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INDIVIDUAL DIFFERENCES IN INTROVERSION-EXTRAVERSION, REACTIVE INHIBITION, AND READING ATTAINMENT

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The theory has been put forward by Peel (1956) that the first stages of school learning take place by the process of instrumental conditioning. The types of task envisaged by Peel as falling within this framework include such things as simple addition and reading, in which the learning process can be regarded as entailing the formation of stimulus-response connections. For example, the child has to learn that the stimulus of the letters C-A-T should elicit the vocal response "cat." The purpose of this paper is partly to suggest that this theory explains certain established findings in educational psychology and partly to report a test of one deduction from the theory.

It is evident that if the theory is correct, children who form conditioned responses readily will, other things being equal, be better at arithmetic and reading than those who condition slowly. One way of testing and extending this theory is through the application of the theory of personality advanced by H. J. Eysenck (e.g., 1957). Briefly, this theory has established by factorial methods three independent dimensions of personality, namely, neuroticism, introversion-extraversion, and psychoticism, all of which are independent of intelligence. It has been postulated by Eysenck that the dimension of introversion-extraversion corresponds to Hull's construct of reactive inhibition, in that it is assumed that extraverts generate reactive inhibition quickly and dissipate it slowly (Eysenck, 1957). It follows from Hull's theory that reactive inhibition acts against the building up of reaction potential and that extraverts should form conditioned responses slowly, and this deduction has been directly confirmed by Franks (1957). The application of Eysenck's theory to the question of educational attainment is simply this: if the theory that acquiring educational skills is a matter of conditioning is correct, then those who learn these skills readily should tend to be introverted and to generate reactive inhibition slowly. There are already available some data to support the first of these deductions. To particularize:

1. A positive association between introversion and educational attainment at the university student level has been reported in England by Furneaux (1956), Broadbent (1958), and Lynn (1959). Although American studies do not use this theoretical framework, it seems likely that such findings as that of Duff and Siegel (1960) that overachievers tend to be unsociable reflect the same association.

2. Introverts tend to have good vocabularies, both in relation to their intelligence (Himmelweit, 1945) and absolutely (Lynn & Gordon, in press).

3. There are no well-developed instruments for measuring introversion-extraversion in children and consequently less is known of the relation of this personality dimension to attainment in this area. However, it is reasonably well-established that delinquents, who display extraverted be-

havior patterns, tend to be educationally retarded (e.g., McCarthy, 1954).

4. Introverts tend to have leptomorphic body build (i.e., to be thin in relation to their height) and leptomorphic children tend to be good readers (Eysenck, 1959a).

5. Women tend to be more introverted than men (Eysenck, 1959b). Girls tend to do better than boys in the national examination which is taken in England by children at the age of 11 (Yates & Pidgeon, 1957), and in America Terman and Tyler (1954) conclude that "school marks almost universally indicate superior achievement for girls." Better achievement in relation to intelligence by women is reported at the university level in America by Duff and Siegel (1960).

6. Brain injury tends to make people more extraverted (Eysenck, 1957), and brain injured children tend to have poor educational attainments in relation to their intelligence (Stephen, 1958).

It is perhaps reasonable to conclude that a consideration of these studies suggests that Eysenck's system pulls together a number of discrete findings and that its possibilities in educational psychology deserve further scrutiny. It is not suggested that the studies referred to above do more than give tenuous support to the application of Eysenck's theory in this field. It appears that one of the chief weaknesses of the application as it now stands is that the associations outlined are between variables which are somewhat far removed from the individual differences in conditioning and the generation of reactive inhibition that are assumed to underlie them. Hence although the observed correlations can be derived from the theory, it nevertheless remains true that other plausible explanations for the observations could be put forward. It is evident that the theory needs more rigorous testing of its fundamental postulates. Accordingly, one of the key assumptions has been subjected to experimental test, namely, that individual differences in the generation of reactive inhibition are responsible for differences in educational attainment. If this is so, the two should correlate. A test of this prediction is reported below.

Investigation

Subjects. The subjects (*Ss*) were 82 children with an age range of 8–11, comprising the entire population in this age range of two small schools. There were 36 boys and 46 girls.

Procedure. The following tests were given to the children:

1. Reading: Schonell's Graded Reading Vocabulary Test. To control the effect of age, a reading score was obtained by subtracting the chronological age from the reading age.

2. Generation of reactive inhibition: (*a*) A reminiscence test involving inverted number printing. This is an individual test in which *S* is instructed to print numbers 0–9 upside down as fast as he can over 12 trials; he is then given a 2-minute rest before a final trial. There is of course a gain in speed after the rest interval, this gain being the phenomenon of reminiscence, and a reminiscence score for each *S* was obtained by subtracting the time on the postrest trial from the mean of the four last prerest trials. It is assumed that this score reflects the amount of reactive inhibition generated, the argument being that reactive inhibition is generated during the task and that the amount of gain following rest reflects the amount of reactive inhibition that has dissipated. For detailed discussion of reminiscence and the part played by reactive inhibition in tasks of this type, the reader is referred to the original experimental reports (Kimble, 1949).

(*b*) A vigilance task: this is essentially a task of maintaining attention and it is assumed that attention fails after an interval of time as a result of reactive inhibition accumulating. The task used in this investigation consisted of listening to a continuous stream of letters delivered from a tape recorder at the rate of three every 2 seconds;

TABLE 1

PRODUCT-MOMENT CORRELATIONS BETWEEN TESTS OF REACTIVE INHIBITION AND READING AND INTELLIGENCE

	Reading Score	Accuracy	Speed
Vigilance	+.33*	+.08	−.03
Reminiscence	−.23*	−.12	+.09

* Significant at the .05 level.

the signal to be watched for was the occurrence of the same three letters consecutively and when this occurred the *Ss* were instructed to write down the letter. There were 40 such signals spread over 20 minutes and the score used was the number correctly recorded from the last 20 (all *Ss* tend to get the first signals correct). All *Ss* noticed the first signal and it is evident therefore that all *Ss* understood the instructions and that failure to notice some signals can be attributed to inattention rather than lack of intelligence. Evidence that tests of this sort measure extraversion (and hence individual differences in the generation of reactive inhibition) is presented by Broadbent (1958) and Eysenck (1959d).

3. Intelligence: The Nufferno test was given. This test gives separate scores for speed and accuracy and was given because of the desirability of avoiding an intelligence test of the verbal type, which is likely to be affected by the introversion-extraversion factor. The method of scoring speed restricted the use of the speed measure to 48 *Ss*.

RESULTS AND DISCUSSION

The product-moment correlations of the variables measured are shown in Table 1. Although the correlations are low, the two measures of reactive inhibition are significantly associated with reading attainment, and the findings therefore give some measure of support to the hypothesis that a tendency to generate reactive inhibition quickly is detrimental to the acquisition of educational skills. The finding that speed and accuracy on the intelligence test are not related to the measures of reactive inhibition is probably due to the fact that the test used was too short for appreciable quantities of reactive inhibition to accumulate. It has been shown by Eysenck (1959c) that it is only towards the end of a lengthy intelligence test that the performance of extraverts begins to deteriorate.

Although this application of Eysenck's theory to educational psychology is strengthened by the present findings, it is evident that further research is needed to put the theory on a firm foundation. One of the merits of the theory is that it generates a large number of predictions that are susceptible to experimental test. One of the most obvious is that there should be a correlation between conditionability and educational attainment. Another concerns the action of drugs. It is argued that stimulant drugs shift those who take them towards the introverted end of the introversion-extraversion dimension (Eysenck, 1957). This is supported by the findings that people condition more readily under the influence of stimulant drugs (Hilgard & Marquis, 1940). It can therefore be predicted that children under the influence of stimulants should learn more readily the educational skills that are assumed to be acquired through conditioning. It is possible that this prediction, if verified and worked out in detail, would have useful practical results for the treatment of educationally retarded children.

SUMMARY

The theory that learning simple educational skills takes place by conditioning, taken together with Eysenck's personality theory, yields the prediction that those who do well in educational tasks should be introverted and generate reactive inhibition slowly. It is suggested that this theory brings into order a number of findings in educational psychology.

A further prediction was made from the theory, namely, that good achievers should show low indices of reactive inhibition as assessed by reminiscence and vigilance tasks. An investigation of the relation of performance on these tasks to reading attainment in children aged 8–11 tended to confirm the prediction.

REFERENCES

BROADBENT, D. E. *Perception and communication*. London: Pergamon, 1958.

DUFF, O. L., & SIEGEL, L. Biographical factors associated with academic over- and underachievement. *J. educ. Psychol.*, 1960, **51**, 43–46.

EYSENCK, H. J. *Dynamics of anxiety and hysteria*. London: Routledge & Kegan Paul, 1957.

EYSENCK, H. J. The Rees-Eysenck body index and Sheldon's somatotype system *J. ment. Sci.*, 1959, **105**, 1053–1058. (a)

EYSENCK, H. J. *Manual of the Maudsley Personality Inventory*. London: Univer. Press, 1959. (b)

EYSENCK, H. J. Personality and problem solving. *Psychol. Rep.*, 1959, **5**, 592. (c)

EYSENCK, H. J *Handbook of abnormal psychology*. Bath: Pitman, 1959. (d)

FRANKS, C. Personality factors and the rate of conditioning. *Brit. J. Psychol.*, 1957, **48**, 119–126

FURNEAUX, W. D Report to Imperial College of Science and Technology. Unpublished, 1956.

HILGARD, E. R., & MARQUIS, D. G. *Conditioning and learning*. New York: Appleton-Century-Crofts, 1940.

HIMMELWEIT, H T. The intelligence-vocabulary ratio as a measure of temperament. *J Pers.*, 1945, **14**, 93–105.

KIMBLE, G. A. Performance and reminiscence in motor learning as a function of degree of distribution of practice. *J. exp. Psychol.*, 1949, **57**, 500–510

LYNN, R. Two personality characteristics related to academic achievement *Brit J. educ. Psychol.*, 1959, **29**, 213–216

LYNN, R , & GORDON, I E. The relation of neuroticism and extraversion to intelligence and educational attainment. *Brit. J. educ. Psychol.*, in press.

MCCARTHY, D Language development in children. In L. Carmichael (Ed.), *Manual of child psychology*. New York: Wiley, 1954

PEEL, E A. *The psychological basis of education*. Edinburgh: Oliver & Boyd, 1956

STEPHEN, E Cerebral palsy and mental defect. In A. M Clarke & A. D. B. Clarke (Eds), *Mental deficiency*. London: Methuen, 1958.

TERMAN, L. M., & Tyler, L. E. Psychological sex-differences In L. Carmichael (Ed.), *Manual of child psychology*. New York: Wiley, 1954.

YATES, A., & PIDGEON, D. A. *Admission to grammar schools*. London: Newnes, 1957.

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