

STUDENT CHARACTERISTICS AND UNDERGRADUATE ACHIEVEMENT

The Differentiation of Task Performance as a Joint
Function of Anxiety-Stability, Introversion-
Extraversion and an Organizational Study Behaviour
Scale.

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INTRODUCTION

From the mid-fifties onwards there have emerged several lines of development in the pursuit of Aptitude-Treatment-Interaction (ATI) research models. The most fully formed of these has been that founded in psychology and derived mainly from studies of personality and individual differences. Aptitudes themselves have become firmly established as psychologically defined entities having essentially trait-like characteristics, and this has meant that the treatments typically countenanced have tended to be psychologically aligned as a natural extension of this. Furthermore, much of the work that has been reported since Cronbach's original statement in 1957 has been carried out with primary reference to psychological issues (e.g. Biggs, 1976; Cowell, *et.al.*, 1971; Dowaliby and Schumer, 1973; Gaudry and Fitzgerald, 1971; Goldman and Hudson, 1973; Knowles, 1975; McCausland and Stewart, 1974; Rowell and Renner, 1975; Rutkowski and Domino, 1975). While it has become clear that many of the earlier hopes that these and similar studies would provide the basis for individualized programmes of teaching have not been realized, it is equally apparent that the complex patterns of relationship which have been explored are, in a number of respects, sufficiently stable and consistent to encourage further study.

Parallelling these psychological developments, though less fully formed because dependence on them, have been economic issues related to pay-off under ATI procedures. When it can be shown that costs associated with the differentiation of treatments or teaching methods are offset in some way by gains in performance, the pay-off must clearly favour what would generally be a more expensive system. In the absence of clear specifications of the relevant principles and procedures for measuring such things as instructional effort, or even student productivity, and

in the face of the often inconclusive results that have been generated by ATI studies, economic considerations are likely to remain inadequately formulated and heavily influenced by political and pedagogical whim.

A third line of development which has more than kept pace with requirements under ATI systems has been that related to statistical method. With the progressive acceptance in educational research of analytic procedures more sensitive to the impact of individual differences, a renewed interest in the complementary roles played by nomathetic and ideographic approaches, and the rapid advances that have been made in developing computer software, techniques for discriminating groups or for analysing complex sets of relationships among variables have become freely available (e.g. Anderson, et.al., 1971; Everett, 1971; Sundqvist, 1973).

Underlying the psychological, economic, and statistical aspects of the ATI model are issues of epistemology. A major feature of the model is its explicit recognition that task-relevant components of individual behaviour should be entered directly into the research design. The ready acceptance of certain intra-individual factors as integral elements in this way has its most emphatic epistemological counterpart in pluralist orientations which admit subjective and ultimately irrational elements as crucial facets of the ways in which people deal with events in the natural world (Watkins, 1968). In its most extreme form, epistemological pluralism reduces to radical subjectivism, thereby locating the individual at the focus of a totally idiosyncratic but, by definition, totally non-communicable knowledge system. At the other pole stands epistemological monism and the complete subjugation of the individual to the substantive and structural forces that constitute knowledge. And at varying distances between these poles are ranged such writers as Hirst (1969), Phenix (1964), Schwab (1964), Ziman (1968), Polanyi (1962), Phillips (1974) and Feyrabend

(1975), ordered very roughly in terms of their willingness to countenance the irrational and the subjective in the acquisition and pursuit of knowledge.

In the context of ATI principles such as those mentioned previously deriving from psychology, economics, and statistics, these underlying epistemological issues may be explored via the general question of subjectivism in learning and teaching. More specifically, the extent to which idiosyncratic approaches to the getting of knowledge can be more or less systematically related to the kind of knowledge involved or the personal qualities of the knower could be seen as an index of the degree to which subjectivist forces must be acknowledged. Broadly conceived, the ATI model can be made to encompass such a system of events with aptitudes representing the subjective components which, in interaction with treatments or teaching methods for particular subject areas, could be expected to yield learning approaches characteristic of particular groups of learners. The question of pay-off in these circumstances would revolve upon the levels of significance associated with group differentiations for groups of varying size and structure.

The present study was undertaken to explore some selected aspects of pay-off under an ATI approach conceived in these broad terms. It was carried out within the relatively naturalistic setting of an ongoing course in the first year of a four year programme of undergraduate studies leading to a BEd degree. The aim of the study was to follow up a series of potential but open-ended group differentiations consequent upon the investigation of a set of theoretically postulated interactions based on an analysis of the probable links between elements in the Personality and Study Behaviour domains on the one hand and particular types of performance on the other. Following a review of the research into undergraduate

achievement as a function of affective and strategic variables, Anxiety-Stability and Introversion-Extraversion were selected as prominent elements from the Personality domain, and an organizational study strategy dimension was identified in the Study Behaviour domain to reflect adaptive mechanisms likely to have compensatory influence under different learning conditions. Four tasks were considered in the study, each being viewed as a treatment which might be expected to enter into predictable interactions with the Personality and Study Behaviour aptitudes to the extent that its components (or infraskills) were appropriately structured (see Table 1). Thus, in keeping with the character of Introversion and the postulated structure of an Essay assignment for example, a compound of Introversion, organizational study skills, and the motivating influence of some degree of trait-Anxiety was hypothesized to have optimal prospects of success. When a similar task analysis was applied to tutorial participation and an analytic exercise, low Anxiety in conjunction with Extraversion were counted potentially optimal, together with inferred compensatory advantages of the organizational study strategy. The fourth task was an observational Child Study which, when analysed, was hard to distinguish from the Essay in the way it was evaluated, thus alining it with the predictions for optimal Essay performance.

In the first of four stages of data analysis, these predictions were tested by the use of multiple linear regression to determine whether, for each performance score entered as a continuous dependent variable, the compound of Anxiety \times Introversion \times Study Behaviour made a significant contribution to the proportion of variance explained over and above that associated with the main effects (Kerlinger and Pedhazur, 1973, pp. 258f). The results failed to support an analytic strategy of this type since in no case was the overall regression sufficient to justify the use of a

TABLE I: Postulated Task Infraskills and Associated Personality Attributes

Task Details	Attributes
(a) Essay - library research; co-ordination of material and ideas; comprehension and synthesis of points of view; generalized motivation.	Study Skills Introversion Anxiety
(b) Analytic Report - analysis of research papers (substance, purpose, internal consistency); discrimination of issues, problems, main theme and its resolution.	Study Skills Introversion Stability
(c) Child Study - observational skills; co-ordination of issues and material; the formulation of a theoretically defensible interpretation of data.	Study Skills Anxiety Extraversion (?)
(d) Tutorial Work - discussion and argument in group setting; text-based weekly assignments to amplify course content.	Study Skills Extraversion Mod. Anxiety

reduced model in testing for the presence of interaction effects (see Table 2)

TABLE 2: Multiple Regression Data for Student Performance on Four Tasks as a Function of Three Predictors and their Joint Interaction

Task	Full Model Mult. R	Mult. R ²	A N O V A	
			df	F
Essay	.148	.022	4,59	<1
Analytic Report	.229	.052	4,59	<1
Child Study	.188	.035	4,59	<1
Tutorial	.243	.059	4,59	<1

At the second stage of analysis, the continuous dependent measures were replaced by group codes. These were set in terms of an intra-individual system of reference which simply assigned each case to the group which corresponded with that particular individual's best standardized score. The groups formed in this way thus reflected achievement as an expression of individual rather than group relativities, and a given group was superior to all other groups by virtue of the fact that each of its numbers had registered his or her individual best performance on the same task. Each such group was then studied with respect to all the remaining groups taken together in order to see whether, under this coarser grouping procedure, group differentiations were evident with particular reference to the impact of the Anxiety \times Introversion \times Study Behaviour compound.

Group differentiations of this kind were extended in the third stage of analysis to an inspection of group contrasts in terms of the

three principal variables and their conjoint interaction, taking the groups two at a time. At this point, the comparisons being studied were intended to yield aptitude \times treatment details more directly related to the specific features of the tasks involved.

The fourth and last stage of analysis represented a simple extension of the two previous stages. Whereas group differentiations at stages 2 and 3 were examined in terms of the specific aptitudes (Anxiety; Introversion; Organizational Study Behaviour) which were known to be salient in undergraduate performance, stage 4 provided for the re-analysis of group differences on a wider basis. This was possible because the original development of key Personality scales was carried out within the setting of a more extensive inventory which had been specifically designed to reflect several areas of personality having probable links with undergraduate achievement. In the remaining sections of the present report, results will be presented based upon the fourth stage of analysis involving the differentiation of groups in this wider context, but with special interest in the extent to which Anxiety \times Introversion \times Study Behaviour as a compound influence was found to contribute significantly to group separation.

METHOD

Sample: The subjects for the study were 64 undergraduate students at the James Cook University of North Queensland who were reading the Child and Adolescent Development course in the Faculty of Education. The participants were volunteers from a total first year enrolment of 117.

Instruments: The personality inventory was developed over two consecutive years from items designed to reflect the principal aspects of achievement-

related behaviour. Factor and item analyses yielded data supporting the use of six factor-based scales accounting for 41.3% of total variance.

Briefly described, these scales were:

Scale 1: 13 items, 13.2% of variance; alpha .83. Generalized intellectual and academic cautiousness versus adventurousness; reluctant to use own ideas; prefers known ways of doing things.

Scale 2: 9 items; 11.0% of variance; alpha .84. Rigidity-Complexity; preference for neat, precise, orderly, and well planned schedules of activity.

Scale 3: 14 items; 6.3% of variance; alpha .87. Anxiety-Neuroticism-Stability; moody, excitable, high-strung, erratic, tense, poorly adjusted.

Scale 4: 11 items; 4.2% of variance; alpha .74. Introversion-Extraversion; retiring; relatively shy and anti-social, avoids crowds and parties.

Scale 5: 8 items; 3.4% of variance; alpha .82. Moral and religious conservatism versus relatively permissive radicalism; wants a return to religious values; rejects trial marriages and abortion.

Scale 6: 11 items; 3.2% of variance; alpha .84. Generalized distractibility versus single mindedness in academic affairs; erratic concentration unless prodded by examinations.

In association with these six personality scales, all ten of Biggs's

(1975) Study Behaviour Questionnaire scales were administered to identify that scale which most satisfactorily met the study's interest in measuring the strategic or organizational aspects of the ways students manage their academic affairs. Scales 5, 6, 8, and 7, in approximate order of significance, had a particular bearing on the study's purposes. Scale 5 reflected an organizational study regimen of a thorough and orderly kind tied closely to the lecture content and required reading. Scales 6, 8, and 7 were concerned respectively with a fact-rote study orientation, a subsumptive meaning assimilation strategy, and study behaviours of an unquestioning and dependent kind.

The results of factor and item analyses clearly indicated that Scale 5 (Study Skills and Organization, alpha .75) was the most appropriate. This scale represented aspects of a Syllabus Bound and somewhat Rigid approach to study, but an approach that was more likely to take on the peculiarly strategic qualities that were of specific interest through its potential for compensatory effects. Thus, an excessively anxious student for example, or one who is abnormally shy, could succeed in ameliorating these influences on his or her performance by developing or adopting study methods of an essentially rigid and orderly kind as a procedural or strategic prop. The Study Behaviour Questionnaire (SBQ) Scale 5 expressed this management strategy most distinctly through items dealing with the orderly planning of time and regular review of material and the conscientious attempt to understand course work.

Procedure: The Personality and SBQ inventories were administered in their entirety to the target sample. Personality data were collected towards the end of the first academic term, but Study Behaviour data were not sought until the start of the third term. This was to ensure that the behaviours reported represented, as far as possible, established patterns of study

rather than idealized responses from students at the start of their first year of undergraduate work. For all aspects of the study, respondents were advised that they were under no obligation to participate, nor to identify themselves.

Analysis of Data: Following a series of regression analyses, groups were formed as described above (p.6) for the investigation of the components associated with group differentiations. A discriminant analysis computer program designed by Veldman (1967; Program DSCRIM) was used in testing group separations. At this stage in the research analysis, group discriminations were under exploratory investigation as an aid in characterizing group differences with respect to the variables making the greatest contribution to group separation (Huberty, 1975). In these circumstances a Type 1 error level of .08 was considered as appropriate.

The variables were examined in two steps. All six personality scales were entered at the first step, together with the Study Behaviour Scale 5 (SBQ5, Organizational Study Skills) and a selection of compound terms regarded as potentially significant. The first step variables, entered in $z + 10$ form, were as follows:

1. Adventurous - Cautious (ADV)¹
2. Complex - Rigid (COM)
3. Anxious - Stable (ANX)
4. Introverted - Extraverted (INT)
5. Radical - Conservative (RAD)
6. Distractible - Single Minded (DIS)
7. ANX²
8. ANX \times SBQ5

1. LHS pole was scored low in each case

9. INT \times SBQ5
10. ANX² \times SBQ5
11. ANX \times INT \times SBQ5

At the second step, group discriminations were re-examined but with reduced discriminators based on first step results so as to test for optimum separation. Each performance group was first studied in comparison with all other groups combined. Groups were then compared two at a time.

RESULTS

Group discrimination data for the Essay group contrasted with the other groups taken together are set out in Table 3. While INT \times SBQ5 and

TABLE 3: Essay versus Others Group Discrimination Data for Selected Variables.

Group	Group Means		
	RAD	INT \times SBQ5	ANX \times INT \times SBQ5
1. Essay (N = 14)	9.58	94.06	931.62
2. Others (N = 50)	10.07	100.92	1011.87
Univariate $F_{1,62}$	2.70	3.38	3.01
p estimate	.10	.07	.08
LDF Correlation	.618	.688	.417
	Wilks' Λ = .891		R^2 = .109
	Chi ² = 7.05 (df = 4)		p < .153

ANX \times INT \times SBQ5 yielded univariate F values associated with p estimates around the .08 level, overall discrimination clearly failed at this pre-set level.

Comparable data for the Analytic Report group contrasted with the other groups taken together are set out in Table 4. Optimum separation in this case was significant based on three elements, each of which was also significant (at $p < .05$).

TABLE 4: Analytic Report Versus Others Group Discrimination Data for Selected Variables

Group	ANX	ANX ²	ANX ² \times SBQ5
	Group Means		
1. An. Report (N = 12)	10.64	106.90	1142.57
2. Others (N = 52)	9.86	98.25	976.79
Univariate $F_{1,62}$	6.64	4.27	6.56
p estimate	.01	.04	.01
LDF Correlation	.946	.773	.941
	Wilks' Λ = .892	R^2 = .108	
	Chi ² = 7.03	p < .071	

Table 5 provides group discrimination data for the Child Study group in comparison with all other groups taken together. Three elements contributed to optimal separation ($p < .014$), each element taken individually being associated with a significant F value (at $p < .08$). The three-way (ANX \times INT \times SBQ5) compound was also significant (univariate $F = 3.77$; $p < .06$) but did not enter into the optimal set.

TABLE 5: Child Study Versus Others Group Discrimination Data for Selected Variables

Group	ANX	RAD	ANX ² \times SBQ5
	Group Means		
1. Child Study (N = 18)	9.61	10.32	909.09
2. Others (N = 46)	10.16	9.82	1046.53
Univariate $F_{1,62}$	4.22	3.49	5.93
p estimate	.04	.06	.02
LDF Correlation	.631	-.577	.738
	Wilks' Λ = .840	R^2 = .160	
	Chi ² = 10.74	p < .02	

TABLE 6: Tutorial Versus Others Group Discrimination Data for Selected Variables

Group	ANX	INT \times SBQ5	ANX \times INT \times SBQ5
	1. Tutorial	9.80	104.82
2. Others	10.11	96.96	968.35
Univariate $F_{1,62}$	1.37	5.80	4.13
p estimate	.25	.02	.04
LDF Correlation	-.442	.881	.752
	Wilks' Λ = .890	R^2 = .110	
	Chi ² = 7.19, df =	p < .07	

Results for the fourth test of this type contrasting the Tutorial group with all others taken together appear in Table 6. Overall group discrimination reached significance, but only with two significant terms in the function. Of the four tests for group discrimination so far considered, this was the only case in which the three-way compound entered significantly into the separation function.

Following this set of group comparisons, six further discrimination analyses were carried out on a group by group basis. Appropriate details for the Essay Group in comparison with the Analytic Report group are given in Table 7. Optimum separation was achieved using six variables, the three-way interactive compound (ANX \times INT \times SBQ5) being a prominent element.

The second group-by-group discrimination involved a comparison between the Essay and Child Study groups. Group separation in this case could not be demonstrated since means on each variable were virtually indistinguishable. None of the F ratios exceeded unity, and the overall χ^2 of 6.46 was associated with a $p > .50$.

Group discrimination data for the third test between individual groups are set out in Table 8. This test involved a contrast between the Essay and Tutorial groups. Although overall group discrimination was significant ($p < .043$), the only term to reach significance among the three best differentiators was the ANX \times INT \times SBQ5 compound (at $p < .018$).

The fourth group contrast was between the Analytic Report and Child Study groups. Data relevant to the optimum separation of these groups appear in Table 9. All three of the contributing variables in this case were associated with p estimates beyond the .06 level, and the preliminary discrimination analysis indicated that the ANX \times INT \times SBQ5 compound was

TABLE 7: Essay Versus Analytic Report Group Discrimination Data for Selected Variables

Group	ANX	ANX ²	ANX \times SBQ5	INT \times SBQ5	ANX ² \times SBQ5	ANX \times INT \times SBQ5	Group Means	
1. Essay (N = 14)	9.93	99.64	96.42	94.06	967.71	931.62		
2. An. Report (N = 12)	10.64	113.72	106.90	99.46	1142.57	1062.70		
Univariate $F_{1,24}$	3.84	3.39	4.67	2.11	4.55	6.44		
p estimates	.06	.07	.04	.16	.04	.02		
LDF Correlation	.555	.526	.603	.425	.597	.688		
							Wilks' Λ =	.552
							R^2 =	.448
							χ^2 =	12.78
							p <	.08

TABLE 8: Essay Versus Tutorial Group Discrimination Data for Selected Variables

Group	ADV	INT	ANX \times INT \times SBQ5
	Group Means		
1. Essay (N = 14)	10.23	9.70	931.62
2. Tutorial (N = 20)	9.80	10.16	1051.44
Univariate $F_{1,32}$	1.28	1.98	6.13
p estimate	.27	.17	.02
LDF Correlation	-.410	.505	.839
Wilks' Λ = .772 R^2 = .228			
Chi ² = 8.16 p < .05			

TABLE 9: Analytic Report Versus Child Study Group Discrimination Data for Selected Variables

Group	ADV	ANX	ANX \times SBQ5
	Group Means		
1. An. Report (N = 12)	9.70	10.64	106.90
2. Ch. Study (N = 18)	10.28	9.61	93.70
Univariate $F_{1,28}$	3.96	7.46	7.44
p estimate	.05	.01	.01
LDF Correlation	-.600	.782	.781
Wilks' Λ = .656 R^2 = .344			
Chi ² = 11.61 p < .01			

also significant ($F_{1,28} = 4.74$; $p < .04$), though it was not included among the optimum set.

Preliminary data for the fifth group contrast involving the Analytic Report and Tutorial groups indicated that no group separation was possible. While Anxiety, both as a linear and a quadratic term, was associated with significant univariate F values ($p < .03$ in each case), the overall Chi² test was not significant ($F = 5.88$, $p > .50$).

The sixth and last test in this set involved the Child Study and Tutorial groups. Data relevant to this comparison are set out in Table 10. Once again the ANX \times INT \times SBQ5 compound was the only element to be associated with a significant F value, but the overall discrimination was still clearly significant.

TABLE 10: Child Study Versus Tutorial Group Discrimination Data for Selected Variables

Group	ADV	ANX ²	ANX \times INT \times SBQ5
	Group Means		
1. Ch. Study (N = 18)	10.28	93.64	935.36
2. Tutorial (N = 20)	9.80	101.24	1051.44
Univariate $F_{1,36}$	3.04	1.60	5.20
p estimate	.09	.21	.03
LDF Correlation	-.609	.451	.776
Wilks' Λ = .791 R^2 = .209			
Chi ² = 8.35 p = .04			

One final analysis was carried out in the light of these results.

The data appeared to indicate that the four groups could be re-grouped into two by joining those groups for which group discrimination tests had been least successful. Cases were therefore pooled for the Essay and Child Study groups on the one hand and the Analytic Report and Tutorial groups on the other. The two groups formed in this way were then re-examined for group separation. Data relevant to this analysis are set out in Table 11. Six terms were selected from the preliminary analysis, all being associated with an F value significant at the .05 level, and overall group discrimination was also clearly significant. The three-term compound of particular interest in the study was again prominent ($p < .002$).

DISCUSSION

The main focus of interest in the present paper was the question whether a given set of aptitude variables under different teaching conditions would satisfy the terms of an Aptitude-Treatment-Interaction system. In particular the relevance of Anxiety-Stability and Introversion-Extraversion as contributors to performance in four academic tasks was considered under the strategic impact of an organizational study behaviour dimension. There was no indication that such a system was in evidence when the several dependent variables were inspected by way of multiple linear regression. But coarser analyses using group discrimination procedures yielded a number of significant results that were of direct interest, especially in the case of a three way interactive compound involving Anxiety, Introversion, and Study Behaviour (SBQ5).

Analyses of group discriminations which compared each performance group with the remaining groups taken en bloc revealed that the Analytic Report, Child Study, and Tutorial groups were distinguishable (at $p < .08$)

TABLE 11: Essay/Child Study Versus Analytic Report/Tutorial Group Discrimination Data for Selected Variables

Group	Group Means					
	ADV	AVX	ANX x SBQ5	INT x SBQ5	ANX ² x SBQ5	ANX x INT x SBQ5
1. Essay/C.S. (N=52)	10.26	9.75	94.89	96.03	934.73	933.72
2. A.R./Tute (N=52)	9.76	10.26	104.85	102.81	1081.01	1054.91
Univariate $F_{1,62}$	4.40	4.54	10.11	4.96	8.64	11.33
F estimate	.04	.03	.01	.03	.01	.01
LDF Correlation	-.478	.485	.695	.505	.649	.730

Wilks' Λ	=	.710
R^2	=	.290
GM^2	=	20.57
p	<	.003

340 and that in both Child Study and Tutorial analyses an ANX x INT x SBQ term was a significant element. This interaction term was also significant in the comparison involving the Essay group and all others, but the overall group separation fell clearly short of significance. Inspection of the directionalities in each case showed that relative Stability was associated with performance in the Analytic Report and Tutorial tasks by comparison with Anxiety in the case of the Child Study; and Extraversion in conjunction with Study Behaviour was also salient for Tutorial achievement.

Pairwise group comparisons yielded four significant discriminations from a possible total of six, and in each of these four the three-way interaction was also significant (at $p < .05$). Directional trends noted above were again apparent in linking Anxiety and Moderate Introversion with Essay and Child Study achievement, and Stability linked with Extraversion in Analytic Report and Tutorial achievement. By combining Essay and Child Study cases for comparison with Analytic Report and Tutorial groups taken together, the group separation was reinforced. The Essay/Child Study cases were reliably more Cautious, Anxious, and rather more Introverted when contrasted with cases in the combined Analytic Report/Tutorial group.

Throughout these analyses the subject-matter base on which student performance was being evaluated was confined to the relatively limited field of child and adolescent development. While the tasks required of students in the course of their studies covered diverse areas within this field, the concentration of work was unquestionably in the domain of empirics. In so far as this represented a constant element, the principal variable was that of teaching-learning style as a function of specific personality dimensions. In these terms the results offer qualified support for the view that a functional relationship of this kind, within a

restricted subject domain, can be demonstrated; and further that such a relationship may be consistent with theoretical expectations based on the nature both of the tasks and the personality qualities involved.

The epistemological impact of these results is necessarily indirect in view of the many un-tested assumptions involved in a study such as this. But a 'limitedist' principle may be discerned which recognizes the overriding role played by substantive aspects of subject matter yet at the same time acknowledges the importance of strategic and stylistic phenomena. To a limited extent, even at the undergraduate level where student samples are highly selected and somewhat homogeneous in terms of ability and general academic orientation, it would appear that identifiable interactions exist involving teaching styles and personality attributes. And the evidence presented here indicates that these interactions can be sensed in contrasts between groups based on relative excellence across tasks rather than by comparing degrees of performance within a task.

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AN EVALUATION OF A
PROGRAM OF COMMUNITY-SCHOOL RELATIONS
FOR TEACHERS FROM DISADVANTAGED SCHOOLS

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