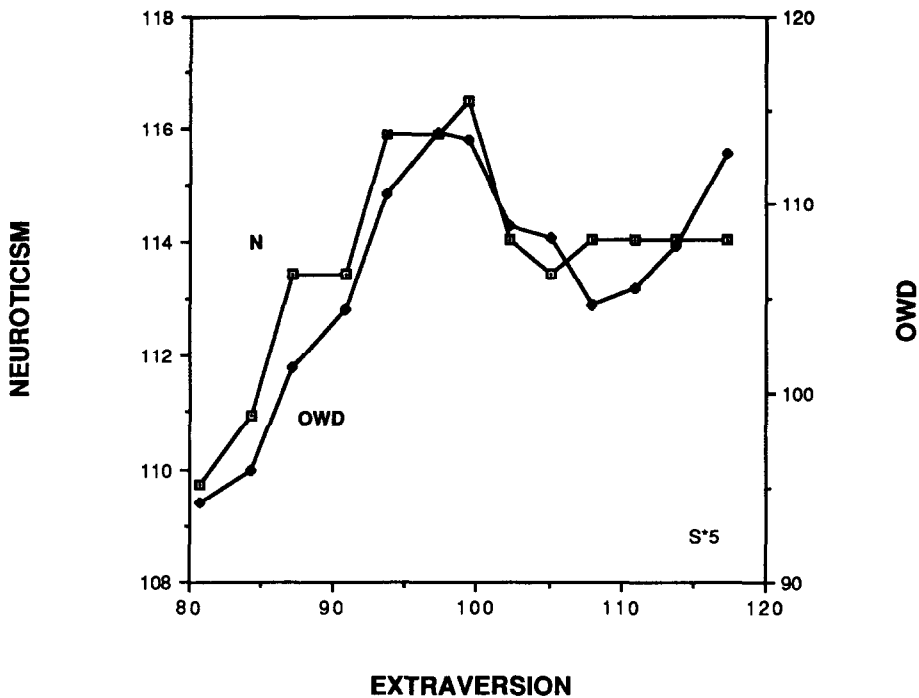


Fig. 2. Average N scores and the "oral minus written" or OWD variable plotted against corresponding "rolling" or "moving" averages of E scores obtained from individuals with N scores > 15.

Although not explicitly predicted, the particular alignment of E and P revealed by the factor analysis is consistent with theory. This is so since the second factor is clearly related to our second hypothesis and may therefore be associated with differences in overall cerebral arousability. Differences in cerebral arousability subsume variation of damping ratio and greater damping relates to higher P so that, all else equal, one would expect a tendency towards higher P scores in choleric individuals and a tendency towards lower P scores in melancholics.

DISCUSSION

The results indicate that N accounts for 23% of the total variance of the French oral examination scores. This value is almost certainly an underestimate of the relationship between N and oral performance since the correlation would be attenuated by measurement error and by restriction of the range of variation. The lower than usual SDs for E and N indicate that some range restriction has occurred. A possible explanation for this, suggested by the discussion to follow, is that people high on E and high on N have a special aptitude for language learning and are therefore more likely to become participants in tertiary level language learning courses. To place the value of 23% in perspective, it is noted that the oral and written examination results correlate to the extent of 0.55 and hence share 30% of common variance. Thus, for the oral examination scores, N scores are approaching the predictive power of the written examination scores.

N, cerebral arousal, learning and language learning ability

The factor analysis results shown in Table 3 provide a useful summary and confirmation of the pattern of relationships suggested by the more specific results. The first factor, linking N and the measure of overall French examination performance, was expected from the language learning literature. It is consistent with results obtained in other studies using less reliable or valid measures variously described in terms of "affect", "anxiety" or "emotionality". *There is also support here for the hypothesis that high cerebral arousal causes high N scores and that this facilitates learning and language learning in particular.*

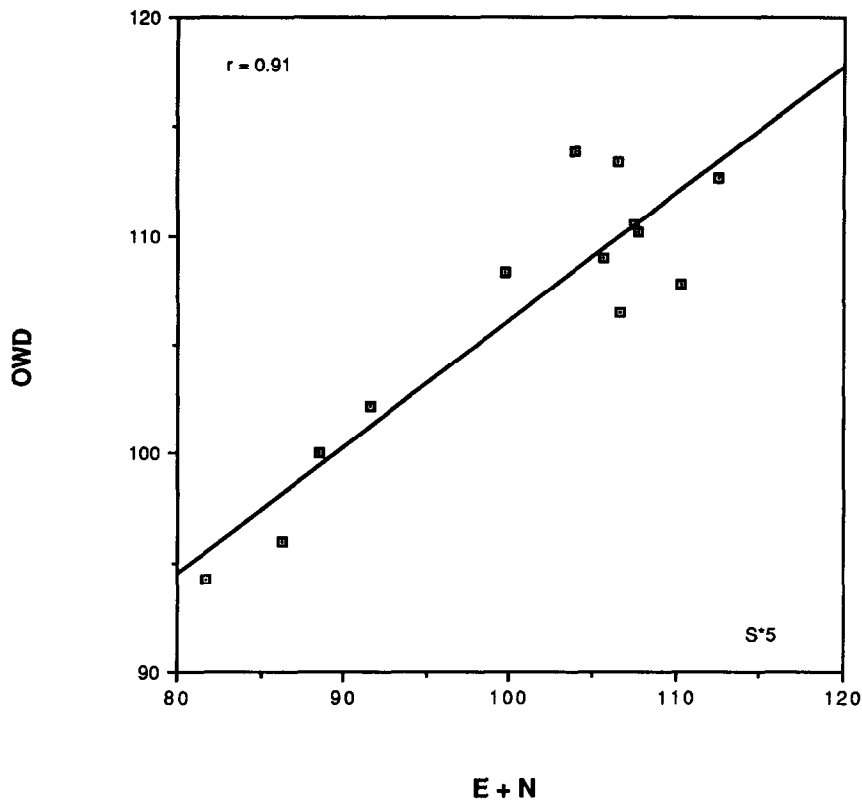


Fig. 3. Averages of the "oral minus written" or OWD variable plotted against composite E + N scores. These data are from individuals with N scores >15 and the E and N scores for this group were standardized before adding them together to obtain the E + N composite. The method for calculating the "moving" averages is explained in the text.

It has already been suggested that the loading of the OWD difference variable on the first "neuroticism" factor indicates that the oral test is more strongly associated with N than the written test. It is worth emphasizing here that the data obtained in the present study provide no support for the view that the performance of high N individuals is impaired on the written tests relative to the performance of low N individuals or that such a possibility might account for high OWD scores when N is very high. As we have seen, high N scorers can obtain both high and low OWD scores as a function of extraversion differences. In addition, as N approaches maximum values in neurotic extraverts it is quite clear from the data that oral and written scores are both increasing to above average levels albeit that for such individuals the oral scores are higher than the written scores.

E and P, cerebral arousability and oral language superiority

The second factor in Table 3 is loaded by the E and P variables and there is an appreciable loading for the oral vs written differences variable. This is consistent with the notion that differences

Table 3. Factors obtained for personality and French examination variables using principal components analysis with varimax rotation of axes

Variables	Factor 1	Factor 2	Factor 3
Neuroticism	0.81	—	—
OWM	0.65	—	—
OWD	0.57	0.50	—
Extraversion	—	0.76	—
Psychoticism	—	0.63	—0.50
Lie	—	—	0.86

Factor loadings <0.25 have been omitted.

in cerebral arousability, and the associated inhibition of the brain-stem arousal system, can alter the relative influence on behaviour of the cerebral and brain-stem systems.

At the psychological level, it has been argued, differences in the relative influence of cerebral and brain-stem processes are manifest as the contrast between melancholics and choleric. In the case of melancholics, with relatively greater cerebral influence over brain-stem processes, there is therefore greater involvement of conscious, voluntary processes. In the case of choleric, with less cerebral control of brain-stem processes, the psyche is influenced to a greater extent by unconscious, involuntary, automatic, processes. These differences would account for a relatively better oral than written performance of choleric and for a relatively better written than oral performance of melancholics and for the loading of the OWD difference variable on the second factor in Table 3.

The personality and performance relationships summarized by the second factor, and attributable to differences in cerebral arousability, clearly relate to reports in the language learning literature that extraverts do better on oral than on written tests. It is notable here that better oral performance is only indicated for extraverts high on N and high on P and our data suggest that such individuals achieve the very best oral performances. This, of course, is consistent with the observation that such persons combine the advantages for language learning and performance of high brain-stem mediated cerebral arousal with low intrinsic cerebral arousability and may therefore be associated with the favourable end of both factors.

Neurotic extraverts or choleric appear to be twice blessed. Presumably this is because factors one and two are independent and uncorrelated and thus the oral advantages attributable to each are additive. Clearly the advantage associated with the second factor and associated with low cerebral arousability cannot be accounted for in terms of attendant differences in arousal that are already accounted for by factor one.

It is also noted that individuals falling at both ends of the second "arousability" factor will experience high arousal. This again indicates that one cannot fall back on a general arousal-related learning facilitation to account for the oral advantage conferred by factor two. Thus the oral vs written differences associated with the relative influence of cerebral and brain-stem processes, with factor two, and specifically with choleric individuals, are attributed to functional variations that can influence performance as distinct from learning (Robinson, 1989, 1991, to appear).

As secondary consequences of such functional differences one would expect different learning modes and preferential learning of particular kinds of information as well as different modes of responding. Arousal-related differences of this kind may explain reported differences in "verbal learning" of introverts and extraverts in the personality literature (Eysenck, 1973; Eysenck & Eysenck, 1985). Alternatively it is possible that, in studies where N differences were not also taken into account, results attributed to E differences might actually be due to variation of N. The present findings are also consistent with earlier reports that introverts do better on "verbal" IQ measures whereas extraverts do better on "performance" or "spatial" IQ measures (Robinson, 1985, 1986) although the more refined model employed here contrasts neurotic introverts with neurotic extraverts.

With factor two explained in terms of differences in cerebral arousability and differences in the relative influence of cerebral and brain-stem processes one cannot avoid mention of Krashen's monitor model. First, because there is explicit reference to a contrast that can be made between self-conscious, introverted individuals, on the one hand, and outgoing uninhibited individuals on the other. Secondly, because Krashen's evaluation of individual cases (Krashen, 1976, 1978, 1981) has resulted in a conceptualization of the learning styles of these personality types which is remarkably similar to that embraced by the neurological model informing the present study.

According to Krashen, adult learners and children can pick up a language informally and unconsciously. This *language acquisition* is contrasted with *language learning* which involves the conscious formal study of a language that is more often associated with adults. It is Krashen's view that in *language learning*, as distinct from *language acquisition*, adults have an opportunity to *monitor* language output using the rules that they have been taught to edit their language production.

Krashen claims that those individuals who do most monitoring are self-conscious and introverted. This translates readily into the more specific designation of "melancholic" since stable

introverts are not very self-conscious. Those who do least monitoring are outgoing and uninhibited. This translates into "choleric" since stable extraverts are outgoing but not all that uninhibited.

Since Krashen's model is based on a comprehensive study of individual cases there is very strong support for the kind of explanation of E and P differences in oral and written performance that derives from the more general neurological theory referred to in this paper.

Personality and the linguist: the Henderson study

A study by Henderson (1984) is mentioned here in some detail because the results suggest the same kind of "two-factor" model indicated by the present study. This is so despite the use of Cattell's 16PF, a completely different system of personality description and measurement.

Henderson points out that lay-persons perceive the functions of interpreters and translators to be very similar but for those involved in these occupations the differences are as important as the similarities. According to Henderson, it is widely held that the different mental approach required for conference interpreting and professional translating is reflected in corresponding differences in personality. To test this hypothesis, personality profiles were obtained from a sample of 65 translators and 35 conference interpreters working for international organisations in Western Europe. In addition, data were obtained from a sample of 46 postgraduate students in a diploma course on interpreting and translating.

A biographical and attitude questionnaire provided confirmation that stereotypes exist such that translators are believed to be introverted whereas interpreters are thought to be extraverted. Trends in the personality data were consistent with this hypothesis but did not achieve a convincing level of statistical significance. Again paralleling the present study, it was found that both interpreters and translators have high scores on the 16PF scales that measure emotional instability or neuroticism. This provides additional evidence that N facilitates learning and is related to a general language learning aptitude.

Before leaving the Henderson study, it is worth pointing out that there are quite general psychological grounds for suggesting that melancholic individuals might be more suited to translating than interpreting whereas the opposite would be true for choleric. Our present results go further since they indicate that melancholics and choleric also have different linguistic aptitudes that might attract such persons differentially to translating and interpreting. Consequently, there is good reason to suppose that outright rejection of Henderson's hypothesis would be premature despite his own failure to find statistically significant personality differences.

CONCLUSION

In conclusion, it is suggested that the results obtained in this study provide strong evidence that personality differences play an important role in second language acquisition. The results indicate that N facilitates learning and that this dimension is related to a general language learning aptitude. There are new insights concerning the involvement of the EPQ E, N and P dimensions with a clear indication of the way in which these dimensions relate to *both* oral and written tests of second language acquisition. It has been demonstrated that a "two-factor" model is necessary to account for a general language learning aptitude and special aptitudes contrasting oral and written performances.

The results obtained are consistent with the revised version of Eysenck's "arousal and language-learning" theory described in the introduction. This theory is useful because, as we have seen, it provides a detailed and comprehensive account of relations between personality differences and language learning aptitudes and performance that would otherwise be incomprehensible. The theory is also important because it has general relevance in the psychological domain. This last mentioned attribute provides a basis for integrating research on second language learning with relevant research carried on in the domain of psychology. It is hoped that the theory will stimulate research on personality and learning as well as stimulating the more specific language learning research. It does appear from our results that there is at least the promise that it will be possible to map out a very comprehensive picture of the psychological differences that influence both learning in general and language learning in particular. Our findings also indicate that any attempt to understand language learning in terms of narrow situation-specific variables is just not viable.

The data presented in this report have special relevance with respect to the design of any future study. Clearly any study that fails to take account of both E and N and/or fails to employ oral and written measures of language acquisition will not yield comprehensive or conclusive results. With hindsight, and referring to the results of the Henderson study, it would also seem important to assess intelligence differences since these might obscure or distort relations between personality variables and language tests and for that matter lower the validity of any putative tests of general or specific language learning aptitudes. As noted earlier, it would also seem important in any study of learning to ensure that "consolidation" is complete before any attempt is made to evaluate learning differences and to ensure as far as possible that experimental conditions do not confound "learning" differences with "performance" differences that might have nothing at all to do with learning.

Acknowledgement—We would like to thank Ms A. Liénard for her assistance with this research.

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