Test Scores and Academic Bias in Canadian Grade Nine Children

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Abstract

This study was an attempt to examine some correlates of a convergence-divergence intellectual dimension, initially suggested by Hudson in England, and later elaborated by others, on a Canadian sample.

One hundred thirty seven ninth grade boys from a Montreal school population participated in the study. The Henmon-Nelson test of mental ability and two Guilford type open-ended tests were used to generate the convergence-divergence dimension (independent variable) according to Hudson's procedure. Fifteen convergers and seventeen divergers emerged as extreme groups.

These two groups were compared on 27 measures (dependent variables), which included Sandall's eight interest scales, student scores on an attitude measure toward eleven school subjects, and two other scales derived from the Hanrahan Toy Questionnaire. Only two of these 27 measures discriminated the two groups. One other variable discriminated two less extreme groups of convergers and divergers.

Neither discriminant analysis nor a Q factor analysis produced a clear separation of convergers and divergers. The attempt to confirm Hudson's hypotheses with Canadian Children by the above methods was not successful.

Résumé

Cette étude fut un essai pour examiner quelque correspondances, initialement suggérées par Hudson en Angleterre et plus tard elaborées par'autres, de la dimension intellectuelle de convergence/divergence, conforme à un exemple Canadien.

Cent-trente-sept garçons de 9e année des écoles montréalaises ont participé à cette étude. Le test Henmon-Nelson d'habileté mentale et deux tests de créativité de type Guilford ont été utilisées pour engendrer la dimension convergence-divergence (variable indépendante) selon la procédure d'Hudson. Cette procédure a identifié aux extrimités de la distribution quinze convergeurs et dix-sept divergeurs.

Ces deux groupes ont été comparés sur 27 variables dépendantes parmi lesquelles l'on retrouve: les huit mesures d'intérêt de Sandall, les résultats des élèves sur une mesure d'attitude touchant onze matières scolaires, et deux autres mesures dérivées de l'Hanrahan Toy-Questionnaire. Seulement deux des 27 mesures distinguent les groupes extrêmes de "convergeurs" et de "divergeurs." Une autre variable distingue les "convergeurs" des "divergeurs" des groupes "moins extrêmes."

Les résultats des analyses discriminante et des analyses factorielles "Q" démontré aucune évidence afin de discriminer clairement les "convergeurs" des " divergeurs." Les hypothèses d'Hudson n'ont donc pas été soutenues dans cette présente étude.

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Table of Contents

List of Tables

List of Tables (cont'd)

List of Tables (cont'd)

List of Tables (cont'd)

List of Tables (cont'd)

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Chapter 1

Introduction

The Problem

For any student the choice of field of study and subsequent career represents an important decision with far reaching social and personal implications. In any education system this career decision is determined by the educational offerings available and the student's ability or abilities and the opportunity to profit from them. These broad determinants are intricately related to three major areas, namely, the school and university curriculum, the intellectual development of the individual and the educational organizations of the institutions which he may attend. Many research efforts that attempt to examine the patterns of students' educational and vocational choices are often of an exploratory nature and are seldom able to encompass all the necessary variables. Because of the generality of the problem research has been conducted in many countries and within many different educational systems. Some of these have attempted to examine the effect of different systems of education in a comparative perspective (Noah and Eckstein, 1969; Husén, 1967) and by applying the same measurement techniques in all instances, and assuming equality of initial ability distributed among all the participating schools, have sought to explain differences

in the outcome as attributable to differences between the educational systems. Some examinations of the topic have applied different tests and measurement techniques and by ignoring systems differences have sought for a more general explanation in terms of the tests and measurement procedures used. Many North American efforts have sought explanation in terms of individual personality structure within a conjunction of intelligence, interests and opportunity.

The prediction of vocational adjustment and successful entry into a vocation, the acquisition of skill under training conditions have been of paramount importance to many psychologists and to most educational authorities. Some years ago attention was focussed upon a study by Hudson (1962, 1963, 1967, 1968) who found that the relative bias towards the conventional intelligence test as compared to open ended tests was or could be useful in predicting the 'natural bent' of some British schoolboys to specialize in arts or science, traditional aspects of the British educational system. These choices were often made at or about the age of 16 and once made seemed to continue in further, similar educational choices at university level. Butcher (1968) suggested that it would be worthwhile trying Hudson's procedures with population samples of different levels of ability and with different cultural backgrounds. One such different cultural background would be found in Canada, and the level of ability, broadly defined, might be that of Grade IX children in English schools in the Province of Quebec.

An attempt will be made to conduct such research at that level and in that area, knowing at the outset that it will be impossible to duplicate Hudson's enquiry exactly. It would also be impossible to ignore North American influences upon curriculum, and curriculum choice for Canadian students, and equally impossible to ignore the rich American literature that bears directly and indirectly upon the topic, and which, Hudson initially did. As a first step towards establishing the research it will be necessary to examine differences between the two systems of education, and some differences in methods employed by psychologists in the two countries, England and Canada. A more detailed review of relevant literature will then follow. In continuing the enquiry one aspect of the antecedents of the bias towards arts or science in curriculum choice, previously examined in the case of English children, (Hanrahan, 1972) will be incorporated, a study of the possible effects of the toys of childhood upon various interests and curricular choice.

Chapter 2

Some points of difference: England and North America

Educational Systems

Historically there have been two systems of education in England, a publicly provided system, originating in 1832 with minimum funds, and a private system paid for by parental contributions and some historically important financial endowments, in land or in money. The educational organization within the publicly provided system had one level of primary education for all (originally designated as elementary education). Secondary education developed from 1902 onwards, and after 1945 attempts were made to provide some measure of equality of regard for three types of secondary education, grammar, technical and modern. Those public bodies required by statute to provide secondary education (the Local Educational Authorities, County Councils and so on) have or had increasingly 'bought' places for students in the private schools, the private schools were sometimes constrained by the terms of their endowments to offer places to children from the publicly provided system, and, until recently, some Direct Grammar Schools were required to offer 25% of their places to such children in return for support from the Public Exchequer. Transfer from the elementary (later primary) system to the more expensive secondary (later grammar) schools was almost invariably by some form of

entrance examination of a competitive nature. Thus, secondary education was guarded by the traditional examination, which came to be known as the 'eleven plus', which aimed to examine the pupils' attainments at the end of their primary years. The efforts of psychologists such as the late Sir Godfrey Thomson, and Sir Cyril Burt, through the institution of the Northumberland Tests, and then by the better known Moray House Tests, (Thomson, 1952) led to the incorporation of intelligence tests into this scheme of selection. Thus, only those pupils ranking at the top, in ability and aptitude, and attainment, were given the opportunity to proceed to the type of liberal secondary education which, historically, had been provided by the endowed grammar schools. It was the limited number of grammar school places provided at public expense which ensured that the examinations were competitive, and it was not necessarily the ability to meet a predetermined acceptable level of performance which decided the fate of those pupils of academic potential.

Securing a place in a grammar school was not an end but for many it was the beginning of an even more acute competition for entry into a university, especially the Oxbridge universities. Recent developments of some 45 new university level institutions since the first World War have not apparently reduced the strains of such competition. Foreign observers (Learned, 1927) regarded such an organization as effective in maintaining high academic standards, whilst others, (e.g. Rickover, 1963) would have sought to import such a system into the United States of

America. On the other hand, others (e.g. Kandel, 1936) saw the use of competitive examinations as barring the way, deliberately, to higher education and to admission to the liberal professions except to a favoured few. Debates on the system have been fierce, and some of the arguments used reflected the chaotic state of educational measurements, and public ignorance or emotional rejection of what such measurements entailed. Thomson (Thomson, 1945) produced some figures for the level of intelligence of those admitted to Scottish universities, the lowest quartile of which were below I.Q. 105 while Burt, working from a theoretical distribution of intelligence, and the number of university places available in England, concluded that if intelligence alone were to be the criterion, then an I.Q. of 135 would be necessary for admission. (Burt, 1943a). He wrote further that, "about 40 percent of those whose innate abilities are of university standard are failing to reach the university, and presumably an equal number from the fee-paying classes receive a university education to which their innate abilities alone would scarcely entitle them." Arguments about this so-called "reservoir of intelligence" influenced the Robbins Commission to advocate the creation of more universities in England and Wales, a step which they argued could be taken without lowering the quality of the entrants (Robbins, 1961-63).

Some common beliefs about the early identification of talent had been expressed by such diverse individuals as Thomas Cranmer in England, and Thomas Jefferson in America. These

beliefs were extended and given beautiful literary expression in the Norwood Report of 1941. Here we find descriptions of three kinds of children who admirably "fitted" the three kinds of school which Norwood proposed. Thus children destined for a grammar school were those "who can grasp an argument, or follow a piece of connected reasoning, who are interested in causes...who are interested in the relatedness of related things, in structure, in a coherent body of knowledge." Those who have "an uncanny insight into the intricacies of mechanisms whereas the subtleties of language construction are too delicate for them...are concerned with the control of material things," are destined for an education provided in technical schools. Those "who deal more easily with concrete things than with ideas... abstractions mean little to them" must find their way into the modern schools. Psychologists were more sceptical and many, like Burt, (Burt, 1943b) suggested that allocation to the three kinds of school, if they were brought into existence, could probably only be done on the basis of 'general ability'. Those of high general ability would perform equally well in a grammar school or a technical one.

Lack of money and materials prevented the building of many schools in the immediate post-war years, and egalitarian influences and political determination led to the building and operation of many comprehensive schools, where the three kinds of children (envisioned by Norwood) would be in the same school, and where each child might be allowed to develop at his own pace and along the lines set by his interests and patterns of

development. Some believed that the Comprehensive School in England would be like the comprehensive schools which had developed in North America, particularly those of the United States. Others believed that they would develop and function in a radically different manner. The growth of the idea of the comprehensive secondary school was slow to come to fruition, and by the time of Hudson's investigations of the early 1960's few of them existed. Even now, after legislation to make them a central feature of the English educational system they have not displaced the private grammar school, and few of the Direct Grant Grammar schools have ceased to exist, but have elected instead to become independent of the public purse. Hudson's first venture into schools (Hudson, 1960) took him into two private grammar schools (Public Schools, as recognized by the Headmasters' Conference) and two other grammar schools not so recognized.

In North America, it is claimed, the organization is vertical, and there are reputed to be no barriers to the movement, with increasing age, from the elementary, to the secondary to the college or university level. While this model reflects the democratic ideal, it presents problems related to individualization, on the one hand, and differentiation on the other. Some years ago, Learned, (Learned, 1927) criticized American educational organization on the grounds that "it sacrifices the aspiration of the ablest pupils to those whose abilities are of a mediocre quality." Such a complaint has been heard in various forms in subsequent years (e.g. Conant, 1959)

but have usually had little effect on the prevailing organization. It is widely believed that by adjusting the curriculum to the pace of development of the students, each individual is adequately provided for. In addition, extensive use of counselling services in these schools has provided information to and help for students in deciding their future career and the choice of curriculum most likely to make such a career choice possible.

Education in Canada has been greatly influenced by ideas long held in England and Scotland, more particularly the latter. But the proximity of Canada to the United States has been significant in the development of its various systems of education. According to the Second Annual Review of the Canadian Economic Council (1965) "a careful historical appraisal of the development of education in Canada suggests that spectacular advances were made in education from the latter part of the nineteenth century to the early 1920's. In this period literacy and elementary education for all citizens were strongly promoted...but the Canadian educational advances appear to have tapered off by 1910; the earlier momentum at the primary school was not maintained, and there were only limited advances at the secondary school level. Renewed dynamism has clearly characterized major segments of Canadian education in the post war years." The developments since the 1960's will clearly testify to this. A further comment from the same report is worth noting; "it will take many, many years to bring about a substantial rise in the average level of education; even up

to the level which has already been achieved in the United States. And it would clearly take large and sustained efforts over a period of many decades to close the gap with the United States." Almost two decades later there is some evidence that that gap might well be closing, if not already closed.

The educational expansion post 1960 brought about changes in the curriculum in all provinces, and more attempts were made to meet the needs of the individual, as attested by reports emanating from the separate provinces, and more were urged. One may refer merely to such reports as the Parent Report in Quebec, the Hall-Dennis Report in Ontario and the Worth Report in Alberta and their subsequent effects upon education in those provinces. More diversity was to be found in school programs, and a wide range of options was introduced. By the mid seventies, annual examinations administered by the Provincial Departments of Education had largely disappeared and promotion by subjects studied became more the rule. Terminal provincial examinations still remain, and may fulfill a function for the universities akin to that performed by the examinations of the various Examining Boards in England and Wales. Some doubt may exist about this, as universities are said "no longer (to) have a reliable index to support decisions as to students' capabilities" (A.U.C.C. Policy Studies, No. 1, 1977).

The educational scene in Quebec has been effected by many such changes. From a system which only introduced compulsory attendance in 1943, and for which the school leaving age was fourteen, though many were permitted to leave at age 12,

compulsory secondary education now exists up to the end of the eleventh grade or to age 16 or 17. Collèges d'Enseignement Général et Professionnel (CEGEP'S) were established by consolidating a great number of non degree-granting institutes (many had granted a Baccalaureate es Arts, which should not be confused with the B.A. as more generally recognized) that had existed for many years as private institutions, i.e. as Collèges Classiques. CEGEPS were defined as a level of education separate from secondary and university studies and under a different form of governance. They were designed to limit the flow of students into universities which might appear to contribute to an elitist system of education, but at the same time to offer direct preparation for a career, and by maintaining all students in the same or similar educational milieu up to age 19 or 20 reduce social differences among youth, and one might hope, amongst the adults who emerged from the system. As recommended by the Parent Commission:

> "there be established a level of education, complete in itself, of two years' duration, after the eleventh grade, which shall be clearly separate from both the secondary school course and higher education. . . . it shall be the preparatory stage required for higher education, in the case of those intending to continue their studies, and, for all others, a terminal phase in general education and vocational training, preparing directly for a career. . . ."
> (Report of the Royal Commission, 1965, 368-369)

It should be pointed out that in the 32 CEGEP's so established, in spite of official hopes that 70% would follow career training,

75% followed university preparation courses. As Whitelaw suggested, (Whitelaw, 1968) this should not be so surprising, for:

> ". . . . there is first the fact that the creation of CEGEP offers access to university to a large group of students who could rarely have found their way into the university in pre-CEGEP days when the normal channel was through a fee-paying classical college. A generation committed to control of its own destiny (Maîtres chez nous) not unnaturally assumes that a university training is the proper means to this end."

Whilst each CEGEP sets its own standards, these are monitored by the Ministry of Education, and possession of a CEGEP Diploma virtually entitles one to university admission if the correct "mix" of subjects has been followed at CEGEP. Thus the influence of the universities and the CEGEP's reaches down into the High Schools, as the secondary schools are generally known in the province. Such influence might be expected to play a part in the career choices and subject choices of students who will be involved in the research to be delineated later.

Psychological Interpretations of Test Data

In earlier references to psychological reaction in England to the Norwood Report, it was noted that selection for admission to the grammar schools for secondary education would presumably be based upon 'general ability'. This remained a prevailing concept which affected discussions about the English educational system. Some such notions had preceded the work of Galton, notably in the work of Spencer, and gave that impetus

to a genetic basis of intellect which has generally prevailed. Spearman's so called two factor theory of intelligence (in reality a single general factor of ability) gave statistical justification which prevailed against the views of Thomson (Thomson, 1952). The latter argued that "ordinary methods of factor analysis (of the inter correlations of tests) create very large specific factors found in one test only, and then conveniently forget all about them, and, (2) that a hurly-burly of many small influences creates correlations which are inter-related in exactly the same way as would be the case if only a small number of common factors--plus very large specifics--were the cause." Not only was Thomson arguing that any 'g' must be much more complex than many were assuming but that there was danger in building psychological hypotheses upon what were essentially mathematical phenomena. Burt had adopted a method of Simple Summation which derived 'saturation coefficients' from the unweighted sums of rows or columns, and showed that Simple Summation as a device yielded simple explanations which were at least as good as those derived from more sophisticated methods, such as Least Squares and other Weighted summation methods. Spearman's method too, was an unweighted summation method. Later, Vernon was to elaborate the results of such methods applied to test data from school children, and gave rise to what became known as the Burt-Vernon hierarchical theory (Vernon, 1950).

This Hierarchical theory should be seen as clearly distinct from the notion of a hierarchy among correlation coefficients,

which, with the statistics of the distribution of tetrad differences, had been regarded by Spearman as prima facie evidence for the existence of a general factor. Hierarchical structure, as used by Cronbach, would be a more accurate description (Cronbach, 1970) of the procedures fairly widely followed by English psychologists in the interpretation of test results. With the gradual acceptance of some kinds of group factors the initial insistence of the existence of a general ability, 'g', entering into every test was gradually weakened. Guilford asserted that zero correlations between cognitive tests in any given population would be sufficient to destroy such a theory. Nevertheless in the heterogenous populations of children used by English psychologists zero order correlations among cognitive tests were not found, and some 50% or more of the variance in tests was directly attributed to 'g'. The group factors, which appeared at the next lower level in the hierarchy, seldom contributed more than 10% of the total variance explained by analysis. Of greater importance was the original notion of Spearman, to separate the cognitive from the orectic, and to devise an explanatory system for the cognitive processes and test results. This, and his adherence to the principle of Occam's Razor, may have contributed the most to the development of this area of British psychology. One never used methods more sophisticated than the data warranted, never used methods more sophisticated than the analysis required, and showed a willingness to advance tentative hypotheses and to seek confirmation

of these over extended periods of time. The non availability of mechanical computational aids in England certainly inhibited the use of large scale analyses. (Eysenck,1972). Crelle's Tables, and hand operated Monroe calculators marked the general level of working on data which were still prevalent at the time of Hudson's entry into psychology.

In the United States, Hull (Hull, 1925) had produced a device for the mechanical computation of correlations. Thurstone (Chesire, Saffir, & Thurstone, 1938) went even further in producing a family of graphs from which tetrachoric coefficients of correlation could be read directly, and thus made possible his first large scale enquiry which led to the subsequent production of tests of Primary Mental Abilities and which facilitated the many factor analyses produced, for example, by the U.S. Army Air Force under the leadership of Guilford (Guilford, 1947, 1948; Guilford & Zimmerman, 1947). Thurstone's further work, (Thurstone, 1947) entitled Multiple Factor Analysis virtually advocated the handing over to clerks of the routine (for him) factor analysis of extensive data, a practice designed to increase the use of the method and to lead to more sophisticated approaches to the use of tests and to the interpretation of tests results. When Kaiser, (Kaiser, 1956) followed up the earlier work of Ferguson, of Carroll, of Neuhaus and Wrigley, and gave an acceptable solution to the rotation problem, the time had arrived for factor analytic approaches to be almost the only acceptable method of proceding in a North American psychometric context. The increasingly easier access to computers

in North America virtually made factor analysis with varimax rotation an automatic process with large tables of test intercorrelations. Other methods, including multiple regression analysis and discriminant analysis have also been facilitated by such access to computers. With this access there has been a requirement that students in education and psychology should have more detailed introductions to statistical theory and statistical methods as the many available texts e.g. Ferguson's, (Ferguson, 1966) will indicate. At a more sophisticated level, building upon the work of Lawley, (Lawley, 1949) the method of Maximum Likelihood has been developed by Jöreskog (Jöreskog, 1967, 1969) the UMLFA (unrestricted maximum likelihood factor analysis) has been used.

Other important differences

There remain two other important differences between England and North America which enter into this topic. The Rede Lecture of 1957 delivered by C.P. Snow, on the topic of Two Cultures provided a convenient point of departure for a renewed interest in the education of scientists in England. It was this interest which no doubt caused Professor Oldfield to advise Hudson that if he wished to receive funds for graduate study he should make some acknowledgement to arts and science students or to their education. The Two Cultures followed statements of alarm voiced by a former Prime Minister, Sir Winston Churchill, on the superiority of scientific and technical manpower in the Soviet Union. In the United States this

alarm was mirrored by the National Science foundation's publication in 1955 of 'Soviet Professional Manpower'. More startling however, was the appearance in the sky of the first Sputnik launched by the Russians on October 4th 1957, to which the Americans were able to reply with the small Explorer in January 1958. But 1958 saw also the massive move in the Soviet Union, following Khruschev's denunciation of Stalin, of a re-organization of the whole educational system. The effect on the American general population was mirrored in the Conant Report and the efforts towards the recruitment of people of high ability, of originality, of those wishing to become proficient in foreign languages, and of 'creative' individuals. This focussing of public interest, and the liberal provision of funds, merely added to the opportunities for research of a kind which had already begun, especially the Aptitudes of High-Level Personnel initiated by Guilford in 1950 with support from the Office of Naval Research. This enabled Guilford to build upon his research efforts during World War II, summarized in 'Printed Classification Tests' of the Army Air Forces Aviation Psychology Program Research Papers, Vol. 5. His Presidential Address to the American Psychological Association, published in 1950, dealt with the topic of creativity. In this address he suggested that the study of creativity, an area which most psychologists approached with trepidation, had been for him a long standing ambition. He considered creativity to be an aspect of personality, itself a unique pattern of traits, a set of behaviour traits that "come under the broad categories

of aptitudes, interests, attitudes and temperamental qualities." He could not see how "some of the creative abilities, at least, can be measured by means of anything but completion tests of some kind." By 1951 his laboratory had published the hypotheses and tests necessary for an investigation of the "factor analytic study of creative thinking" as Report No.4, and the results themselves were available in Report No. 8 published in 1952. Immediately preceding and following the launching of Sputnik he was one of the participants at annual conferences on the subject of creativity sponsored by Taylor at Utah, conferences held in the delightful retreat of Bryce Canyon, Utah. (Taylor and Barron, 1963). The flurry of research which followed the allocation of funds was perhaps most commonly recognized by the work of Torrance, and by Getzels and Jackson.

Thus, we had the situation where a public lecture in England drew attention to a problem, and placed it in some context of the pace of industrial revolution in various countries, and aroused some interest but no practical action, whereas the action had preceded public arousal in the United States. This state of affairs should be placed in the general attitudinal context of the two publics towards research and its funding. It is probably true to say that in England it has always been assumed that if one looks after the 'bright' individuals one of them will produce the necessary invention or discovery at the appropriate moment, so that an elite system of education and serendipity will keep a nation ahead. Examples were to hand in the fortuitous discovery of Florey, and its retrieval by a

graduate student, (with a refusal to patent it) gave the world a free gift of penicillin, as well as the work of Whittle and the jet engine, or Turing's work which made possible the solution of any problem which could be expressed in mathematical terms, and so laid the foundation of modern computers, or the pioneer work of Williams and Kilburn at Manchester in the years prior to 1939. In the United States there was an almost contrary belief that if a sufficiently large number of individuals was put to work on any problem, that problem would be solved. This was best examplified in the Manhattan project, and was to be vindicated later by the NASA people at Cape Canaveral (Kennedy).

If this analogy is followed it is easy to see that the work of Hudson was conducted in the amateur fashion of much English research without regard to other research, and in fact to the active disparagement of much of the methods used by others. On the other hand when American interest was aroused, then large numbers of individuals, and co-operative research organizations, saw the problem was delineated clearly even if its final solution was not reached.

Chapter 3

Review of the Relevant Literature

Since the work which follows is an attempt in part to replicate Hudson's own work, any review of the literature should begin with Hudson's contributions. As he set out to establish arts/science dichotomy, he declared his opposition to triviality of measurements, the use of too complicated statistics for the data, and a general objection to theory outrunning the facts available. These can be wise precautions or they may indicate that his work is not well founded in theory. The bulk of Hudson's work would suggest that attempts to justify the separation of English school boys into arts and science by psychometric means are not impossible. He assumed that specialization may exist prior to training, and thus early identification of scientists and arts specialists may be feasible. Such an identification is tied, in Hudson's original theory, to the question of predicting future excellence, so that his early attempt was to look for marks of distinction, at the highest level, such as becoming a fellow of the Royal Society (1958). His next attempt was to examine the psychological test records, provided by Heim, of arts and science undergraduates with whom she had worked on the standardization of her test. From combinations of sub-scores on that test he found that "arts specialists usually had verbal biases of ability while scientists

had numerical or diagrammatic ones" (Hudson, 1967, p. 32), a not-unexpected finding since some elements of numeracy below the VIth form would be factors in the selection/allocation to further study of science, especially physical science.

From the undergraduate level Hudson moved down to the sixth form where the boys in the schools he visited were already committed to their specialization, and generally speaking, committed to applying to university. It was only after he completed his Ph.D. in 1961 and after the publication of Getzels' and Jackson's work on creativity and intelligence in 1962 that Hudson became familiar with open-ended tests and the nature of creativity. While the later American study was promptly reviewed in England and its drawbacks were pointed out (e.g. Burt, 1962; Vernon, 1964), Hudson was not devastated about the research and regarded some other reviews, possibly that of De Mille and Merrifield in Educational and Psychological Measurement (De Mille and Merrifield, 1962) as being waspish. Some of Hudson's own bias, or ignorance of the literature, (Burt, 1967) shows in the scant recognition he accorded Guilford's proposed terms of convergent and divergent productive thinking, a point made by Butcher in his review of Hudson's subsequent publication, Frames of Mind, (Butcher, 1969b). However he took to himself the terms convergers and divergers, as applied to classes of individuals. He did so explicitly because he objected to the ambiguities introduced by Getzels' and Jackson's use of the terms 'HIGH IQ' and 'HIGH CREATIVE', though it was "this distinction, renamed and refurbished in detail, which

forms the basis of the rest of the work described in this book (Contrary Imaginations)." This makes it important to point out that the Getzels and Jackson groups were formed by taking only two groups, the high-lows, and the low-highs, on the two kinds of tests separately, ignoring the high-highs, who may have been quite numerous, but about whose numbers no information was given.

Guilford conceived of convergent and divergent thinking as separate intellectual dimensions, whereas Hudson combined both in one dimension namely the differences in performance (bias) on representative tests. Hudson distributed these differences in the proportions of 1:2:4:2:1 and restricted his analysis to the extreme ends (30%), and ignoring the middle 40 percent, leading us to think that he was considering psychological types, as Smith (Smith, 1966) and Vernon have (Vernon, 1973) indicated.

In this second phase of Hudson's research he worked with bright students from the "public schools" and grammar schools. From that time on he used the A.H.5 I.Q. test which consists of verbal, numerical, and diagrammatic items tapping five principles; theories, analogies, directions, similar relations, and features in common. In addition, he employed two open-ended tests of Guilford, "Meanings of words" and "Uses of Objects." He noted that intercorrelations among different types of open-ended tests were low, a point indicated also by Wallach and Kogan, (Wallach and Kogan, 1965) albeit he used only two of these tests. He failed to point out that the

correlations between open ended and closed tests were generally higher than those between different kinds of open-ended tests. This latter point indicates the possibility of either different dimensions being present in the different open-ended tests, or that the reliability of the tests would vary with the conditions of presentation. Wallach and Kogan considered that they measure a creativity factor distinct from convergent intelligence only if given individually under permissive, untimed, 'game like', conditions (Vernon, 1971). For his part, Vernon concluded from research with Canadian grade 8 children that higher scores were produced under relaxed conditions but that similar factor patterns existed for scores obtained under group testing and under 'relaxed' testing conditions. Hudson's two groups, whom we may call convergers and divergers, or would be scientists and arts specialists, were compared on a number of measures constructed specially for use with these groups. These measures dealt with the quality of students' drawings, autobiographical details, personal qualities, controversial statements measuring liberal/authoritarian attitudes, general knowledge and expressed interests. Bias was determined on the aforementioned 1:2:4:2:1 scale in terms of scores on the intelligence test (A.H.5 now used as a single score) and the pooled score obtained from "Uses of Objects" and "Meanings of Words." In general those about to be called 'convergers' scored more highly on the A.H.5 than those about to be called 'divergers' but the notion of bias removed from both groups those who scored highly on both measures. Thus, a high diverger could

have much lower scores on the intelligence test than those called convergers. The autobiography was used with only 95 students and exhaustive analysis, involving thirty indices, failed to find a single quantifiable difference between the two groups. The personal qualities questionnaire had five sub scales, authoritarianism, rigidity, social conformity, defensiveness, and freedom of emotional expression, of which only the first three provided any discrimination between convergers and divergers. The test involving controversial statements permitted Hudson to derive a score for liberal/authoritarian values. The drawing test was clearly related to Getzels' and Jackson's "Playing Tag in the School Yard," and he reported his findings as similar to theirs. He provided no clear evidence of how he obtained scores on the interests of the two groups. He suggests that "we could guess that divergers would have cultural interests and convergers, ones that are practical and out-of-doors; and this is what happens." In a footnote he adds that $P<0.001$.

Hudson was fortunate in that his major reviewer, Burt (Burt, 1967) took the opportunity to oppose Hudson's attack upon conventionally represented but incorrect attacks upon traditional psychology, the nature of intelligence tests, and literature which had accrued. In his conclusion Burt said, "the main value of the book lies in the detailed discussion of the intricate processes, temperamental as well as intellectual, which underlie original or creative thinking . . . and throughout the chapters his points are illustrated with a

fascinating wealth of detail." It is a moot point whether the detail was added as gloss by Hudson or was available in a manner which permitted replication by others. Finally, Burt was to say, "above all, let us be grateful for a writer who can express himself with such clarity of style and convey a complex argument in words so free from needless technicality and jargon." It was left until later for Vernon, and his commentator at the Third Banff Conference of Theoretical Psychology , T. E. Wecknowicz, to show the technical skill required to make full and proper enquiry into Hudson's propositions concerning his views on cognitive styles.

One clue to the value of any work lies in the amount of work which follows, especially work by other investigators. Butcher (Butcher, 1968) who had already been involved in a partial replication with Scottish children of Getzels' and Jackson's study (Hasan and Butcher, 1966) appeared quite enthusiastic and as well as suggesting that Hudson's work should be replicated under different conditions with different students, gave the names of three individuals who were likely to publish on the topic in the near future. Examination of British journals failed to turn up any references to these individuals or their work. One of the few researches which used convergence-divergence explicitly in the title was that of Sacks and Eysenck (junior) of 1977 which used the A.H.5 and Uses of Objects as their classifying device, and then examined subjects' memory for concrete versus abstract words. Most English work which has been reported tended to deal only with divergent thinking,

which might well have been a way of avoiding the pejorative connotations, to English psychologists, of the notion of creativity. Thus, we find the work of DiScipio, carried out under Eysenck's supervision but with New York children, examining divergent thinking as a complex function of interacting dimensions of Extraversion-Introversion and Neuroticism-Stability, a topic well within the framework utilized for so long by Eysenck (senior).

Of work reported in the British Journal of Educational Psychology, Cropley's report on Creativity and Intelligence appeared in the same issue as Smith's Critical Notice of Contrary Imaginations and can scarcely be seen as arising from Hudson's text. The first report, which made direct reference to Hudson, appeared in 1968 from Haddon and Lytton, and apparently was induced more by Vernon's 1964 review of creativity and intelligence (Vernon, 1964) and Guilford's earlier work (Guilford, 1956) than by other influences. It examined the differences induced by education in schools which could be classified as Informal and Formal. They concluded that convergent thinking and divergent thinking were complementary aspects of intellectual ability, and that the informal atmosphere of some schools provided "an environment which develops qualities of personality that result in a high level of divergent thinking ability." Curiously, the next published piece on Divergent Thinking Abilities--A Validation Study (Bennett, 1973) made no reference whatsoever to Hudson. It found that "Guilford's premise concerning the relationship of convergent

and divergent thinking was only partially supported" but differentiated between abilities and attainment whether conventional or creative, and disproved the threshold hypothesis, which demands a certain level of ability before creativity can appear, something previously disproved in Australian based research reported earlier in the Journal.

What promised to be a more sustained effort on the topic has been made at the University of Bradford by Child and Smithers. Using a sample of more than 300 freshmen and women volunteers, and following Hudson's procedures with A.H.5 and Uses of Objects and Meanings of Words they identified 53 convergers and 51 divergers with the remainder being all-rounders. 35 of the convergers were science based and 38 of the divergers were non-science based, which they took as confirming the arts-science dichotomy claimed by Hudson. Since the procedure for determining the converger/diverger dichotomy required over two hours of testing, they experimented further with a questionnaire developed by Hudson, and used by Hudson and Joyce on medical students and lecturers (Joyce and Hudson, 1968) which would considerably shorten the time required for making the distinction between convergers and divergers, if its validity were established. By factorial methods they produced 14 items which loaded significantly on the first factor to emerge. However, these items, and in fact the whole 20 item scale, failed to yield the expected dichotomy but did indicate a measure of academic subject orientation. (Child and Smithers, 1973). Later (Smithers and Child, 1974) they used the data collected above

to examine a further suggestion of Hudson that neuroticism in convergers would take a different form from that of divergers, taking their primary data from students' response to the Eysenck Personality Inventory. They found no differences between any of their three groups, convergers, divergers, all-rounders, on levels of extraversion nor on neuroticism.

Subsequent research from Hargreaves, (Hargreaves, 1974, 1977) first at Durham and later at Leicester looked at situational influences on divergent thinking, following the suggestions of Wallach and Kogan on creating game like situations for the facilitation of divergency in thinking, and in the mode of Vernon, (Vernon, 1971) which was followed by an enquiry into sex roles in divergent thinking. Only in the latter research was any reference made to Hudson and then only to his suggestions in Frames of Mind. Meanwhile Channon (1974) had determined that test conditions produced higher average scores on divergent tests than relaxed ones for boys, but that girls possibly treated all occasions alike and strove for higher scores under both conditions. Again, the occasion for the research could be traced back to Wallach and Kogan rather than to Hudson. There is no doubt that the same authors sparked lively controversy on interpretations of their results, and that the methods of factor analysis, especially the use of oblique rather than orthogonal rotations played a large part in the controversy. This apart, it might well be that much of the work arose from consideration of styles of teaching, and classroom climates rather than academic concern with any

convergers/divergers dichotomy. At a somewhat later stage the influence of De Bono was detectable, when lateral thinking intruded upon the research scene.

As we have seen above, Hudson turned aside from his intriguing question of why some students should choose to specialize in science and others in the arts, putting aside interests as a reflection of personality and their role in influencing the direction in which abilities may specialize, Hudson neglected the issue and turned to the area of originality. Although he never acknowledged the debt to Guilford, it was his paper on Creativity (Vide supra) which gave the rationale if not the impetus for a prolonged study of creativity, originality, or whatever name might be used for its description. Hudson derived two indices of accuracy from a consideration of right and wrong answers. These he called 'worse accuracy' and 'range accuracy', the former being the ratio of correct to incorrect items on the verbal versus numerical and diagrammatic part of the A.H.5. The latter was the difference between the two ratios. In a sense it was a measure of rate of working, or a belief that speed and inaccuracy might be related in some individuals. The notion appeared later, in other hands, as 'personal tempo' and was undoubtedly a personality variable. Hudson was to translate these scores, or to use them as a measure of originality. We have seen above how his own work and some of the work of others was developed from that point onwards. A corresponding look at the general topic of creativity may now be in order.

Research in creativity has followed several approaches. Investigators would seek persons who may be identified as creatives by one criterion or another, such as, ratings of peers or supervisors, occupational salary, output of patented inventions, etc., and contrast them with non-creative workers in the same field with respect to a variety of personal and intellectual variables. Others would use a clinical approach to study the personality dynamics and antecedent experiences of eminent scientists. Still others would attempt to come to grips with the creative process through the study of biographies and autobiographies of creative artists and scientists (Ghiselin, 1952). It was recognized that despite many variations between artists and scientists, creative persons have much in common especially when different media of expression are taken into account. While creativity has traditionally been associated with artistic production, the increasing demand for talented scientists gave impetus to the study of scientific creativity. To meet such a demand, an early identification of potentially creative scientists was necessary. It is within the latter context that Hudson developed his theory of potential originality in relation to arts and science specialization.

The existence of divergent thinking factors is by no means decisive, so much so that investigators sought to interpret creative production in terms of individual personality within a conjunction of intelligence and interest. It was only after the publication of Guilford's studies from the Aptitudes Research Project that investigators became interested

in looking for intellectual factors that could be identified in their own right as contributing to creative production. In these studies Guilford was testing a highly intelligent group of military personnel (post World War II) and seeking new aptitude measures among a potential officer group. Some of his studies were focussed upon problem solving and reasoning (Guilford et al. 1950, 1951). As a result of several factor analytic studies, Guilford and his colleagues developed a model of the structure of intellect. Apart from the use of a morphological model to represent intellectual functioning as the product of process acting upon material content, a major feature was the distinction made in productive thinking between convergent productive thinking and divergent productive thinking. Guilford, however, was unlikely to espouse a theory of psychological types based upon such a distinction. Convergent production thinking involves factors that were consistently found to be underlying conventional I.Q. tests which contain closed items requiring one right answer, whereas divergent production thinking allows the respondent to initiate his own response by searching for a solution of a given problem in many directions, hence they are open-ended.

By 1967 as many as 120 factors were hypothesized as comprising the structure of human intellect. The multiplicity of these postulated factors should not be surprising in the light of the fact that each was conceived as specific to one of four kinds of content (figural, symbolic, semantic, or behavioural), and one of six kinds of product (systems, classes,

units, relations, etc.). In addition, each factor or test may involve, divergent production, convergent production, memory, cognition, or evaluation. A variety of open-ended tests was developed by Guilford and his students. The two tests used by Hudson may suffice as examples of the Guilford's type creativity tests. The "Uses" test contains a number of common objects, the respondent being required to list as many uses as he can think of for each. For some time the Guilford "brick" test attained great popularity among certain text-book writers as an illustration of a test of originality. The "Word-Association" test presents the examinee with a number of words, and he is asked to list as many meanings as he can for each. The former test presumably measures a factor specific to divergent production of symbolic units (DSU), the latter is assumed to measure divergent production of semantic units (DMU).

Following Guilford, other writers developed creativity test batteries. The Torrance Tests of Creative Thinking reflect an emphasis on the distinction between figural and verbal creativity--but his manual recommends combining the figural and the verbal score (Torrance, 1966). Wallach and Kogan devised a five-test battery, one of which is directly borrowed from Guilford, the "Uses", another involves "Similarities"--think of as many ways in which violin and piano are similar to each other. Two tests are concerned with giving meanings to certain lines and patterns, and one involves instances. The latter authors stress a playful-like testing situation which they believe to be conducive to creative thinking. Their study

(Wallach & Kogan, 1965) in which they demonstrated the interaction between creativity and intelligence, as separate dimensions, was later shown to be indefensible (Cronbach, 1968).

Of all divergent thinking sub-factors that Guilford and his students claimed to have isolated (Guilford, 1956), only ideational fluency and originality appear to be of some acceptable status. Barron (1955, 1957, 1963) found a strong relationship between ideational fluency and originality when effects of intelligence were partialled out, suggesting that the former two factors while functionally dependent on one another may be independent from the latter. With two open-ended tests, Garwood (1964) found that the originality score on either to correlate substantially with the ideational fluency score on the other. Piers, Daniels, and Quackenbush (1960) obtained a negative correlation of -.03 between a number of ideational fluency measures and the Otis Intelligence Test with seventh and eighth graders. McGuire, Hindsman, King, and Jennings (1961) factor analysed correlations among a number of convergent measures and four of their Guilford type divergent measures obtained from 1000 seventh graders. Using an orthogonal Varimax solution, there emerged a factor clearly defined by the ideational fluency measures. Orpet and Meyers (1966) report similar results with six-year-old children.

In one study, Cropley (1966) took issue in the long-lasting question of creativity-intelligence dimensionality. He administered two sets of convergent and divergent measures to a sample of 320 Canadian seventh graders. His convergent

measures consisted of the verbal and non-verbal sub-tests of the Lorge-Thorndike scale, Vocabulary, Inferences, Length estimation and Academic Average. Divergent measures were, Seeing problems, Tin can uses, Consequences, Symbol production, Circles, Hidden figures, and the Remote Associates Test, scored for originality as measured by the degree of rarity of responses. Factor analysis of the intercorrelations of these two sets of measures yielded five factors, but only those with eigen values greater than one, of which there were two, were retained for further analysis. When these two factors were orthogonally rotated, the first factor was defined by the convergent measures. Measures of Academic Average, Verbal I.Q., Vocabulary, Performance I.Q., and Inference had the highest loadings on the first orthogonal factor which derives 81 per cent. of its variance from the Verbal I.Q., the Performance I.Q., and the Academic Average measures. The second orthogonal factor was defined by the scores on Seeing problems, Tin can uses, Circles, Consequences, and Symbol production, which contributed 85 per cent. of that factor's variance. Still a proportion of 12.3 per cent. of the total variance accounted for by the latter measures on the divergent factor was explainable by the scores on the Verbal I.Q., Performance I.Q., and Academic Average measures. When these two factors were obliquely rotated, convergent measures clearly defined one of the two oblique factors. While the second oblique factor was predominantly dependent on the divergent thinking measures, its loadings on the convergent measures were only reduced.

Cropley concluded:

> "It would be wrong to argue either that convergent and divergent thinking can not be distinguished from each other factorially, as some authors have suggested, or that they are completely independent of each other as has been suggested by others." (Cropley, 1966, p. 264)

Since there is no strong evidence to support the validity of divergent thinking tests, some writers object to the use of these tests for predictive purposes (e.g. McNemar, 1964). Scores on a number of divergent tests that were given to a Canadian sample correlated about .51 over a period of 5 years with non-academic activities such as art, music, and drama rated for creativity (Cropley, 1972). Vernon (Vernon, 1972) found a similar coefficient with a sample of Canadian, eighth grade boys. Haddon and Lytton (1968) reported a test-retest reliability coefficient of .62 over a period of four years. Drevdahl (1956) found a relationship between scores on divergent thinking tests and assessed creativity of arts and science students.

With this in mind, it may be possible to evaluate the research claiming to have identified distinct cognitive types of students. Getzels and Jackson's study (1962) was an American antecedent of Hudson's work in England. Using nearly 500 students from a highly selective private school in Chicago, Getzels and Jackson administered five open-ended measures, Uses of objects, Word association, Hidden shapes, Fables-requiring the examinee to make up a humorous, a moralistic, and a sad ending, and a test involving making up as many mathematical

problems as possible from given information. These tests were scored for the number and rarity of responses. The convergence index was derived from scores on previously administered group intelligence tests. Two groups were formed. The high creativity group consisted of those students who scored in the top 20 per cent. on the open-ended measures, but below that percentile on the intelligence measure, and the high intelligence group comprised those students who scored in the top 20 per cent. on intelligence and below that percentile on the creativity index. After eliminating students who scored in the top 20 per cent. on the two types of measures, only 26 and 28 remained in the two respective groups.

The two groups were compared for school achievement, preference by teachers of the personal qualities they preferred for themselves, their identification with those personal qualities they believed made for adult success and liked by their teachers, and the qualities of their projected phantasies. Of importance here are the personal qualities found for the American high creativity and high intelligence groups since they perforce are in line with Hudson's findings for the British divergers and convergers. Getzels and Jackson used an instrument called the "Outstanding Traits Test" to examine to what extent their two groups conformed to conventional values. It presented subjects with examples of thirteen children, each of whom was described as having a desirable personal quality, e.g. the highest I.Q. in the entire school, the best athlete, the best sense of humor, etc.. Subjects were to rank these

qualities in order of the degree to which they preferred them for themselves, the degree they believed teachers would favor them, and the degree they believed made for adult success. There was a close association between the rank order of the personal quality preferred by the high I.Q. group and the rank order of the qualities they believed favored by their teachers (r .67), whereas these same variables were shown to be inversely associated in the high creativity group (r-.25). The relationship was even stronger between the rank order, made by the high I.Q. group, of personal qualities preferred for oneself and personal qualities they believed made for adult success (r .81). The high creativity group was shown to be much less success-oriented (r=.10). But the exclusion of those students who scored in the top 20 per cent. on both creativity and intelligence measures left Getzels' and Jackson's study open to criticism. These authors report a mean correlation of above .3 within the creativity dimension, but that between creativity and intelligence measures was not much lower. Thorndike (1963) factor analysed Getzels' and Jackson's correlation matrix and found one general factor loading equally on both types of measures. Consequently these personal qualities may be found for any group of adolescents chosen at random regardless of their measured intelligence or creativity. In his review of Getzels' and Jackson's study, Burt (1962) concluded that, at best, divergent thinking tests may serve as a useful addition to the conventional I.Q. test items. Some succeeding British work followed Getzels' and Jackson's lead,

ignoring the warnings of Burt (Burt, 1962) and DeMille and Merrifield, two of Guilford's former students (DeMille & Merrifield, 1962).

Hudson attributes the direction of his work after completion of his Ph.D. to a review which he completed of Getzels and Jackson, and his disagreement with the reviews of Burt, and Vernon, for example. Hence it is no surprise to find that he devised a similar instrument to that of Getzels and Jackson to probe almost the same personal qualities in the British divergers and convergers. Hudson compiled thirty qualities in what he called a "Personal Qualities Questionnaire" in which subjects were required to rate each quality on a four-point scale ranging from "strongly approve" to "strongly disapprove." This questionnaire was developed to discriminate between divergers and convergers with respect to Authoritarianism, Rigidity, Social Conformity, Defensiveness and Freedom of Emotional Expression. Hudson stated that "only the first three of these scales discriminated significantly between convergers and divergers" (Hudson, 1967, p. 192). Convergers were more likely than divergers to approve of statements showing respect to authority, to possess rigidity of outlook, and, as their American counterparts with high intelligence had shown, to adhere to conventional social values. That the British diverger or would be arts specialist was independent in his views, less emotionally rigid and more flexible may be in agreement with other research findings, but the personality profile of Hudson's converger or would be scientist appears to

depart greatly from what emerged for the creative American scientist.

The two research conferences organized by C.W. Taylor (1955, 1957) at the University of Utah (vide, supra) reflected the American psychologists' interest in identifying creative scientific talent. American research on creativity and specialization yielded, in general, different results from those of the British work, and even where there is agreement one can not help entertaining some doubt in accepting it because of wide differences in the two methodologies. American psychologists were primarily concerned with comparing personality profiles of creative persons working in different fields, or comparing creative with non-creative persons working in the same field. Roe (1952) intensively studied physical and social scientists, Cattell and Butcher worked with scientists and artists (1968), Mackinnon (1962) contrasted creative and non-creative architects, and Barron (1955) explored the factor of originality using a variety of measures with 100 captains in the U.S. Air Force. Apart from the studies in which the person was the criterion for creativity, there has been one study by Drevdahl (1956) with American arts and science graduate students which, while comparable to the British work, yielded different results, and the latter author concluded that:

> " As far as the science fields are concerned, it may be necessary for the creative individual to be conventional in accepting knowledge, known methods and, perhaps goals. Once these are accepted and internalized, the scientist's unconventionality (which is more intellectual than

> personal) can be expressed within this framework by means of his flexibility and fluency in approach, and in his originality. With respect to the art fields, on the other hand, the creative artist may be less dependent upon what has gone before, and may depend to a greater extent upon his personal unconventionality (Drevdahl, 1956, p. 26)

The importance of the foregoing conclusion can be seen in the light of the experimental control entertained by Drevdahl. He classified his sample into four groups, creative vs. non-creative and arts vs. science, then, using analysis of variance, he compared these groups' scores on intellectual and personality measures. Not only did Drevdahl assess potential creativity by means of nine of Guilford's factors, in which tests with the highest loadings were used, but he also included creativity ratings of his arts and science students by their professors. Indeed, the creative group obtained significantly higher scores on the originality factor than did the non-creative group. The only divergent thinking factor which differentiated arts and science students was that of redefinition, which was never considered by Hudson, with the science group scoring significantly higher. While there were some significant personality differences on the 16PF between the arts and the science groups, Drevdahl tended to stress differences between creatives and non-creatives whether they are found in arts or in science. He points out:

> . . . the creative art group was significantly more radical and self sufficient than the creative science group. In terms of these

> results we might characterize the creative group as somewhat withdrawn and quiescent, more concerned with ideas and things than with people. Creative arts we may further characterize as considerably more radical and self sufficient. These latter characteristics may reflect the creative artist's tendency to break away from the routinized and accepted patterns of work and behavior" (Drevdahl, 1956, p. 25).

Commenting on Drevdahl's results from the study reported above and another one by Drevdahl and Cattell (1958) in which they studied artists and writers, Cattell and Butcher (1968) state:

> " A study of 153 writers of imaginative literature (Drevdahl and Cattell, 1958) shows a profile on the 16 PF that, by any pattern similarity coefficient (an index designed to express over-all similarity between two profiles), would definitely be placed in the same family as the profiles of the creative scientists; and the same is true of artists, taken from persons listed in 'Who's Who' in American Art" (Cattell and Butcher, 1968, p. 294).

Thus the choice of the arts or the sciences can only be seen as a choice of the medium through which the creative person tends by temperament to invest his originality. If the divergent thinking tests used by Hudson were of any discriminatory value at all, even within his notion of relative differences, arts students would have resembled science students in some respects, but he asserted that they were distinctly different. Perhaps the most important distinction that Hudson made was that a high I.Q. is not as necessary for the potentially original artist as it is for the scientist. With the

absence of strong evidence on the independence of intelligence and creativity, most writers can only state with caution that a minimum level of intelligence is necessary for creativity in arts or in science. MacKinnon (1962), for example, reported a mean I.Q. of 156.4 for 20 writers on the concept mastery test, while the mean I.Q. for 40 creative architects on the same test was 113.2. Considering the requirements for creative work in these two fields, the creative architect does not have to be of high verbal intelligence. The samples of architects and writers available must of necessity affect these results.

However, since the convergence-divergence bias of ability was a reflection of personality differences, we may consider the two personality profiles illustrated for the British converger and diverger. It will be recalled, that convergers differed significantly from divergers on the "Personal Qualities Questionnaire" in that they had more respect for authority held conventional values and were rigid emotionally. Hudson (1968) further described the converger as being compartmentalized and philistine, and with respect to his way in acquiring knowledge, he was found to be syllabus-bound. The British diverger was described as being outgoing, has access to his inner life, and tends to entertain his impressions. Divergers enjoyed arguments, handled controversial issues better than convergers, and had a wide range of interests. Convergers preferred precision and limited themselves to a narrow range of practical interest.

It would appear that Hudson's review of American

literature on originality had influenced his inferences from the simple personality measures he used. Barron, (1955) for example, had been concerned with the psychodynamics of persons who show a disposition toward originality. The latter author pointed out, as did Hudson (1968) in his book "Frames of Mind," that research on originality was suggested by Asch's experiment on yielding to group pressure. Barron found that non-yielding persons were characterized by independence of judgement and by their preference for asymmetrical as contrasted to symmetrical designs, and noted some correlates of this tendency:

> "This preference for the complex and asymmetrical had been shown previously to be highly correlated both with the choice of art as a vocation and with rated artistic ability among art students. Furthermore, in a sample of Ph.D. candidates in the sciences, preference for the complex and asymmetrical proved to be significantly related to rated originality in graduate work. This same relationship was found among graduating medical school seniors who were rated for originality by their faculty. Other evidence indicated that the opposed preferences for complexity or for simplicity, were related to a generalized experiential disposition: the preference for complexity is associated with a perceptual attitude which seeks to allow into the perceptual system the greatest possible richness of experience, even though discord and disorder result, while the preference for simplicity is associated with a perceptual attitude which allows into the system only as much as can be integrated without great discomfort and disorder, even though this means excluding some aspects of reality" (Barron, 1955, p. 482).

While the British arts-sciences dichotomy has shades of the above descriptions, the two inquiries can by no means be equivalent, particularly if the precision and preference for

syllabi in the British converger and the liking of controversial issues in the diverger, is contrasted with a simplicity-complexity dimension. The growth of American theories, seeking interpretations for original behavior, proceeded hand in hand with empirical research either on personality or cognitive processes. The work on which the findings cited in the above excerpt were based, may provide an example. These findings and a host of others were derived from data collected during a three days' living-in assessment program at the University of California in which a variety of cognitive measures, projective techniques, ratings by experienced staff, and self-reports were used. The personality dimension of complexity vs. simplicity was measured by the Figure Preference Test developed and standardised on a group of artists by Barron and Welsh (1952). It consists of 62 line drawings varying in degree of complexity and subjects were required to indicate whether they liked or disliked each drawing. Asch's experiment was set primarily to study social group interaction in which certain conflict situations were created through previously arranged conditions between some subjects participating in the experiment and the experimenter. One naive subject at a time was to be the target of the investigation. The problem initiating the conflict was to indicate whether a line was longer or shorter than other three lines which were themselves not equal to one another. Subjects conspiring with the experimenter deliberately gave erroneous judgements. If the person under observation was a yielder he would agree with the group, if he was independent

he would not. Thus persons who were found to prefer complex figures were also found to show independence of judgment in Asch's experiment (p= .01). On the Gough Adjectives Check List, yielders described themselves as determined, efficient, patient, optimistic, etc., whereas non-yielders were more likely than yielders to check adjectives such as, artistic, emotional, original, and so forth, (p= .01). Since Asch's experiment was designed in the field of social psychology and was mainly aimed at the study of social group interaction, its by-product findings, (e.g. independence of judgment) were thought to have been biased, hence another paper and pencil instrument was developed to assess, independently, the latter variable. The validity of the newly developed instrument, or what came to be known as "A Priori Independence Questionnaire," was achieved by administering it without the knowledge of scores in Asch's yielding experiment, yet the relationship between these two procedures was positive and significant at .0I level of confidence.

It is worth noting, however, that Hudson's instrument "Controversial Issues" was constructed on much the same principles, with the exception that the American instrument was based on item analysis and the level of significance of each item in discriminating yielders from "non-yielders" is known, which makes either replications or drawing hypotheses from the American inquiry more feasible. In short, in the American inquiry, the construction of the instrument was borne out by the results. The line of research relating originality to

personality traits had a theoretical basis. It had started as a collection or constellation of factors which was later found, on sufficient evidence, to be related to either a real-life creativity criterion or which were used within a narrow scale to select candidates for jobs requiring creativity (Cattell and Butcher, 1968). In England we find that the work had proceeded the other way around, identifying potentially original students by means of two open-ended tests, one of which, the Uses, was found to be uncorrelated with WFPT (Child, 1965). Moreover, Asch's experimental results taken from the field of social psychology, may not be generalizable to the British cultural or social setting, since the British work suggested that the choice of arts and science may emerge out of one's attempt to reconcile one's perception of oneself to what he thinks others perceive him to be, a hypothesis which Butcher (1969) dismissed.

There are numerous examples showing many discrepencies between the findings of the British work and those found in America with regard to personality interpretations of creative achievements, but since the creativity-intelligence controversy has not yet been settled, the creative process itself may be more worthy of attention. As a part of his inquiry into originality, Hudson (1968) sought to examine the responses of a sample of British six formers to the Uses Test using a different instructional regime from the one he previously used. A number of unique responses to each object was presented to the students of the sample who were told that these responses

to the test had been made by famous men in arts and in science. Upon a subsequent administration of the Uses Test, he found that the number of statistically unique responses increased. He tended to acknowledge, implicitly though, that potential originality as measured by open-ended tests may be influenced by relevant experiences. Had the implication of this finding been pursued, the British work would have contributed more than it did to the understanding of the process of originality. Hudson continued, however, to favor an interpretation based on differences in personality rather than intellectual processes.

Building upon previous research findings which related ideational fluency to originality (Garwood, 1964; Barron, 1955, 1957, 1963), a line of inquiry was initiated by a group of American psychologists advocating an associative interpretation of the creative process. Maltzman et al, (1960) were interested in facilitating "original thinking," so they focussed on the experimental manipulation of different instructional methods as possible factors influencing productivity and uniqueness of associative responses to stimulus words. Maltzman et al (1960) found that when members of a sample of undergraduates were encouraged to give different associative responses to each of 25 stimulus words in each of five successive presentations, a subsequent administration of the Uses Test showed that the number of statistically unique uses given by the experimental group X was significantly greater than that given by groups under control or other instructional regimes. The five groups were instructed in the following manners, respectively: C group

was given the test list of 25 new stimulus words, C_r group repeated their responses in five successive lists of the same 25 words, X_L group received 5 lists of low frequency words, X_H received high frequency words and X group, given the same list five times, was required to produce different associative responses each time. Since the task of responding to a stimulus word by giving an associate has no direct similarity to thinking of uses for an object, these authors sought an interpretation for the transfer of training from the associative task to the uses task, based on the possible influence of each instructional regime on the likelihood of eliciting a unique response. On the basis of this and three variations of the same procedure, and "defining" originality as the increase of scores on the Uses of Objects, they concluded that the standard experimental procedure of repeatedly provoking different responses to the same stimuli was the most successful procedure, that originality varies as a function of the number of repetitions of the training list, and that the effects of training persist for some time. (Maltzman, Bogartz, and Breger, 1958; Maltzman et al., 1960). Expressing this relationship in terms of a probability gradient, provoking different responses to the same stimuli will result in a flattened gradient, while asking the subject to give the same response will result in a steep gradient. That is, the exposure to experiences conducive to the evocation of numerous associates will increase the likelihood of eliciting less probable responses, thus the gradient of more or less probable responses

will start lower and falls flatly. Training to give the same associative response to a particular word results in a probability gradient that starts higher and falls more steeply. Considering the relationship between the varied training methods and the number of uncommon responses to the Uses Test, it makes sense to interpret responses to the Uses Test within the British arts and science contexts by the flatness and steepness of the associative gradient of the arts and science students. Had this proposition been examined in England, this might well have been the case. In all probability, however, and if stronger evidence on the predictive validity of the open-ended tests may in due time be found, the dearth of the British converger's original responses on the Uses Test may well be attributed to his training in science, where acceptance of facts and methods is a prerequisite for subsequent advances (Drevdahl, 1956; Kuhn, 1963). This would leave unanswered the question that Hudson raised: why should some students choose to specialize in science and others in the arts?

Subsequent British research that sought to explore factors underlying the choice of science as a career has considered, in addition to ability measures and interests, familial or environmental antecedents as possible causes (Butcher, 1969a; Hanrahan, 1972). Butcher and Pont (1968) worked with a sizable sample of Scottish University-bound second year high school students to examine factors contributing to the choice of science as a field for further study. They classified their sample according to the probable choice of arts or

science on the basis of students' marks in literary and scientific first year secondary courses, ratings of scientific and literary careers expressed on an essay, and ratings by the class teacher of students' arts and science inclinations. These two groups were compared on a variety of variables among which there were such environmental ones as number of brothers and sisters, position in family, father's occupation (classified as scientific or non-scientific), relatives who were scientists, and attitudes toward literary and scientific school subjects. No significant differences between the two groups were found with respect to the first two variables. Students whose fathers were scientists were significantly more often scientists ($p < .05$), and the science group had significantly more relatives who were scientists than did the arts group. With respect to the ratings of school subjects, mathematics and science were the favourite subjects of the science group, and English, French, and Latin were favoured by the arts group.

Unfortunately, the Scottish study did not consider environmental experiences of a manipulatory nature such as experience with toys and mechanical tools which might be a crucial factor in fostering interest in science, and so stopped short of examining other possible origins of scientific interest or a bias towards a science based curriculum. It may be worthwhile, therefore, to provide a brief account on such a phenomenon denoted by mechanical inclination particularly in the field of applied sciences. The complex nature of mechanical ability was first indicated by Fryer (1922) who found that

individuals with a relatively low measured intelligence may occupy mechanically oriented jobs ranking relatively high on the occupational scale. The work of Vernon (1947) in the British Army during World War II showed that the structure of mechanical ability changes with training, consequently, mechanical aptitude tests were less useful in predicting success in mechanical jobs than were other ability tests. In a comprehensive test battery that Guilford (1947, 1948) used with American Air Force officers, mechanical aptitude tests were shown to be highly saturated with two factors, spatial visualization--acquiring, retaining and reproducing a figural pattern--and mechanical information--acquired knowledge about how things work. This should not be surprising, since it had been found that in one of the leading studies on mechanical aptitude that was conducted in Minnesota with junior high school boys, (1930) environmental items were included along with the Minnesota Assembly Test. Bennett had experimented with a type of Mechanical Comprehension Test in the 1930's and 1940's, one version of which had been used in military selection in Britain in World War II. Subsequently an improved version was copyrighted and incorporated in the Differential Aptitude Test (1947 onwards) and the name eventually changed to Mechanical Reasoning Test. The rationale for such tests was well expressed by Super, who explained:

> "It was recognized that experience or familiarity with mechanical objects might well play an important part in scores on such a test, even at this age; the Minnesota study therefore analysed the relationship between a number of environmental factors which

> reflect or constitute differences in experience, either direct or vicarious, with mechanical objects and processes. Two experience items showed positive correlations with the assembly test: recreational interests (.23) and mechanical household tasks such as electrical repairs performed by the boy (.40)." (Super, 1962, p. 223).

More recently, Hanrahan (1972) conducted a study with sixth form British students which aimed at examining the relationship between childhood experiences and arts-science specialization as shown by their choice of the sixth form courses. Among other measures, the latter author used a Toy Questionnaire which presented subjects with a list of names of toys and asked students to check the ones they remembered as having played with. There were mechanical tools such as pliers and wrenches for whose frequency of use by a subject was to be rated on a 4-point mechanical tool scale, and a similar scale derived for carpentry tools such as a hammer, a saw, etc. In addition, names of eight "old" objects were presented, and subjects were asked to check the ones they remembered as played with at home or elsewhere, subsequently two other 4-point scales, were used on one of which the subject was asked to rate his father's interest in his son's involvement with mechanical things, while on the other scale, subjects were asked to rate the mother's interest in that respect. Hanrahan derived six scores from his sample responses to the Toy Questionnaire. These were the scores on six sub-scales: basic toy, toy imagery, scientific bias, mechanical and carpentry tools, father's interest and mother's interest. These six scores were calculated

with several controls in mind so that they may provide an index of childhood experiences including parental influences, the different amounts of visualization demands required in manipulating different toys, home scientific bias as shown as favoring mechanical rather than non-mechanical toys, etc. However, since the basic toy scale correlated on the average about .80 with the toy imagery scale, Hanrahan concluded that these two scales "were measuring the same thing," and therefore he excluded the latter scale from his analysis. A problem was encountered in determining a scientific bias score, resulting from the fact that some parents can afford more toys than others. This was overcome by the use of special formulae taking into account the proportion of mechanical to non-mechanical toys in the total number of toys that were available for each subject. The Toy Questionnaire was proven useful in that arts specialists and science specialists were shown to differ with respect to exposure to mechanical objects in the expected direction. The basic toy scale and the scientific bias toy scale, respectively, discriminated between the two groups at ($p < .05$) level of confidence. The difference between the two specialists' groups was even greater on the mechanical and tool use scale. ($p < .001$).

To return, now, to another aspect of Hudson's work it soon became apparent that the cognitive bias of the I.Q. test did not show much promise in predicting the field of study among British school boys. Chemists, for example, stood out in that they "were often all rounders, with equal strength in all parts of the test: verbal as well as numerical and

diagrammatic. In this respect, their scores were like those of economists rather than those of other scientists" (Hudson, 1967, p. 45). These negative instances or, as Hudson tended to describe his work at that stage, "loose ends," led him to argue that tests such as those he used to measure simple skills would not correlate with complex tasks in adult life. Hudson assumed that interests may be crucial factors in the specialization of abilities, as he states that :

> "Intellectual abilities do not exist in a vacuum, they evolve as a result of growing interest in and devotion to a given line of work" (Hudson, 1967, p. 47).

In a sense, Hudson's speculation was in line with previous British research. Earle (1947) maintained that "interests may determine the direction in which abilities will be invested." Bradford (1948) also, in one study, concluded that the strength of interest in practical activities may overcome the influence of pursuing a grammar school course of a predominantly literary nature. Despite all the indications and Hudson's own initial observations that interests may be of considerable weight in predicting specialization, he did not use a standardized test to measure interests. Instead, he used an autobiographical type of measure in which he asked his subjects to list those aspects of their lives which seemed interesting. In describing this measure in the Appendix, Hudson admitted that "not a single quantifiable difference between convergers and divergers could be found" (Hudson, 1967, p. 190). Thus from a qualitative analysis of his sample's autobiographies Hudson concluded

that convergers tended to have practical interests and divergers' interests were generally cultural.

Since interests are aspects of personality, convergers' and divergers' interests are tied to the personality type by which Hudson characterized each group. According to Hudson's theory, convergers are innately inclined to specialize in science, divergers in the arts. It follows that the choice of the field of study is determined by personal development. Hudson's argument is to that effect, for he speculated that the distinct personality types of the converger and the diverger are due to certain defence mechanisms generated in their early relations with parents. The diverger comes from families in which parents are warm, accepting, less authoritarian, and place less emphasis on scholastic achievement. The converger's parents are relatively distant and emphasize specific achievements. If we are to accept Hudson's theory on the origins of scientific and literary intersts, we should look for evidence elsewhere in the literature.

Some years before Hudson's work had started, Roe (1957) developed a theory on the origins of interests and some years later she sought to test one part of her theory in collaboration with Siegelman (1964). The core of Roe's theory was that vocational inclinations may be determined by unconscious tendencies to satisfy certain needs originating in the interaction between different types of parents and their children. They hypothesized a six-fold circular model for the types of parents, loving, protecting, demanding, rejecting, neglecting, and casual;

and assumed that parents of the type that can be described by the first three categories foster person-orientation in the child, and parents of the type defined by the last three categories foster non-person-orientation in the child. Their samples were selected from two vocational groups which were thought to reflect person-non-person-orientation, 24 male and 25 female social workers, and 22 male and 23 female engineers; in addition to another sub-sample of 142 senior college stuents. The antecedent variables of child-parent interaction patterns were assessed by recalled childhood experiences and a semi-structured interview. The dimension of person-non-person orientation was measured by scores on five instruments. Eight items to measure the subject's preferences for activities weighted with respect to the amount of interpersonal interaction in selecting an occupation, the personal interest inventory to measure curiosity about persons and the desire for emotional contact with them, Cattell's Contact Personality Test (CPF), and the A Factor (Schizothymia) of the 16PF were utilized. The purpose of the study was two-fold, first, to examine whether the latter measures would differentiate social workers and engineers in the expected direction on the dimension of person-non-person-orientation, and second, to determine if person-non-person-orientation of these two vocational groups would be related to their recalled childhood experiences with their parents. With respect to their first hypothesis, Roe and Siegelman (1964) reported that:

> ". . . it seems clear that engineers and social workers do differ in their general orientation to other persons, as was assumed" (p. 47).

As to the relationship between person-non-person-orientation to childhood experiences, these authors stated:

> "There is limited support for the hypothesis as applied to the men, but it is in the direction of the exception rather than the general rule. That is, that some with early unsatisfactory experiences would become person-oriented in an attempt to find what had been lacking. The male social workers had significantly less closeness to their mothers than the engineers." (p. 48).

Of the antecedent variables of the childhood experiences, only loving-rejection and overt attention were shown to be of a reasonable predictive value of the person-non-person-orientation dimension. However, Roe and Siegelman warned against generalization of their results in making vocational predictions and recommended that the statistically significant factors should be given different weights depending on the life history of each individual case. In view of Roe's and Siegelman's reservations about their results, Hudson's statement with respect to warm and distant parents and their products of the arts specialist and scientist, respectively, did not in fact add more than an affirmation of these authors' doubts about the generality of their results, to which Hudson had made no direct reference.

We should consider, therefore, the choice of an interest inventory which might have been used for Hudson's study. The

question that one must ask in this connection is, had Hudson used a standardized interest inventory, what would it have been like? It would appear that there was not one standardized directly in England when Hudson conducted his research, therefore, he had to devise all the instruments he used to probe the personality of his arts and science groups. However, there were several well developed American interest inventories which he might have used.

The Strong Vocational Interest Blank is a well examined interest inventory. It measures interests in 47 occupations, and its items simply require 'like' and 'dislike' responses, yielding normative scales which makes it amenable to rigorous analysis. In fact, the SVIB may be one of a few instruments that fits into the framework of Hudson's theory, allying arts and science specialization and potential originality. Terman's (1959) gifted children who were, at mid-life, physical scientists, engineers, and medical biologists scored the highest on the scientific and mathematical interests and the lowest on the literary ones. In addition, work with the SVIB has shown that its interest scores are remarkably stable over rather long periods. But the fact that it was standardized on occupational groups of adults could make it unsuitable for subjects under the age of 17.

Another interest inventory which could have been used by Hudson was the Kuder Preference Record. It consists of 160 triadic forced choice items which measure 10 interest areas whose vocational significance compared to the SVIB, is debatable,

and the ipsativity of its scales has been for a rather long period, a drawback. Much work, however, has been done with the KPR the results of which helped in improving subsequent forms. Unfortunately, it was Butcher (1969a) but not Hudson who used form C of the KPR with Scottish secondary school students in a large scale project aimed at identifying factors contributing to the choice of science as a field of specialization. Butcher (1969a) found that scientific, mechanical, clerical and musical interest categories on the KPR, among other measures, to contribute substantially to the emergence of a bipolar factor he designated as a science-orientation factor.

The Guilford, Schneidner, Zimmerman Interest Survey yields two scores, one score for liking the activity as means of earning, the other for liking the same activity intrinsically or as a hobby. One could argue that it would be interesting to see how the second score would behave with scores on the open-ended tests, (which Hudson favoured at a later date) since there is evidence to suggest that clever school boys who are inclined to science have intrinsic liking for it (Edwards & Wilson, 1958). To this writer's knowledge, the GSZ interest survey has not been used in research studies with Canadian or English samples to suggest any hypotheses.

Holland developed the Vocational Preference Inventory based on a theory matching personality types to vocational interests. It yields a personal profile of six interest categories or personality types, Realistic, Intellectual, Social, Conventional, Enterprising and Artistic. Since the

HVPI yields profiles, its results lend themselves more readily to qualitative rather than quantitative analysis.

Since Hudson did not take the initiative to use one of the well tried American interest inventories as did Butcher, and since he stressed that arts-science distinction is a characteristic of the British educational context, it is not unlikely that he would have used Sandall's Factorial Interest Blank had it been available when Hudson collected his research data. Sandall (1960) developed the FIB on a British sample of secondary school pupils, but it was published and made available to users in 1967. Since the only reference to Sandall's interest inventory is the author's Ph.D. thesis, it is still in a trial stage and, to this writer's knowledge, it does not seem to have been used by many researchers. Reviewers of Sandall's inventory tend to rate it lowly compared to many well tried ones. It becomes important, for the present-work, however, to examine its construction and the author's defence of his test.

Sandall (1960) constructed the FIB to satisfy a need then felt in England for an interest inventory for counsellors and research users. Initially, he developed a sort of a try-out interest inventory by compiling 378 forced-choice items with paired comparisons and classifying these items into 28 interest categories (judged by his own experience). He administered this initial interest form to a sample of 254 boys and 175 girls, British high school students aged 11 to 16. Intercorrelations of the 28 interest categories for the boys and the girls were factor analysed, separately, using Thurstone's

centroid method. Then a combined correlation matrix, formed from the average correlation coefficients of the two correlations matrices for boys and girls, was subjected to a quartimax analysis. According to Sandall, the factor structures which emerged in the two analyses showed no fundamental difference. In total, eight interest factors were identified, these being:

(1)	Rural-Practical	(5)	Athletic
(2)	Social-Display	(6)	Literary
(3)	Humanitarian	(7)	Aesthetic
(4)	Entertainment	(8)	Scientific-Mechanical

Sandall (1960) compared these eight categories to those found by Guilford (Guilford et al, 1954) and found a close similarity between the British and the American interest categories, as he explains:

> "Of Guilford's twenty-five factors, thirteen can be identified with reasonable certainty in the two English analyses; the eight fields of interest derived from the latter have their counterparts in the American factors" (p. 277).

Again, since there is no other source of information available on the reliability and validity of the FIB other than this reported by its developer, we can only accept the FIB at its face value. Sandall (1960) reports a mean test-retest reliability coefficient of .903 over a four week interval. According to the manual, the FIB is valid in as much as it has

been able to predict the choice of arts and science courses at one and two years intervals, but no validity coefficients are reported.

A number of studies have suggested that scientific interest makes its appearance at an early age. When one considers that many events take place in early childhood; then it is possible that the toys available to young children, and children's preoccupation with some of them, whether in terms of object-investment of libido, or as a reflection of variables in a family constellation, may be the precursors of later interests and attitudes. MacCurdy (1956) found that crafts and carpentry, repairing mechanical things and photography were common leisure time activities among science talent winners who excelled in science during their college career. Zim (1940, 1949) observed that early interests in chemistry sets, electricity and radio, motors, and first aid are potential sources of science interest among adolescents. Holland (1962) found a considerable agreement between recalled artistic and scientific hobbies and scores on his Vocational Preference Inventory among a large sample of those who successfully passed the National Merit Examination of 1959. As we have seen above, Hanrahan (Hanrahan, 1972) using a sample of English sixth formers, developed a toy scale for measurement of science-orientation. A lengthy list of toys was culled from many sources. External observers rated each toy on the amount of mechanical skill required in its use, and each toy was given its scale value (0 to 3). When placed in an extensive battery

of scores derived from tests and questionnaire items, the toy scale loaded highly on a factor which Hanrahan labelled science orientation. This scale may provide a useful adjunct to attempts to trace the early development of scientific interests.

Summary

Thus, Hudson's work which rose from an initial study at university level or beyond of arts and science specialization, led him after a publication of Getzels' and Jackson's text to examine with high school students the performance on open-ended vs. closed tests. From this and other less quantified studies, he arrived at some conclusions permitting a classification of high school students as convergers and divergers. When this classification was checked against their proposed specialization at the upper level of the high school and university he concluded that divergent thinking, to use Guilford's original term, was more likely to be found in the arts students than in science students. Per contra convergers or convergent thinking was more likely to be found among future science specialists. It has been shown above that Hudson ignored a great deal of relevant evidence which was readily available in North America on the relation between interests, ability, personality structure and future occupational choice.

Whilst accepting that Hudson's statements might well be true of English sixth formers, the degree of generalization to other populations was unknown. Butcher had suggested that it would be worth while trying Hudson's procedures with population samples of different levels of ability and with different cultural backgrounds. In order to take advantage of Butcher's

suggestion in a North American context, some North American tests might be substituted for English tests. Having noted that Hudson had not used standardized interest tests, it becomes obvious within a North American framework one should incorporate such a test and preference might well be given to one produced in England and which was available for Hudson but was not used by him (i.e. Sandall's interest blank).

Occupational choice or curriculum specialization prior to occupational choice is not something determined only in the final year of high school. The roots go much deeper. Interest tests give information of a personal nature preceding high school experiences. To go back beyond this to even earlier origins would demand the use of some such scales as those provided by Hanrahan under the heading of Toy Scales. But curriculum specialization leading to occupational choice might also be determined by the courses available in high school, and of a student's access to them. Interest in such courses might also be coloured by attitudes to them, and to their teachers, either projected into the future or based upon previous experience.

All of the foregoing suggests that as well as using the conventional means of Hudson, of Child and Smithers, for attempting to recognize such convergers and divergers, i.e. from a single intelligence test score and two scores of DSU and DMU, information derived from an interest test, an attitude to school subjects test, and a toy scale might well be included in any Canadian replication or extension of Hudson's original work.

Chapter 4

Hypotheses and Methodology

1. Hypotheses

While research studies cited in the review of the literature have indirect bearings on Hudson's work in England, they fall short of indicating the form in which hypotheses for the present study should be stated. One reason, perhaps, is that Hudson's methodology was uniquely different from that employed by most of the studies which dealt with the significance of the difference between scores on the I.Q. test and open-ended tests. Findings of the studies that directly replicated Hudson's work have been equivocal. With British secondary students, Povey (1967) found a strong relationship between convergence-divergence dimension and the choice of arts and science three years later. Mackay and Cameron (1968), however, using a sample of first year Scottish undergraduates, found that, that relationship held for students who were decided on their choice, and disappeared among those who were undecided. Cropley (1968) found no relationship between the choice of arts or science and convergence-divergence dimension among Australian secondary students, whereas Australian university science graduates were mostly divergers (Cropley, 1967).

It would appear that such a relationship may be influenced

by other factors, Lytton (1971) suggested that teachers' and peers' influence may contribute to the choice of specialization. Hanrahan (1972) observed that parents' literary or scientific interests, as perceived by sons, may foster the inclination to either field, and found a relationship between convergence-divergence dimension and the choice of the course of study. Number of relatives who were scientists was related to expressed and inventoried scientific interests (Butcher, 1969a). To this writer's knowledge there has not been a study which controlled for all these factors together while using Hudson's procedure of classifying convergers and divergers. It is not unlikely, therefore, that the lack of control of the effects of the above mentioned variables may have led to the inconsistency of the findings of the studies which attempted to replicate Hudson's work. It is also not unlikely, as Cropley tended to conclude in his Australian studies, that the quality of science teaching in Australian universities may be better than that of science teaching in England, a variable which is related to the basic characteristics of a particular educational system.

The three replications of Hudson's work mentioned above, however, have used the actual choice of arts and science as a criterion against which to validate convergers-divergers dichotomy. One would assume that Mackay and Cameron's undecided students on their actual choice were subject to conflicting inclinations toward arts and science. That ability is not the only crucial factor as the student is called upon to make a choice is supported by Burt's contention that

academically oriented students who do well in literary could do as well in practical courses. It may be legitimately assumed then that had Mackay and Cameron's undecided students been presented by an attitude measure toward arts and science academic subjects they would have expressed their emotive reactions uncontaminated by other factors which may influence the actual choice.

In the present study there is no actual life criterion against which to validate a convergence-divergence dimension. The criterion measures used were self-validating ones, namely, scores on an attitude measure toward eleven arts and science school subjects, Sandall's eight interest scales, and two scales measuring the frequency of recalled childhood involvement with mechanical toys. None of these measures has been tried with Canadian samples, hence, no findings are available to suggest any hypotheses. Thus, hypotheses for this study may justifiably be stated in a null form, yet this would ignore much of the theoretical symmetry shared by this inquiry and previous research.

Sandall found that the Factorial Interest Blank measures factors common to the British and North American societies. He also found, from records of more than 400 British secondary students, that those who were inclined to arts subjects had high scores on the LIT scale, and low scores on the SCI scale, whereas students who chose scientific and technical subjects had high scores on the scientific interests scale and low scores on the SOC and ENT. Thus, it may be anticipated that SCI , LIT,

and SOC scales would discriminate convergers and divergers.

Since, at best, the relationship between the independent variable and the three sets of the criterion variables would concomitantly validate a convergence-divergence dimension, one may entertain some hypotheses which may be obviously indicated. These hypotheses may be stated:

1. - Convergers and divergers will be differentiated on the SCI, RUR, SOC, LIT and AES scales of Sandall's Interest Blank.

2. - Convergers and divergers will be differentiated on the attitude measure toward SCIE, PHYS, MATH and other school subjects.

3. - Convergers and divergers will be differentiated on the measure of the frequency of recalled toys they have played with as children.

4. - There would exist a bias for convergers to choose the further study of science subjects, and for divergers to choose arts subjects.

5. - There would be no difference in the proportions of divergers/convergers who wish to go to a university at a later date.

6. - There would be no relation between convergers/divergers and socio economic status of the parents.

2. Method

In applying Hudson's procedure to a sample of the Quebec school population, two open-ended tests identical to his were used, Meaning of Words and Uses of Objects. The intelligence test used was one readily available in Canada,

suitable for the age range of the students, and containing items of verbal, numerical and spatial content. This was the Henmon-Nelson test of mental ability, (Form A) for grades from 6 to 9, with time limit of 30 minutes, which yields a total score.

Scores on these three tests were treated according to Hudson's procedure so as to place students on a divergence-convergence continuum (independent variable). This involves differences between standard scores on the I.Q. test and the two open-ended tests combined, then grading these differences A, B, C, D and E in the proportions of 1:2:4:2:1. Since the present experiment was conducted under different conditions from those of the British work, it was necessary to designate the dependent variables accordingly. One such variable used in the present, Canadian study, was the attitude toward academic subjects instead of the actual choice of arts or science courses made by students in Hudson's work. Two additional dependent variables were included, Sandall's interest categories and Hanrahan's toy questionnaire (Appendix 1).

Sampling from the Quebec school population proved to be difficult because of its heterogeneous composition (Hanrahan, 1970). However, it was thought that a sample for this study should be drawn from the ninth grade population at which level the choice of academic subjects is made. Ideally, the sample should be representative of the two denominational school systems in Quebec. This was not possible because of the different languages of instruction, generally English in the Protestant system and French in the Catholic school system.

A sample of 150-200 was sought. It was not possible to obtain such a sample of boys in a single school, so testing was conducted in two schools, one a Catholic High School and the other a Protestant High School. After the rejection of incomplete protocols (due to absences during testing sessions) a sample of 137 was secured (87 Catholic, 50 Protestant). In the former school, testing of the whole sub-population was done in the auditorium, in two testing sessions on successive days, each session lasting for approximately two hours and thirty minutes. In the latter school, children were tested by class, each class requiring more than one visit to complete the testing. Anonymity was secured by distributing numbered cards, each student retaining his own number throughout.

The order of testing was:

1 - Henmon-Nelson (closed test)

(Break)

2 - Uses of objects. (open-ended)

3 - Meanings of words. (open-ended)

(Break)

4 - Attitude measure

5 - Sandall's Factorial Interest Blank.

6 - Hanrahan Toy Scale.

7 - Information Blank.

It will be recalled that Sandall's Interest Blank was standardized on a sample of British secondary school pupils of the same age as Hudson's samples. Some additional reference should be made to the Attitude measure, (4, above) and to the

Toy scale (6, on the preceding page).

The attitude scale used in this study was constructed along the lines of Osgood's (1965) Semantic Differential Method. This method was based on a theory advocating that people attach certain meanings to different objects through associative learning, and these meanings can be measured on scales anchored by various polar adjectives (opposite in meaning). Factor analysing a number of such polar adjectives, Osgood et al (1965) found that three factors accounted for most of the semantic loadings, one was called an evaluative factor deriving most of its high loadings from polar adjectives such as good-bad, kind-cruel, etc., another was labelled a potency factor defined by adjectives as, hard-soft, and an activity factor loaded by adjectives like, fast-slow, excitable-calm, etc. More commonly the semantic differential method is used as an attitude scale.

In constructing an attitude scale for this study to measure emotive reactions to school subjects, ten pairs of polar adjectives, mostly from the evaluative category, were selected. These ten pairs of polar adjectives were arranged at opposite ends of seven-point scales. This was done for each of eleven school subjects. The respondent's task was to rate each school subject according to how he percieves it or feels toward it at the moment by placing an X somewhere along each of the ten scales. Responses were converted to numerical quantities by assigning a score of 1 for an extreme negative to a score of 7 for the extreme positive on each scale. For

each school subject, sub-scores on the ten scales were summed up to give a total score of a range from 0 to 60. Using the Semantic Differential Method with 135 subjects, Tannenbaum (1953) reported an average reliability coefficient of .91 over a period of five weeks interval. Like any attitude measure, the SDM shows a moderate validity. Pace (1950) found correlations of .40, .37, and .33, respectively, between attitudes toward music, art, and literature and actual engagement in these activities.

The Toy Questionnaire used in this experiment was borrowed from a study by Hanrahan (1972) which he had conducted with sixth form British students, mentioned earlier in this paper. It consists of six sections. The first comprises 50 toys (basic toy scale) weighted for mechanical content and the subject was to check all the toys he could remember as having played with as a child. Two four-point scales were employed, on one of which the subject was to rate his recalled frequency of use of mechanical tools, pliers, wrenches, etc., on the other he was to rate his recalled frequency of use of carpentry tools, saw, hammer, etc. The fourth section consists of eight 'old' objects and the subject was to check those he remembered manipulated as a child at home or elsewhere. The last two sections involved two four-point scales and the subject was to rate his father's and his mother's interests, respectively, in their son's involvement with mechanical objects.

As was mentioned earlier, in Hanrahan's study, six scores were derived from the Toy Questionnaire: basic toy, toy imagery,

scientific bias, mechanical and carpentry tools, father's interest and mother's interest. Of concern for the present study is the relationship between early manipulation of mechanical objects and scores on the convergence-divergence continuum. Of the first three scales, mentioned, the basic toy had the highest reliability, .84 over a period of two weeks interval, and had a considerable share in discriminating between Hanrahan's arts and science specialists groups. Therefore, it was decided that the basic toy scale would satisfy the purpose of this study. Moreover, since some toys on that scale are more mechanically important than others, consequently, 22 such toys were identified and accordingly each was given a weight of either 1, 2, or 3, thus yielding a potential score range from 1 to 46. No attempt was made to extract other scores from the basic toy scale, since it was felt that their inclusion would not add appreciable information.

Chapter 5

Results and Discussion

As the data were to be processed by means of standard programs using the McGill computer, the data were entered on cards, two cards per individual. Each card began with a three digit serial number and a one digit card number. On card 1 were entered in 16 columns the results of the Sandall Interest Questionnaire, followed by the test scores on Henmon Nelson Form A, Meaning of Words, Uses of Objects, and the sum of the latter two as a Creativity Index. This was followed by attitudes to various school subjects, and a coded entry to indicate extreme convergers, extreme divergers and the approximately middle 80% of all-rounders. Subsequently, a score on the Toy Scale was added. Card 2 entered the responses to the fifty item toy scale, and certain other information, such as school options of future courses, whether the boy hoped to proceed to university or not, father's SES, mother as working or not, position in the family, the number of brothers and sisters. The data from both cards were collected as complete files , reproduced as Appendix 2.

In this chapter a number of analyses will be reported before providing answers to the six hypotheses stated in the preceding one. A summary of univariate statistics on Sandall's interest scales and the three reference variables, INT, DSU,

DMU, and the composite creativity score comprising DSU and DMU along with intercorrelations of these variables will be displayed. The relative importance of each of Sandall's interest measures in predicting scores on the INT measure, DSU, DMU and the Creativity index (DSU+DMU) will be examined. This will be followed by an examination of the underlying linear combinations of the two reference variables (Intelligence and Creativity) and Sandall's interest scales. Then attitude scales to school subjects in relation to INT, DSU, DMU, and the composite creativity score (DSU+DMU) will be considered for the same foregoing analyses. Then Hudson's procedures of the identification of convergers and divergers will be examined by means of a comparison of all variables' mean values for the five categories of a convergence-divergence distribution. This will be followed by the results of a discriminant analysis and an application of Q technique factor analysis. Finally, an examination of the six hypotheses of this study will be provided.

Analyses with Respect to Sandall's Interest Scales, INT, and Creativity.

Mean scores and standard deviations for the 137 boys on Sandall's interest scales, the intelligence measure, and the two open-ended measures, separately and combined, are shown in Table 1. Table 2 shows the intercorrelations among the same variables. Of 28 correlation coefficients among the interest measures, 19 are significant ($r = .16$, for 135 df),

TABLE 1

MEAN SCORES AND STANDARD DEVIATIONS FOR 137 BOYS ON SANDALL'S EIGHT INTEREST SCALES, INT, DSU, DMU, AND THE CREATIVITY INDEX (DSU + DMU)..

Variable	Mean	Standard Deviation
RUR	10 . 47	2 . 86
SOC	9 . 82	3 . 41
HUM	7 . 29	3 . 42
ENT	12 . 82	3 . 28
PHY	13 . 69	4 . 37
LIT	6 . 78	3 . 03
AES	8 . 70	3 . 35
SCI	11 . 26	3 . 75
INT	50 . 37	12 . 57
DSU	11 . 93	4 . 52
DMU	9 . 67	4 . 54
CREAT	21 . 61	7 . 33

Legend:

RUR =	Rural (Practical)	PHY =	Physical	INT =	Score on Henmon-Nelson Test of Mental Ability
SOC =	Social	LIT =	Literary	DSU =	Score on Uses of Objects Test
HUM =	Humanitarian	AES =	Aesthetic	DMU =	Score on Meaning of Words Test
ENT =	Entertainment	SCI =	Scientific (Mechanical)	CREAT =	Sum of DSU, DMU

TABLE 2

INTERCORRELATIONS AMONG SALDALL'S EIGHT INTEREST SCALES, INT, DSU, DMU, AND THE CREATIVITY SCORE

	SOC	HUM	ENT	PHY	LIT	AES	SCI	INT	DSU	DMU	CREAT
RUR	-.52	-.05	-.20	-.27	-.19	-.23	-.39	-.15	-.12	-.04	-.09
SOC	—	-.09	.13	.26	-.12	.20	-.70	.01	.12	-.02	.07
HUM		—	-.59	-.24	.07	-.11	.05	-.27	-.22	-.01	-.14
ENT			—	.31	-.22	-.12	-.20	.15	.08	-.13	-.03
PHY				—	-.45	-.23	-.29	.08	.09	-.09	.01
LIT					—	.07	.16	.00	-.11	-.05	-.09
AES						—	-.23	-.03	.09	.19	.18
SCI							—	-.01	-.06	.11	.03
INT								—	.56	.28	.52
DSU									—	.31	.81
DMU										—	.81

and 15 of these are negative. Seven of eight interest areas are independent of the measure of intelligence but Humanitarian interests are inversely related to this measure. There is a significant correlation between HUM and the test of DSU, and a significant correlation between AES and DMU. None of the other interest measures correlate with these two variables DSU and DMU. Thus, in general, Sandall's interest measures are independent of the measures of divergent thinking (DSU and DMU) and of intelligence. However, the intelligence measure and the two open-ended tests are clearly

correlated. While the correlation between the latter two measures is only .3, similar to that previously reported by Hudson for samples of clever fifth formers, these two measures combined correlate as highly as .52 with the intelligence test results.

In order to further examine the relation of interest scores with the intelligence measure, DSU, DMU and the creativity index (DSU+DMU), multiple regression analyses were completed. These last four dependent variables were entered, one at a time, as criteria to be predicted from interest scores. As can be seen in Table 2, the highest correlation

TABLE 3

CUMULATIVE R AND R^2 OF THE INT MEASURE (CRITERION) AND SANDALL'S INTEREST SCALES (PREDICTORS).

Variables	Cumulative R	Cumulative R^2
HUM	.269	.072
RUR	.300	.090
SOC	.315	.099
AES	.324	.105
ENT	.335	.112
LIT	.338	.114
PHY	.346	.119
SCI	.349	.122

TABLE 4

CUMULATIVE R AND R^2 OF DSU (CRITERION) AND SANDALL'S INTEREST SCALES (PREDICTORS).

Variables	Cumulative R	Cumulative R^2
HUM	.215	.046
SOC	.239	.057
LIT	.252	.063
RUR	.266	.071
ENT	.288	.083
PHY	.292	.086
SCI	.294	.086

TABLE 5

CUMULATIVE R AND R^2 OF DMU (CRITERION) AND SANDALL'S INTEREST SCALES (PREDICTORS).

Variables	Cumulative R	Cumulative R^2
AES	.193	.037
SCI	.248	.061
LIT	.264	.069
ENT	.280	.079
RUR	.298	.089
HUM	.307	.094
PHY	.318	.101
SOC	.318	.100

TABLE 6

CUMULATIVE R AND R^2 OF THE CREATIVITY INDEX (CRITERION) AND SANDALL'S INTEREST SCALES (PREDICTORS).

Variables	Cumulative R	Cumulative R^2
AES	.176	.031
HUM	.214	.046
ENT	.240	.058
LIT	.269	.073
RUR	.295	.087
SCI	.316	.099
PHY	.324	.105
SOC	.326	.106

of interest scores with one of the variables (though negative) is that between intelligence and Humanitarian interests, though both share only 7 per cent of their variance (Table 3). Variations in the remaining seven interest scales contributed only 5 per cent more of their variance that is shared with the intelligence measure. This offers confirmation of the statement that the relative preferences of the interest activities included in Sandall's Interest Blank are virtually independent of the type of abilities measured by the intelligence test. "Uses of objects" test (DSU) behaves in a similar way--the HUM scale being the only interest scale to correlate with DSU, and multiple R does not increase appreciably with the addition of other interest variables.

As expected, AES contributes the most to the multiple R of interest variables and DMU ("Meaning of Words" Test), and with the creativity index (DSU+DMU). No single interest measure accounts for more than 7% of the variance of the criterion measures and all interest measures together account for less than 12% of the criterion variance.

It is desirable, however, to explore in another way these variables' relative coherence with one another. Since there is no strong evidence to indicate the factor structure the variables included in this study would yield, it will be quite sufficient at the outset to employ an exploratory method of factor analysis to examine the extent to which they could be simplified; in other words, to explore through rotation, the proportion of variance accounted for by their simplest possible clusters. To accomplish this a principal axis factoring of eight interest tests plus intelligence and creativity scores was conducted with iterations following adjusted communalities. The operation of the computer programme used was as follows: Intercorrelations between the ten variables were calculated with unity in the diagonal, and the matrix was subjected to analysis during which more than 25 iterations were performed. The analysis yielded 10 factors of which only four with latent roots greater than unity were retained (Guttman, 1954), and these were rotated by the Varimax procedure (Kaiser, 1956).

TABLE 7

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, INT, AND CREATIVITY (USING 1'S IN THE DIAGONAL).

Variables	F_1	F_2	F_3	F_4	h^2
RUR	-.524	.253	-.219	-.209	.431
SOC	.728	-.452	.139	-.058	.757
HUM	-.413	-.472	.104	-.338	.518
ENT	.549	.412	-.376	.344	.732
PHY	.521	.131	-.315	-.256	.452
LIT	-.306	-.227	.339	.582	.598
AES	:141	-.184	.322	.115	.170
SCI	-.677	.405	-.016	.073	.628
INT	.231	.414	.349	.025	.348
CREAT	.221	.487	.742	.263	.906
Percentage of Variance	40.1	24.1	21.9	13.9	

An examination of the four Varimax rotated factors reveals that factor 1 is highly loaded on SOC, SCI, and RUR interest scales (only loadings of a minimum of .6 were considered significant). While the polarity of this factor appears to be indicated in as far as RUR and SCI interest scales may represent one pole and SOC may represent the other pole, an inference as such should depend on the degree of resemblance between SCI and RUR interest activities. Factor 2

TABLE 8

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, INT, AND CREATIVITY (USING 1's IN THE DIAGONAL).

Variables	F_1	F_2	F_3	F_4
RUR	-.620	-.165	-.082	-.111
SOC	.853	.023	.006	-.171
HUM	-.033	-.689	-.197	.051
ENT	.101	.822	-.021	-.215
PHY	.219	.273	-.009	-.574
LIT	.029	-.033	-.056	.769
AES	.308	-.074	.145	.222
SCI	-.753	-.057	.069	.229
INT	.025	.226	.544	.008
CREAT	.057	-.051	.948	-.039

appears also to be a bipolar one with a positive loading on ENT and a negative loading on HUM interest scales. Factor 3 derives almost entirely from the creativity index, and factor 4 from LIT interest scale. These four factors account for 71.3 per cent of the total variance in the data.

Whereas in the preceding analysis the composite creativity score was used, this creativity score can be separated into its two elements. Using separate entries for DMU and DSU, and placing squared multiple correlations of each variable with the remaining variables as communalities, yielded only a slightly different picture on rotation. The

percentage of variance extracted by each unrotated factor was virtually identical with the former analysis. On rotation factor 1 retains high loadings on SOC, SCI and RUR; the second factor puts HUM and ENT as opposites; the third factor now places INT and DSU as the defining variables, being a reflection of the numerically higher correlation of INT with DSU rather than DMU or than DSU and DMU combined. The fourth factor contrasts the interests of PHY and LIT.

TABLE 9

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, INT, DSU AND DMU (USING R^2 AS ELEMENTS IN THE DIAGONAL).

Variables	F_1	F_2	F_3	F_4	h^2
RUR	-.509	.252	-.236	.201	.419
SOC	.702	-.482	.175	.045	.759
HUM	-.429	-.426	.144	.303	.478
ENT	.578	.353	-.456	-.369	.803
PHY	.528	.061	-.343	.303	.492
LIT	-.293	-.140	.337	-.536	.506
AES	.127	-.172	.346	-.144	.186
SCI	-.653	.444	-.045	-.057	.629
INT	.294	.512	.386	.035	.499
DSU	.348	.469	.475	.186	.601
DMU	.022	.228	.410	.141	.240
Percentage of Variance	40,8	24.7	21.6	13.0	

TABLE 10

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, INT, DSU, AND DMU.

Variables	F_1	F_2	F_3	F_4
RUR	-.614	-.158	-.085	-.103
SOC	.856	.018	.009	-.163
HUM	-.040	-.664	-.182	-.059
ENT	.105	.681	-.066	-.214
PHY	.222	.251	-.005	-.616
LIT	.016	-.033	-.051	.709
AES	.314	-.071	.135	.254
SCI	-.756	-.056	.068	.223
INT	.020	.235	.666	-.008
DSU	.100	.117	.754	-.094
DMU	-.009	-.116	.472	.063

Analyses with Respect to Attitude Scales to School Subjects, INT, and Creativity.

Having examined Sandall's interest variables in relation to scores on the intelligence test, on the tests of DSU and DMU, and their sum expressed as a creativity score, it is desirable to examine students' attitudes to school subjects in relation to the same four variables. Tables 11 to 20 parallel Tables 1 to 10.

TABLE 11

MEANS AND STANDARD DEVIATIONS OF SCORES ON THE ATTITUDE SCALES TO SCHOOL SUBJECTS.

Variables	Mean	S.D.
GEO	41.87	12.49
MAT	44.38	13.22
CHE	38.47	16.83
PHYS	38.07	16.34
ELIT	40.50	12.81
EGRAM	39.02	12.66
HIS	41.85	11.78
FREN	35.36	15.72
ART	48.15	15.52
MUSIC	37.14	17.88
SCIE	47.40	14.20

Legend:

GEO = Geography
MAT = Mathematics
CHE = Chemistry
PHYS = Physics
ELIT = English Literature
HIS = History
Fren = French
ART = Art
MUSIC = Music
SCIE = Science

TABLE 12

INTERCORRELATIONS AMONG ATTITUDE SCALES TO ELEVEN SCHOOL SUBJECTS, INT, DSU, DMU, AND THE CREATIVITY SCORE.

	CREAT	DSU	DMU	GEO	MAT	CHE	PHYS	ELIT	EGRAM	HIS	FREN	ART	MUSIC	SCIE
INT	.52	.56	.28	.05	.21	.05	-.04	.04	.08	-.01	-.04	-.05	.15	-.03
CREAT		.81	.81	.04	.06	.01	-.12	.02	.11	-.07	.08	-.02	.26	-.07
DSU		-	.31	.07	.01	-.04	-.22	.05	.14	-.04	.07	-.06	.22	-.07
DMU			-	-.01	.08	.06	.02	-.02	.03	-.07	.05	.03	.19	-.05
GEO				-	.13	.02	.06	.21	.24	.32	.20	.03	.19	.22
MAT					-	.24	.39	-.00	.08	.08	.19	-.05	.09	.29
CHE						-	.58	.16	.04	.15	.01	.09	.23	.42
PHYS							-	.02	.00	.19	.13	.16	.14	.31
ELIT								-	.63	.24	.16	-.19	.22	.08
EGRAM									-	.19	.26	-.14	.13	.06
HIS										-	.07	-.03	.21	.17
FREN											-	-.07	.14	.16
ART												-	.11	.13
MUSIC													-	.14

The intercorrelations between the variables INT, DSU, and DMU have already been considered in relation to Sandall's interest variables. Among the attitudes to school subjects only MAT shows a significant correlation with INT, PHYS with DSU, and MUSIC shows significant correlations with DSU and DMU. Some expected relationships among the attitudes appear. Thus the highest correlation of GEO is with HIS and vice versa. MAT shows the highest correlation with PHYS, and significant correlations with CHE and SCIE. CHE is most highly correlated with PHYS, and vice versa, but it also correlates significantly with SCIE, whilst PHYS correlates with MAT and SCIE. The most substantial correlation of ELIT is with EGRAM, of HIS is with GEO and a smaller one with ELIT, EGRAM also correlates with FREN. MUSIC has its highest correlation with CHE, as does SCIE. ART has only one significant correlation, a negative one with ELIT.

Tables 13, 14, 15 and 16 show that attitudes to school subjects bear some relation to each of the four criterion scores, but of the variance of these criteria explained by attitude to school subjects much is due to contributions from MAT, MUSIC and PHYS, as could probably have been inferred from the correlations reported in Table 12, and discussed above.

TABLE 13

CUMULATIVE R AND R^2 OF THE INT MEASURE (CRITERION) AND ATTITUDE TO SCHOOL SUBJECTS (PREDICTORS).

Variables	Cumulative R	Cumulative R^2
MAT	.207	.043
MUSIC	.244	.059
PHYS	.283	.080
FREN	.296	.088
SCIE	.304	.092
CHE	.314	.098
EGRAM	.319	.102
HIS	.322	.104
GEO	.323	.104
ELIT	.324	.105
ART	.324	.105

TABLE 14

CUMULATIVE R AND R^2 OF DSU (CRITERION) AND ATTITUDE TO SCHOOL SUBJECTS (PREDICTORS).

Variables	R	R^2
MUSIC	.225	.051
PHYS	.338	.114
EGRAM	.355	.126
MAT	.366	.134
ELIT	.376	.141
CHE	.383	.147
SCIE	.389	.151
HIS	.393	.154
FREN	.396	.157
GEO	.398	.158
ART	.398	.158

TABLE 15

CUMULATIVE R AND R^2 OF DMU (CRITERION) AND ATTITUDE TO SCHOOL SUBJECTS (PREDICTORS).

Variables	R	R^2
MUSIC	.190	.036
HIS	.221	.049
MAT	.232	.054
SCIE	.247	.061
CHE	.252	.063
ELIT	.256	.065
EGRAM	.263	.069
PHYS	.265	.070
FREN	.266	.071
ART	.267	.071

TABLE 16

CUMULATIVE R AND R^2 OF THE CREATIVITY INDEX (CRITERION) AND ATTITUDE TO SCHOOL SUBJECTS (PREDICTORS).

Variables	R	R^2
MUSIC	.255	.065
PHYS	.302	.091
MAT	.319	.102
HIS	.335	.112
EGRAM	.345	.119
ELIT	.355	.126
SCIE	.363	.132
CHE	.376	.141
FREN	.379	.144
GEO	.380	.144
ART	.380	.144

Of the five rotated factors, shown in Table 18, four appeared to load on attitude scales to school subjects, and one on INT and CREAT. In their order of emergence, factor 1 is loaded on CHE and PHYS; factor 2, ELIT and EGRAM; factor 3, INT and CREAT; factor 4, on GEO; and factor 5 is loaded on MAT. When the two elements of the composite creativity score (DSU+DMU) were considered separately, five factors emerged on rotation. Four of these are defined by the same attitude scales described above, but the DSU measure, with the measure of INT, defines the fifth factor which in this case emerges as factor 2 (Table 20).

Some correlates of the Hanrahan Toy Questionnaire.

In Hanrahan's study, mentioned above, one of the problems encountered in using the Toy Questionnaire with a sample of sixth formers was related to whether they could recall toys played with prior to entering high school. In that study this was indirectly checked by the use of samples of fifth, third and first form students who were asked to list toys they remembered as having played with when they were children. The results showed that various toys were recalled with a considerably high frequency indicating that the sixth form students should be able to do the same. In the present study the frequency of recall of each toy and the percentage of the frequency with reference to the whole sample were calculated for the 50 toys of the Toy Questionnaire, although only the 22 toys to which Hanrahan had given weights greater than zero will be considered for further analysis.

TABLE 17

UNROTATED FACTOR MATRIX OF INT, CREAT, AND ATTITUDE SCORES TO SCHOOL SUBJECTS.

Variables	F_1	F_2	F_3	F_4	F_5	h^2
INT	.159	.221	.554	-.003	-.070	.386
CREAT	.129	.380	.754	-.120	.074	.750
GEO	.393	.191	-.098	.285	.400	.442
MAT	.489	-.243	.246	.483	-.323	.660
CHE	.640	-.452	.068	.437	-.070	.815
PHYS	.529	-.490	-.009	-.026	-.063	.525
ELIT	.531	.573	-.350	-.221	-.187	.816
EGRAM	.443	.515	-.197	.009	-.137	.520
HIS	.379	.063	-.167	.060	.229	.231
FREN	.297	.127	-.045	.211	.007	.151
ART	.014	-.249	.062	-.075	.258	.138
MUSIC	.390	.107	.164	-.104	.245	.261
SCIE	.465	-.266	-.045	.066	.113	.306
Percentage of Variance	20.6	14.7	12.2	8.8	8.0	

TABLE 18

VARIMAX ROTATED FACTOR MATRIX OF INT, CREAT, AND ATTITUDE SCORES TO SCHOOL SUBJECTS.

Variables	F_1	F_2	F_3	F_4	F_5
INT	-.004	.047	.604	-.019	.137
CREAT	-.067	.019	.862	.026	-.029
GEO	-.007	.071	.033	.655	.080
MAT	.269	.028	.129	.099	.772
CHE	.898	.051	.079	.008	-.004
PHYS	.653	-.069	-.089	.111	.271
ELIT	.133	.848	.021	.251	-.122
EGRAM	.001	.654	.086	.285	.048
HIS	.172	.131	-.051	.427	-.000
FREN	.026	.178	.028	.273	.209
ART	.173	-.294	-.008	.099	-.111
MUSIC	.235	.067	.289	.335	-.077
SCIE	.426	-.038	-.055	.294	.182

TABLE 19

UNROTATED FACTOR MATRIX OF INT, DSU, DMU, AND ATTITUDE SCORES TO SCHOOL SUBJECTS.

Variables	F_1	F_2	F_3	F_4	F_5	h^2
INT	.187	.413	.511	-.011	-.081	.473
DSU	.128	.641	.513	-.066	.086	.701
DMU	.106	.214	.346	-.072	.001	.182
GEO	.401	.145	-.154	.330	.381	.459
MAT	.483	-.186	.289	.440	-.358	.673
CHE	.614	-.410	.196	-.424	-.020	.764
PHYS	.522	-.512	.130	-.044	-.068	.557
ELIT	.540	.416	-.518	-.242	-.173	.821
EGRAM	.453	.412	-.350	-.001	-.143	.518
HIS	.378	-.000	-.180	.076	.222	.230
FREN	.300	.093	-.087	.213	-.017	.152
ART	.009	-.219	.137	-.060	.262	.139
MUSIC	.398	.139	.126	-.092	.244	.262
SCIE	.456	-.272	.037	.072	.113	.301
Percentage of Variance	35.3	25.8	20.4	9.9	8.6	

TABLE 20

VARIMAX ROTATED FACTOR MATRIX OF INT, DSU, DMU, AND ATTITUDE SCORES TO SCHOOL SUBJECTS.

Variables	F_1	F_2	F_3	F_4	F_5
INT	-.009	.672	.049	-.018	.138
DSU	-.152	.815	.070	.076	-.052
DMU	.047	.422	-.020	-.022	.022
GEO	-.009	.029	.072	.669	.080
MAT	.271	.126	.022	.101	.757
CHE	.868	.086	.051	.016	.002
PHYS	.675	-.102	-.066	.098	.279
ELIT	.135	.008	.855	.239	-.121
EGRAM	-.001	.080	.657	.279	.052
HIS	.174	-.056	.136	.423	-.002
FREN	.027	.024	.181	.270	.213
ART	.181	-.009	-.290	.094	-.114
MUSIC	.245	.288	.075	.327	-.082
SCIE	.423	-.047	-.034	.296	.178

TABLE 21

FREQUENCY OF RECALL AND % FREQUENCY OF 50 TOYS WITH MECHANICAL WEIGHTS (0-3).

	Toy Name	Degree of Mech. Content	Frequency of Remembering	% Frequency
1	Electric Battery	1	60	44.1
2	Aquarium	0	44	32.4
3	Model Generator	2	20	14.7
4	Binocular	0	83	61.0
5	Model Airplane Kit	0	96	70.6
6	Cowboy & Indian Set	0	61	44.9
7	Model Car Kit	2	103	75.7
8	Cops & Robbers Set	0	45	33.1
9	Microscope	3	67	49.3
10	Paddling Pool	0	35	25.7
11	Pedal Car	0	73	53.7
12	Rocking Horse	0	61	44.9
13	Toy Weighing Scale	1	10	7.4
14	Soldier Suit	0	22	16.2
15	Toy Truck	1	98	72.1
16	Toy Zoo	0	35	25.7
17	Bicycle	2	128	94.1
18	Telescope	0	38	27.9
19	Radio Const. Kit	3	44	32.4
20	Chemistry Set	0	47	34.6
21	Scooter	1	39	28.7

Continued

TABLE 21 – Continued

	Toy Name	Degree of Mech. Content	Frequency of Remembering	% Frequency
22	Detective Set	0	28	20.6
23	Model Boat Kit	2	56	41.2
24	Toy Carpentry Set	2	64	47.1
25	Jack-in-the-box	0	62	45.6
26	Toy Crane	2	69	50.7
27	Puppet	0	79	58.1
28	Electric Train	2	85	62.5
29	Slide	0	70	51.5
30	Electric Motor	2	49	36.0
31	Sail Boat	0	56	41.2
32	Engineering Kit	3	17	12.5
33	Skate Board	0	42	30.9
34	Electric Race Kit	2	76	55.9
35	Space Ship	0	43	31.6
36	Electric Kit	3	22	16.2
37	Toy Record Player	0	53	39.0
38	Wagon	0	85	62.5
39	Toy Garage	0	60	44.1
40	Meccano	3	64	47.1
41	Toy Telephone	0	73	53.7
42	Mini drill	2	19	14.0
43	Tent	0	74	54.4

Continued

TABLE 21 - Continued

	Toy Name	Degree of Mech. Content	Frequency of Remembering	% Frequency
44	Steam Engine	3	22	16.2
45	Paint Set	0	95	69.9
46	Toy Clock Build. Set	3	14	10.3
47	Fishing Rod	0	78	57.4
48	Camera	1	78	57.4
49	Skates	0	94	69.1
50	Guitar	0	51	37.5

A product moment correlation was first run between the frequency of recall of each of the 22 toys and scores on Sandall's SCI interest scale. It was hoped that the correlational pattern would show a generally descending order in the size of correlation between the frequency of recall of toys and SCI interests corresponding to the decreasing weights of the mechanical content assigned these toys. As shown in Table 22, the average correlations decrease numerically from toys weighted 3 to toys weighted 1 (.17, .14, .06) but only the first is statistically significant. Table 23 shows the means and standard deviations associated with different combinations of recalled toys. One, two, and three represent the totals of those toys weighted by Hanrahan as one, two and three. The other values represent additional possibilities of combinations of toys. A decision as to which to use in

TABLE 22

CORRELATIONAL PATTERN OF THE FREQUENCY OF RECALL OF SELECTED 22 TOYS WITH MECHANICAL WEIGHTS OF 1, 2, OR 3 TO SANDALL'S SCI INTEREST SCALES.

Toy No.	Toy Name	Degree of Mech. Content	Correlation with Scientifice Interest Scale	
9	Microscope	3	.22	*
19	Radio Const. Kit	3	.13	
32	Engineering Kit	3	.21	*
36	Electric Kit	3	.17	*
40	Meccano	3	.26	*
44	Steam Engine	3	.18	*
46	Toy Clock Build. Set	3	.05	
3	Model Generator	2	.11	
7	Model Car Kit	2	.17	*
17	Bicycle	2	.16	*
23	Model Boat Kit	2	.10	
24	Toy Carpentry Set	2	.22	*
26	Toy Crane	2	.14	
28	Electric Train	2	.08	
30	Electric Motor	2	.24	*
34	Electric Race Kit	2	.06	
42	Mini Drill	2	.09	

Continued

TABLE 22 - Continued

Toy No.	Toy Name	Degree of Mech. Content	Correlation with Scientific Interest Scale
1	Electric Battery	1	.09
13	Toy Weighing Scale.	1	-.004
15	Toy Truck	1	-.06
21	Scooter	1	-.11
48	Camera	1	-.02

* Significant at .05

subsequent analyses would rest between 1+2+3 and 2+3. The final decision to use Hanrahan's own version here represented as 1+2+3 was arrived at after consideration of the data in Tables 23 and 24. Hence, TOYS in subsequent analyses is a score on 22 designated toys.

Table 24 shows the correlations for different combinations of weighted toys with all the Sandall interest variables, attitude scales to school subjects, INT, DSU, and DMU. In general, the use of weights two and three, assigned to some seventeen of the twenty-two toys, produces the highest column of correlations, being more noticeable in the correlations with Rural/Practical, and Scientific interests; and the attitude to school subjects, Chemistry and Science.

TABLE 23

MEANS AND STANDARD DEVIATIONS OF SCORES ON RECALLED TOYS.

Weighted Values	Mean	Standard Deviations
one	2.17	1.13
two	10.18	4.38
three	5.73	4.86
one & two	12.35	4.92
one & two & three	18.08	8.86
two & three	15.91	8.37

TABLE 24

CORRELATION COEFFICIENTS OF RECALLED TOYS OF MECHANICAL CONTENT OF WEIGHTS 1, 2, and 3 (AND DIFFERENT COMBINATIONS OF THESE) WITH SANDALL'S INTEREST SCALES, ATTITUDE SCORES TO SCHOOL SUBJECTS, INT, DSU, AND DMU.

	School Subjects					
	1	2	3	1+2	1+2+3	2+3
RUR	.04	.20	.16	.19	.19	.20
SOC	.12	-.16	-.24	-.12	-.20	-.22
HUM	-.03	-.09	-.03	-.09	-.07	-.07
ENT	.03	.02	-.05	.03	-.01	-.02
PHY	.07	-.06	-.11	-.04	-.09	-.10
LIT	-.06	-.03	-.04	-.04	-.04	-.04
AES	-.06	-.12	-.05	-.12	-.09	-.09
SCI	-.06	.26	.32	.22	.30	.32

Continued

TABLE 24 - Continued

CORRELATION COEFFICIENTS OF RECALLED TOYS OF MECHANICAL CONTENT OF WEIGHTS 1, 2, AND 3 (AND DIFFERENT COMBINATIONS OF THESE) WITH SANDALL'S INTEREST SCALES, ATTITUDE SCORES TO SCHOOL SUBJECTS, INT, DSU, AND DMU.

	School Subjects					
	1	2	3	1+2	1+2+3	2+3
GEO	.08	-.07	-.21	-.05	-.14	-.16
MAT	.02	.12	.12	.11	.13	.13
CHE	.07	.16	.25	.16	.23	.23
PHYS	-.02	.04	.10	.03	.08	.08
ELIT	-.13	.03	.05	-.00	.03	.04
EGRAM	-.06	.08	.03	.06	.05	.06
HIS	-.04	-.21	-.06	-.19	-.14	-.15
FREN	-.03	.11	-.03	.09	.04	.04
ART	.04	.05	-.02	.05	.02	.02
MUSIC	.04	-.11	.05	-.08	-.02	-.03
SCIE	.12	.26	.24	.25	.27	.27
INT	-.16	-.16	-.02	-.18	-.11	-.09
DSU	-.11	-.13	-.06	-.14	-.11	-.11
DMU	-.09	-.02	.10	-.04	.03	.04

It will be noted that correlations between the Toy Questionnaire scores, whatever the presumed mechanical content, and the intellectual measures shown in Intelligence, DSU and DMU are generally small, and most frequently not significant. Significance is shown only in the inverse correlations between scores on the Intelligence test and the scores of the least-weighted mechanical toys.

Factor analysis of Sandall's interest scales, INT, CREAT, Attitude Scales to school subjects, and the Toy Scale yielded eight factors. On rotation, the first factor appeared to contrast RUR and SCI with SOC interest scales, the second factor had its highest loading on the attitude scales to CHE and PHYS, the third factor contrasted HUM with ENT interests, the fourth factor is defined by attitude scales to ELIT and EGRAM, the fifth is heavily loaded on the LIT interest scale, the sixth factor appeared to be an intellectual one with high loadings on INT and CREAT measures, the seventh is defined by the attitude scale to GEO and there is indication that the attitude to HIS could possibly be related, and the eighth factor is an Aesthetic one (Table 26). This is not surprising--the first two factors of the analysis of Sandall's Interest Scales appear, as do the first two of the analysis of Attitudes to School Subjects, and a factor related to INT and CREAT. As we see from Table 28 the splitting of CREAT into DSU and DMU confirms this, except that DSU and INT now appear as factor 4, but ELIT, EGRAM as factor 5.

TABLE 25

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, CREAT, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	h^2
RUR	.370	-.418	.063	.376	.115	.052	.148	.203	.536
SOC	-.611	.367	-.183	.176	-.238	.012	-.064	-.053	.636
HUM	.281	-.241	-.559	.011	-.294	.340	-.106	-.160	.689
ENT	-.370	.182	.599	.003	-.030	-.290	-.016	.084	.622
PHY	-.380	.214	.361	.148	-.315	.186	-.022	-.097	.487
ELIT	.496	.188	-.284	-.479	.139	-.428	-.418	-.047	.972
AES	-.167	.258	-.405	-.374	.269	-.116	.601	.136	.863
SCI	.591	-.417	.231	.041	.321	.004	.029	-.097	.692
INT	-.092	.333	.229	-.021	.490	.261	-.221	-.040	.531
CREAT	-.114	.302	.042	-.007	.597	.401	-.010	-.100	.632
GEO	.120	.372	-.095	.206	-.115	.118	-.086	.374	.379
MAT	.368	.233	.260	-.135	.114	-.023	-.041	.222	.340
CHE	.510	.331	.293	-.241	-.233	.167	.184	-.308	.725

Continued

TABLE 25 - Continued

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, CREAT, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	h^2
PHYS	.543	.198	.156	-.298	-.222	.121	.148	.029	.535
ELIT	.238	.499	-.184	.551	.021	-.254	.100	-.268	.790
EGRAM	.141	.474	-.148	.465	.060	-.179	.045	-.081	.527
HIS	.303	.249	-.243	.149	-.174	.172	-.035	.207	.339
FREN	.221	.187	-.044	.182	.001	.009	-.069	.148	.145
ART	-.011	.034	.091	-.252	-.144	.094	.050	.043	.107
MUSIC	.175	.423	-.105	-.100	.100	.109	-.004	.012	.253
SCIE	.384	.252	.323	-.044	-.261	.016	-.010	.114	.399
TOYS	.258	-.095	.264	.061	-.027	-.133	.165	-.118	.201
Percentage of Variance	23.5	18.3	14.8	12.5	11.5	7.8	6.5	5.1	

TABLE 26

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, CREAT, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
RUR	.669	-.112	-.094	.016	-.160	-.134	.147	-.038
SOC	.775	-.121	.061	-.018	-.097	.009	-.028	.083
HUM	.008	.017	-.801	-.039	.034	-.176	.064	-.097
ENT	-.178	.035	.736	-.026	-.138	-.009	-.093	-.139
PHY	-.363	.120	.236	.010	-.455	-.032	.013	-.277
LIT	-.022	.195	-.095	.051	.959	-.013	.050	.014
AES	-.201	-.016	-.014	.008	.080	.072	-.045	.899
SCI	.767	.161	-.070	-.039	.163	.085	-.160	-.106
INT	-.049	-.004	.188	.015	.039	.694	.052	-.088
CREAT	-.012	-.053	-.007	.053	-.074	.776	-.006	.135

Continued

TABLE 26 - Continued

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, CREAT, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
GEO	-.101	.040	.004	.111	-.036	.041	.593	-.003
MAT	.192	.332	.222	-.052	.210	.152	.273	.016
CHE	.039	.836	-.067	.110	.012	.076	-.086	-.033
PHYS	.124	.671	-.084	-.089	.123	-.050	.175	.072
ELIT	-.007	.075	-.024	.867	.014	.008	.176	.017
GRAM	-.041	-.001	.041	.667	.005	.066	.270	.034
HIS	-.012	.140	-.262	.133	.015	-.032	.481	.016
FREN	.085	.054	-.017	.168	.057	.033	.318	-.041
ART	-.118	.205	.016	-.219	-.018	-.029	-.009	.043
MUSIC	-.133	.227	-.067	.141	.150	.261	.221	.142
SCIE	.078	.512	.156	.014	.028	-.078	.277	-.149
TOYS	.298	.242	.131	.106	-.035	-.118	-.128	-.040

TABLE 27

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, DSU, DMU, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	h^2
RUR	.384	-.361	.116	.424	-.046	.050	.111	.215	.535
SOC	-.620	.283	-.242	-.292	-.139	.029	-.038	-.062	.633
HUM	.314	-.256	-.557	-.038	-.162	.380	-.135	-.174	.694
ENT	-.394	.168	.576	-.088	-.118	-.295	-.011	.081	.630
PHY	-.400	.182	.320	-.047	-.368	.216	-.040	-.110	.493
LIT	.494	.211	-.289	-.363	.325	-.469	-.401	-.066	.994
AES	-.159	.211	-.394	-.219	.359	-.118	.578	.170	.779
SCI	.604	-.326	.296	.213	.287	-.017	.028	-.097	.697
INT	-.147	.401	.251	.186	.448	.188	-.207	-.038	.561
DSU	-.264	.401	.112	.307	.449	.240	-.104	-.054	.611
DMU	.015	.169	-.000	.095	.408	.245	.152	-.074	.293

Continued

TABLE 27 - Continued

UNROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES, ATTITUDES TO SCHOOL SUBJECTS, INT, DSU, DMU, AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	h^2
GEO	.092	.373	-.114	.122	-.206	.114	-.107	.362	.374
MAT	.346	.272	.258	-.098	.123	-.041	-.030	.213	.333
CHE	.481	.350	.357	-.325	-.107	.197	.161	-.283	.682
PHYS	.545	.214	.134	-.379	-.076	.156	.137	.036	.555
ELIT	.196	.504	-.192	.456	-.282	-.256	.135	-.257	.767
EGRAM	.102	.488	-.158	.411	-.205	-.194	.083	-.091	.537
HIS	.288	.256	-.256	.075	-.211	.181	-.081	.215	.349
FREN	.202	.209	-.043	.160	-.085	.005	-.059	.130	.140
ART	.004	.017	.071	-.294	-.009	.116	.040	.042	.109
MUSIC	.144	.443	-.118	-.053	.133	.094	.011	.016	.261
SCIE	.364	.272	.297	-.177	-.238	.049	-.035	.095	.395
TOYS	.264	-.073	.273	.029	-.073	-.112	.182	-.127	.218
Percentage of Variance	23.4	18.4	14.5	12.4	12.1	7.9	6.3	4.9	

TABLE 28

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES ATTITUDES TO SCHOOL SUBJECTS, INT, DSU, DMU AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
RUR	.670	-.113	-.087	-.127	.016	-.160	.150	-.038
SOC	-.772	-.125	.059	.013	-.017	-.097	-.027	.086
HUM	.010	.012	-.805	-.171	-.039	.031	.072	-.092
ENT	-.181	.037	.738	-.015	-.025	-.134	-.100	-.153
PHY	-.367	.117	.232	.031	.010	-.448	-.013	-.298
LIT	-.020	.195	-.091	-.030	.053	.970	.048	.016
AES	-.210	-.024	-.011	.088	.008	.080	-.035	.848
SCI	.767	.170	-.076	.087	-.038	.158	-.171	-.101
INT	-.049	-.003	.194	.709	.008	.054	.059	-.108
DSU	-.098	-.139	.107	.745	.090	-.062	.054	-.004
DMU	.074	.061	-.101	.473	-.010	-.036	-.057	.213

Continued

TABLE 28 - Continued

VARIMAX ROTATED FACTOR MATRIX OF SANDALL'S INTEREST SCALES ATTITUDES TO SCHOOL SUBJECTS, INT, DSU, DMU AND TOYS.

Variables	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
GEO	-.096	.044	.013	.037	.116	-.032	.589	-.006
MAT	.193	.348	.219	.135	-.045	.202	.254	.027
CHE	.031	.810	-.069	.076	.109	.018	-.028	-.041
PHYS	.120	.687	-.089	-.066	-.087	.115	.168	.085
ELIT	-.008	.072	-.024	.008	.854	.016	.175	.013
EGRAM	-.040	.003	.042	.069	.678	.003	.260	.036
HIS	-.011	.133	-.250	-.036	.132	.027	.499	.001
FREN	.089	.064	-.018	.037	.176	.051	.303	-.032
ART	-.119	.209	.013	-.029	-.218	-.021	-.012	.047
MUSIC	-.133	.229	-.065	.270	.142	.151	.222	.145
SCIE	.077	.517	.151	-.076	.024	.024	.262	-.154
TOYS	.297	.252	.120	-.114	.115	-.046	-.150	-.028

To summarize so far; having demonstrated from simple correlations that Sandall's interest measures were relatively independent of DSU, DMU and INT, confirmation of this was forthcoming from multiple correlation analyses of Sandall's variables against DSU, DMU, CREAT, and INT as criterion measures. Multiple R's in the .30 - .35 range were obtained; values which would account for no more than 12% of the separate criteria. Factor analyses with varimax rotation, of interest scores, INT, and either a simple creativity index, or DSU and DMU entered separately, yielded four interpretable factors. The first factor contrasted SOC and SCI interests, the second ENT and HUM, the third loaded most heavily on CREAT or DSU as the case may be with a lower value on INT, whilst the fourth appeared to contrast LIT with PHY interests. Turning to the attitudes toward school subjects, it was seen that these variables, too, were independent of intelligence, DSU and DMU, and presumably of CREAT. Multiple correlations of the attitudes towards school subjects with criterion measures of DSU, DMU, CREAT and INT were found to be in the range of .27 to .40, explaining less than 16% of the variance of criterion scores. Factor analyses of attitude scores, intelligence, and either a single creativity index, or DSU and DMU entered separately yielded five factors, four being related to school subject orientations and one to INT and DSU.

Attention was next directed to the Hanrahan Toy Questionnaire, and alternative combinations of toys of some designated weight (of mechanical content) were considered. The highest

correlation of the Toy score was, as expected, with SCI interests. Among school subjects the highest correlation was with attitudes to chemistry and to science.

The time has come, therefore, to consider the foregoing data in relation to Hudson's statements about "convergers" and "divergers" in so far as these individuals can be identified from the test data above.

On the identification of convergers and divergers using Hudson's procedure.

Hudson defined his convergers and divergers as the extremes of a distribution of scores, i.e. the difference between the standard score on the intelligence test and the standard score on the two tests, Meanings of Words and Uses of Objects. In the present experiment, the score of each individual on the variables INT and CREAT was expressed on a scale with a mean of 50.0 and a standard deviation of 10.0. This yielded groups with scores ranging from 27 to -24 on the scale so derived, the extremes representing convergers and divergers respectively. They were categorized as either extreme convergers, moderate convergers, nonconvergers-nondivergers, moderate divergers, or extreme divergers in the proportions of 1:2:4:2:1. The actual distribution among the 137 students taking part in the present study was as follows:- 15:25:55:25:17. Table 29 presents the complete distribution. These categories were entered on the data cards.

Table 30 shows the means and standard deviations of scores on all variables sub-divided into five categories

TABLE 29

CATEGORIZATION OF CONVERGERS AND DIVERGERS

Description	Category	Number	Members	Range of Scores*
Extreme Convergers	1	15	6,25,26,27,34,37,51,72,88, 100,103,127,129,132,137.	27 to 12
Moderate Convergers	2	25	5,11,15,20,22,23,29,35,36,38, 52,64,65,67,68,70,75,89,96, 98,113,117,119,131,133	12 to 5
Non-Convergers Non-Divergers	3	55	1,2,4,9,10,13,16,17,18,19,21, 24,30,32,33,39,40,42,43,44, 46,47,50,53,54,55,58,62,66, 73,77,78,81,83,85,90.92,93, 97,101,104,105,109,110,111, 112,121,122,123,124,126,128, 130,134,135.	+5 to -5
Moderate Divergers	4	25	3,8,12,41,48,49,57,60,61,63, 71,74,79,80,82,86,91,94,99, 102,107,114,115,120,136.	-5 to -12
Extreme Divergers	5	17	7,14,28,31,45,56,59,69,76,84, 87,95,106,108,116,118,125.	-12 to -24

* Scores obtained by subtracting score of (DSU+DMU) from score of INT (intelligence), each expressed on a scale of mean = 50.0,S.D. =10.0

TABLE 30

MEANS AND STANDARD DEVIATIONS FOR THE FIVE CATEGORIES OF THE DISTRIBUTION OF INT/CREAT DIFFERENTIAL SCORE.

	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
RUR	9.87	10.84	10.36	10.28	11.00
	(2.53)	(3.16)	(2.67)	(2.76)	(3.52)
SOC	9.00	9.68	9.60	11.16	8.88
	(3.16)	(3.89)	(3.31)	(3.30)	(3.62)
HUM	5.73	6.84	7.98	6.36	8.47
	(2.25)	(3.17)	(3.20)	(3.76)	(4.14)
ENT	13.46	13.84	12.49	13.12	11.29
	(4.08)	(3.09)	(2.82)	(3.24)	(3.89)
PHY	13.67	13.12	14.35	14.20	11.71
	(4.94)	(5.02)	(3.69)	(4.76)	(4.09)
LIT	7.93	6.60	5.78	6.32	6.71
	(4.76)	(3.22)	(2.96)	(2.38)	(1.76)
AES	7.60	8.44	8.36	9.52	10.00
	(3.31)	(3.10)	(3.14)	(2.93)	(4.62)
SCI	11.67	10.92	11.11	11.04	12.24
	(4.69)	(3.94)	(3.31)	(3.53)	(4.48)
INT	60.67	58.20	48.72	47.56	38.59
	(7.78)	(10.65)	(10.98)	(10.90)	(13.23)
DSU	9.93	11.84	11.42	13.80	12.77
	(3.49)	(4.27)	(4.83)	(4.59)	(3.87)
DMU	6.07	7.88	9.06	11.68	14.53
	(2.22)	(3.63)	(3.49)	(3.75)	(6.23)
CREAT	16.00	19.72	20.47	25.52	27.29
	(3.96)	(6.04)	(6.47)	(6.98)	(8.75)
GEO	41.40	44.16	40.49	41.64	43.71
	(15.68)	(10.02)	(13.25)	(12.45)	(10.84)
MAT	47.87	49.48	42.58	41.12	44.29
	(13.34)	(10.33)	(13.99)	(14.60)	(10.54)

Continued

TABLE 30 - Continued

MEANS AND STANDARD DEVIATIONS FOR THE FIVE CATEGORIES OF THE DISTRIBUTION OF INT/CREAT DIFFERENTIAL SCORE.

	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
CHE	35.27	39.20	39.06	39.52	36.82
	(17.98)	(13.55)	(17.60)	(16.66)	(19.28)
PHY	36.93	37.32	39.71	38.24	34.47
	(18.08)	(10.95)	(16.99)	(17.57)	(18.47)
ELIT	40.87	40.00	41.13	40.16	39.41
	(13.04)	(10.62)	(13.11)	(14.18)	(13.84)
EGRAM	35.93	39.08	39.91	39.64	37.88
	(10.17)	(10.05)	(12.48)	(15.23)	(15.26)
HIS	40.67	43.12	42.73	39.72	41.29
	(13.14)	(10.39)	(12.03)	(11.93)	(12.26)
FREN	34.20	32.64	34.82	38.04	38.24
	(13.57)	(14.15)	(16.04)	(17.53)	(16.63)
ART	50.73	43.52	49.22	49.12	47.82
	(16.60)	(15.94)	(14.85)	(15.18)	(17.00)
MUSIC	38.80	31.36	38.78	33.64	44.00
	(16.14)	(19.71)	(17.62)	(17.97)	(15.55)
SCIE	46.67	48.68	46.87	48.36	46.47
	(14.18)	(12.27)	(15.57)	(12.03)	(16.41)
TOYS	17.27	16.88	18.00	17.60	19.53
	(10.74)	(8.18)	(8.72)	(6.75)	(9.54)
MT	2.87	2.96	3.15	3.08	3.12
	(1.13)	(1.02)	(.80)	(.81)	(.78)
CT	2.80	2.68	3.13	3.00	2.65
	(1.01)	(.95)	(.90)	(.82)	(1.00)

ranging from extreme convergers (category 1) to extreme divergers (category 5). If the separation by categories is reflected in all variables we would expect progressive change in means as we proceed across from category 1 to category 5. There is uneven tendency for increase on RUR, HUM and AES; for decrease in ENT and LIT. Among attitudes to school subjects there is an increase with FREN and MUSIC. though the pattern of increase is irregular. There is another uneven pattern of increase with TOYS. The clearest indication obviously occurs with INT which declines from category 1 to category 5, whilst increases are most obvious in DMU and CREAT.

The next step taken was to correlate these scaled differences in scores (INT - CREAT) with each variable in turn for the whole sample of 137 subjects. Correlation coefficients presented in Table 31 appear to confirm the results shown in Table 30. Table 31 shows that only ENT and AES of Sandall's interest scales correlate significantly with the convergence-divergence variable (.05), and among attitudes to school subjects only the attitude scale to MAT appears to be barely significant.

It appeared to be useful to conduct a series of t tests using the various categories of convergers and divergers. It will be recalled that Hudson was prepared to consider the extremes of 30 percent as possible convergers and possible divergers. A series of such tests will be made, using only the most extreme categories 1 and 5 (n=15 and n=17) whose results are shown in Table 32.

TABLE 31

CORRELATION COEFFICIENTS OF 22 VARIABLES WITH DIFFERENTIAL SCORES (INT - CREAT).

Variables	Correlation Coefficients
RUR	-.05
SOC	-.08
HUM	-.13
ENT	.17 *
PHY	.07
LIT	.10
AES	-.20 *
SCI	-.04
GEO	.01
MAT	.16*
CHE	.05
PHYS	.10
ELIT	.03
EGRAM	-.02
HIS	.06
FREN	-.10
ART	-.03
MUSIC	-.10
SCIE	.05
TOYS	-.08
MT	-.05
CT	.00

* Significant at .05

TABLE 32

t-TEST COMPARING 15 CONVERGERS (CAT 1) AND 17 DIVERGERS (CAT 5) ON 26 VARIABLES.

Variable	t	p	Variable	t	p
RUR	-1.03		GEO	-0.49	
SOC	0.10		MAT	0.85	
HUM	-2.28	*	CHE	-0.24	
ENT	1.54		PHYS	0.38	
PHY	1.23		ELIT	0.30	
LIT	0.99		EGRAM	-0.42	
AES	-1.67		HIS	-0.14	
SCI	-0.35		FREN	-0.75	
INT	5.65		ART	0.49	
DSU	-2.16		MUSIC	-0.93	
DMU	-4.98		SCIE	0.04	
CREAT	-4.59		TOYS	-0.63	
			MT	-0.74	
			CT	0.43	

* Significant at .05

Next, categories one and two were combined as convergers, and categories four and five as divergers (n=40 and n=42). In the third case, a sample consisting of the two quartiles of convergers and divergers was used--a rather more conservative figure than the 30% of Hudson. The three sets were used to test possible limits of the extent of convergers and divergers if any were in fact recognized. Results are presented in tables 33 and 34. It will be seen that significant values (5% level) are found only for AES and MAT (apart from the classifying variables), i.e. on one of Sandall's Interest Variables and on the attitude to one school subject, results which are also obtained in the two 25% samples. These results should be set beside those obtained from the two extreme groups where only HUM differentiated the two groups.

Whilst few single variables show possibilities of differentiating between those who might be convergers and those who might be divergers, it is possible that combinations of variables might be more successful. Since convergence-divergence is a dichotomous variable, a discriminant analysis was used to examine the extent to which three sets of variables would differentiate convergers and divergers representing the two extremes on that continuum. The discriminant analysis technique was proposed by Fisher (1936) as a solution of a problem of classifying a number of correlated variables into two groups taking into consideration the combined effects of these variables. The variables selected

TABLE 33

t-TEST COMPARING 40 CONGERGERS (CAT 1 + CAT 2) AND 42 DIVERGERS (CAT 4 + CAT 5) MEAN VALUES ON 24 VARIABLES.

Variables	$\bar{x}$ Convergers	$\bar{x}$ Divergers	t	P
RUR	10.48	10.57	- .15	
SOC	9.43	10.24	-1.02	
HUM	6.43	7.21	-1.02	
ENT	13.70	12.38	1.70	
PHY	13.33	13.19	.13	
LIT	7.10	6.48	.91	
AES	8.13	9.71	-2.10	*
SCI	11.20	11.52	- .36	
INT	59.13	43.93	6.12	**
DSU	11.13	13.38	-2.44	**
DMU	7.20	12.83	-5.98	**
CREAT	18.33	26.24	-5.30	**
GEO	43.13	42.48	.24	
MAT	48.88	42.40	2.38	**
CHE	37.73	38.42	- .19	
PHYS	37.18	36.71	.13	
ELIT	40.33	39.86	.17	
EGRAM	37.90	38.93	- .36	
HIS	42.20	40.36	.71	
FREN	33.23	38.12	-1.43	
ART	46.23	48.60	- .67	
MUSIC	34.15	37.83	- .92	
SCIE	47.93	47.60	.11	
TOYS	17.03	18.38	- .72	

* Significant at .05

** Significant at .01

TABLE 34

t-TEST COMPARING MEAN VALUES OF 34 CONVERGERS AND 34 DIVERGERS (EACH REPRESENTING 25% OF THE TOTAL SAMPLE) ON 26 VARIABLES.

Variables	$\bar{x}$ Convergers	$\bar{x}$ Divergers	t	P
RUR	10.59	10.76	- .24	
SOC	9.44	10.21	- .91	
HUM	6.59	7.21	- .72	
ENT	13.35	12.21	1.26	
PHY	13.41	13.06	.30	
LIT	7.29	6.62	1.02	
AES	7.94	9.76	-2.18	*
SCI	11.41	11.71	- .29	
INT	58.88	44.65	4.99	**
DSU	10.41	13.74	-3.03	**
DMU	7.15	13.56	-5.91	**
CREAT	17.56	27.32	-5.80	**
GEO	43.24	42.85	.13	
MAT	48.94	43.68	1.92	*
CHE	37.50	38.85	- .34	
PHYS	37.79	35.29	.67	
ELIT	40.82	41.68	- .28	
EGRAM	37.50	40.91	-1.15	
HIS	42.71	41.29	.50	
FREN	33.00	38.18	-1.37	*
ART	45.26	46.15	- .21	
MUSIC	34.59	39.32	-1.07	
SCIE	47.00	47.38	- .12	
TOYS	17.24	18.41	- .55	
MT	2.88	3.12	-1.03	
CT	2.74	2.94	- .97	

* Significant at .05

** Significant at .01

were the eight interest scales, the attitudes towards school subjects, and the single measure derived from Hanrahan's Toy Scale, these twenty variables and two groups (convergers and divergers) were utilized in the discriminant analysis using an SPSS computer program. The results shown in Tables 35 and 36 indicate that there is little separation between the group centroids whether we use only the extreme convergers and divergers or the two 25% samples. It is very interesting to note that in an attempt to form a discriminant function for the two extreme groups only four variables are selected, whereas in the 25% sample as many as 7 variables are included. More interesting still is the fact that none of the four are included in the seven. This seems to suggest that it is largely a matter of chance which variables are related to the discriminant function, i.e. none are very clearly and unequivocally involved. It will be noted that in the larger sample the variables AES and MAT are the first two variables selected, a confirmation of the results obtained with the correlational and t test studies.

TABLE 35

SUMMARY TABLE OF DISCRIMINANT ANALYSIS (CAT 1 AND CAT 5).

Variables	Dis. Function coefficient	WILKS'LAMBDA	P
HUM	1.039	.8525	.03
ART	- .621	.8015	.04
MUSIC	.548	.7642	.05
PHYS	- .451	.7278	.06

Discriminant Functions Evaluated at Group Centroids (Means)

Group	Function 1
1	-.630
5	.556

TABLE 36

SUMMARY TABLE OF DISCRIMINANT ANALYSIS (THE TWO 25% SAMPLES)

Variables	Dis. Function coefficient	WILKS'LAMBDA	P
AES	.750	.9327	.03
MAT	-.668	.8816	.02
FREN	.656	.8169	.005
SCI	.752	.7911	.005
LIT	-.511	.7625	.004
SOC	.483	.7422	.005
SCIE	.345	.7224	.005

Discriminant Functions Evaluated at Group Centroids (Means)

Groups	Function 1
1	-.611
2	.611

There remains one other method which might check on the convergers and divergers in the present study. This entails the Q technique or inverted factor analysis of correlations between persons. A transpose of the matrix of twenty-two variables made this analysis possible. The variables were eight Sandall's Interest Scales, attitudes to eleven school subjects, scores on twenty-two toys, and the mechanical tools and carpentry tools responses. These variables were the rows of the transposed matrix; convergers and divergers were selected from the columns. In factor analyis the number of columns may not exceed the number of

TABLE 37

UNROTATED FACTOR MATRIX FOR 10 MODERATE CONVERGERS AND 10 MODERATE DIVERGERS (Q - technique).

Convergers	F_1	F_2	F_3	h^2
S 5	.98	.03	.01	.94
S 20	.71	.09	.34	.81
S 23	.83	.16	-.17	.84
S 25	.93	-.03	-.25	.90
S 27	.61	.43	.35	.77
S 36	.90	.11	.28	.92
S 37	.90	-.31	-.13	.90
S 64	.83	-.02	.18	.82
S100	.25	-.13	.52	.40
S137	.80	.39	.31	.83
Divergers				
S 14	.93	-.02	-.20	.90
S 56	.78	-.17	-.36	.81
S 57	.71	-.51	-.03	.82
S 59	.87	-.32	.14	.88
S 76	.91	-.20	.06	.90
S 79	.67	.48	-.10	.77
S 86	.93	-.02	.17	.93
S 87	.66	.32	.09	.74
S 95	.87	-.09	-.16	.87
S120	.93	-.03	-.03	.94
Percentage of Variance	67.4	7.8	7.2	

TABLE 38

VARIMAX ROTATED FACTOR MATRIX OF 10 MODERATE CONVERGERS AND 10 MODERATE DIVERGERS (Q - technique).

Convergers	F_1	F_2	F_3
5	.68	.59	.38
20	.34	.42	.58
23	.55	.64	.15
25	.77	.56	.12
27	.29	.76	-.12
36	.49	.56	.60
37	.88	.30	.25
64	.55	.43	.49
100	.08	-.05	.58
137	.23	.72	.57
Divergers			
14	.75	.56	.17
56	.78	.38	-.02
57	.82	.02	.28
59	.77	.23	.48
76	.75	.36	.42
79	.22	.79	.13
86	.62	.50	.51
87	.25	.63	.32
95	.73	.46	.19
120	.69	.52	.33

TABLE 39

UNROTATED FACTOR MATRIX OF 10 MODERATE CONVERGERS AND 10 MODERATE DIVERGERS - MINEIGEN VALUE = 1.5 (Q - technique).

Convergers	F_1	F_2	h^2
S 5	.98	.04	.96
S 20	.70	.09	.50
S 23	.82	.16	.71
S 25	.92	-.05	.86
S 27	.60	.37	.49
S 36	.90	.13	.83
S 37	.91	-.32	.92
S 64	.83	-.01	.69
S100	.24	-.08	.07
S137	.79	.38	.77
Divergers			
S 14	.93	-.03	.86
S 56	.77	-.17	.62
S 57	.71	-.52	.77
S 59	.87	-.30	.84
S 76	.91	-.20	.86
S 79	.67	.48	.68
S 86	.93	-.00	.87
S 87	.67	.35	.57
S 95	.87	-.09	.76
S120	.93	-.02	.87
Percentage of Variance	67.4	7.8	

TABLE 40

VARIMAX ROTATED FACTOR MATRIX FOR 10 MODERATE CONVERGERS AND 10 MODERATE DIVERGERS USING MINEIGEN VALUE = 1.5 (Q - technique).

Convergers	F_1	F_2
5	.71	.68
20	.47	.53
23	.51	.67
25	.72	.58
27	.21	.67
36	.59	.69
37	.89	.36
64	.63	.54
100	.24	.10
137	.35	.81
Divergers		
14	.71	.59
56	.69	.38
57	.87	.08
59	.85	.35
76	.81	.45
79	.19	.80
86	.70	.61
87	.27	.70
95	.71	.51
120	.71	.60

rows or analysis is impossible. This meant that not more than eleven convergers and eleven divergers could be selected. In the present instance it was decided to limit the number of individuals appearing in any one analysis to twenty, ten chosen from among the convergers and ten from among the divergers. The subjects were ranked in order of their scores (INT - CREAT) and for the first analysis the ten highest and ten lowest scores were selected; for the next analysis the next ten from each end of the continuum were chosen.

Using the less extremes first, three factors emerged, rather than the two which would be expected if there were a neat classification into two groups, convergers and divergers. Two of these three factors explained 75% of the variance and the remaining 25% was taken up by 13 small factors. While factor 1 takes 67.4% factor 2 and factor 3 each took between 7 and 8% of the variance. On rotation, (Table 38) the heaviest loadings for most individuals were on factor 1, fewer on factor 2 and only two significant loadings on factor 3. By using an artificially high mineigen value (or specifically limiting the number of factors to 2) an equally artificial solution can be obtained. Perhaps (Table 40) students 57, 59 and 76 provide the clearest evidence in support of Hudson's hypotheses but by the same evidence student 37 would belong with them, or three divergers and one converger would be placed together. Subject 137 would be different, i.e. a converger, but we should have to accept student 79 also as a converger, whereas Hudson would have placed him as a diverger.

TABLE 41

UNROTATED FACTOR MATRIX FOR 10 EXTREME CONVERGERS AND 10 EXTREME DIVERGERS (Q - technique).

Convergers	F_1	F_2
6	.21	.15
26	.23	-.03
27	.18	.49
34	.23	-.05
51	.24	-.08
72	.25	-.06
88	.24	-.04
103	.22	-.28
127	.23	-.24
132	.24	.11
Divergers		
7	.18	.41
28	.25	.09
31	.21	.11
45	.25	-.12
69	.23	-.13
84	.18	-.45
108	.18	.35
116	.23	.08
118	.21	-.14
125	.24	.02
Percentage of Variance	74.6	8.5
Eigen Values	14.91	1.71

TABLE 42

VARIMAX ROTATED MATRIX FOR 10 EXTREME CONVERGERS AND 10 EXTREME DIVERGERS (Q - technique).

Convergers	F_1	F_2
6	.23	.13
26	.07	.22
27	.52	-.05
34	.05	.23
51	.03	.25
72	.06	.25
88	.07	.23
103	-.16	.32
127	-.12	.32
132	.20	.17
Divergers		
7	.45	-.01
28	.18	.19
31	.19	.14
45	-.00	.28
69	-.02	.26
84	-.33	.35
108	.39	.01
116	.17	.18
118	-.03	.25
125	.12	.21

When we select the ten most extreme students of each kind and repeat the process, two factors do result. The first factor has a very large eigen value of 14.91 and the second has an eigen value of 1.71 with no other eigen value exceeding unity. But the varimax rotation fails to provide any evidence of two groups, all loadings being extremely low, and, according to Kaiser's criterion, not significant. Once again we find that using the most extreme groups, the members of whom should be the most probable supporters of the Hudson theses yield, from his point of view, the least evidence. In the slightly less extreme groups things look only slightly more promising.

There remains one other tactic in a search to examine whether or not Hudson's theses are applicable to Canadian ninth grade children, with confirmation being provided from three sets of measures, Sandall's Interest Scales, Attitude to School Subjects and the Hanrahan Toy Questionnaire. That tactic is to attempt to predict a limited number of convergers (and divergers, separately) by means of regression techniques. The standard SPSS regression program was used, with all variables included, to predict the difference score (INT minus CREAT), each expressed on a scale with a mean of 50.0 and a Standard deviation of 10.0. In the first place the two groups forming 25% of each end of the continuum were used, and then only the two most extreme groups, which had formed categories 1 and 5. The results are given in Tables 43 and 44. It might well be that different variables would be

TABLE 43

REGRESSION OF VARIABLES ON a) CONVERGENCE b) DIVERGENCE

Variables	MultipleR	SimpleR	Beta
		25% Sample Convergers	
ART	.257	.257	.781
SCI	.326	-.168	-1.03
SOC	.458	-.082	- .987
HIS	.560	-.026	- .355
ELIT	.592	-.042	.389
AES	.617	-.157	- .287
LIT	.634	-.007	.631
MAT	.651	-.183	- .362
		25% Sample Divergers	
CHE	.352	.352*	.065
MUSIC	.531	-.189	- .513
ENT	.591	.251	- .015
TOYS	.618	-.114	.165
EGRAM	.649	.178	.377
PHYS	.683	.334*	.445

* Significant at .05 level.

TABLE 44

REGRESSION OF VARIABLES ON a) CONVERGENCE b) DIVERGENCE.

Variables	MultipleR	SimpleR	Beta
	CAT 1		
HUM	.530	.530*	.861
SCI	.647	-.487	-1.293
SOC	.805	.080	- .804
ART	.862	-.064	- .140
MUSIC	.953	.127	.888
	CAT 5		
SCIE	.361	-.361	-1.377
GEO	.514	.160	.772
TOYS	.623	.185	.801
ENT	.710	-.273	- .038
AES	.755	-.133	- .123

* Significant at .05 level.

selected to predict convergers, from those variables required to predict divergers, but it would be expected that some of the variables used with the 25% samples would also be involved in predicting with the extreme groups, categories 1 and 5. Only then would it be possible to argue for some consistency of prediction. Additionally it would be expected that if Hudson were to be confirmed, then the variables which had differentiated the groups in earlier tables, would appear here also.

It will be noted at the outset that the simple

correlations of the separate variables with the difference score (INT minus CREAT) are generally low, only three of them being significant at the .05 level, and only one other approaches the .10 level (SCI in the extreme converger group). The SPSS regression program does not evaluate the correlations before attempting to use them in the regression equation. Hence, among the convergers eight variables are invoked to 'explain' just 42% of the variance, whereas in the extreme convergers the first two variables 'explain' the same 42% of the variance of the more restricted, more extreme sample, and five variables will account for 90% of the variance. Perhaps more to the point is the fact that only two of the variables are common to both samples, and yet all members of category 1 are also members of the 25% converger sample. These two variables are SCI and SOC from Sandall's Interest Scale. On the prediction of divergers six variables 'explain' 46% of the variance in the 25% sample, and four variables will account for 50% of the variance for the category 5 sample. Again, only two variables are common to the two predictions, in this case TOYS and ENT.

When we review these attempts to predict convergers and divergers, chosen according to Hudson's method by finding the difference score in some standard form between INT and CREAT we find that the variable AES was indicated by Table 30, AES, ENT and MAT were indicated by Table 31, HUM by Table 32, AES and MAT by Table 33, AES and MAT by Table 34, HUM shows in Table 35, and AES, MAT, SCI and SOC appear

in the discriminant analysis in Table 36. In Tables 43 and 44 it appears that negative attitude to SCI and attitude to SOC assist in the prediction of convergers, and ENT and TOYS in the prediction of divergers. There is thus little or no stability of confirmatory indicators among Sandall's Interest Tests, Attitudes to School Subjects or Hanrahan's Toy Questionnaire for the convergers-divergers division of the 137 boys according to Hudson's procedure.

Hudson produced evidence of an association between his convergence/divergence dimension and the specialization of his students at the level of the sixth form or in university. Canadian ninth grade students are somewhat younger than English sixth form students and in addition their curriculum permits less specialization, which tends to occur in grades ten and eleven, or at C.E.G.E.P. The only evidence which could be produced on this topic from the present sample was to ask the students for the options they would choose at grade ten. Unfortunately complete data for all students were not available on this point. For the extreme groups there were complete data for only 12 convergers and 13 divergers. Chi squared was insignificant (Table 45). In the 25% sample it was also insignificant. To round out the study data are presented for the reported intentions of students to go or not to go to university (Table 46) and also the SES of the parents of these convergers and divergers was not significantly related to their convergence/divergence score, (Table 47).

It is now possible to examine each of the six hypotheses

in the light of the foregoing evidence.

TABLE 45

THE RELATIONSHIP BETWEEN CHOICE OF OPTION AND CONVERGENCE-DIVERGENCE CATEGORIZATION.

	Convergers CAT 1	Divergers CAT 5	Convergers 25%	Divergers 25%
Science	5	4	8	8
Neutral	3	3	9	7
Arts	2	6	4	13
	χ^2 = 1.75 n.s.		χ^2 = 4.10 n.s.	

TABLE 46

THE RELATIONSHIP BETWEEN REPORTED INTENTION TO GO OR NOT TO GO TO UNIVERSITY AND CONVERGENCE-DIVERGENCE CATEGORIZATION.

	Convergers CAT 1	Divergers CAT 5	Convergers 25%	Divergers 25%
Yes	15	10	29	20
No	—	2	4	5
	χ^2 = .817 n.s.		χ^2 = .207 n.s.	

TABLE 47

THE RELATIONSHIP BETWEEN S.E.S. AND CONVERGENCE-DIVERGENCE CATEGORIZATION.

$\bar{x}$ Convergers CAT 1	$\bar{x}$ Divergers CAT 5	$\bar{x}$ Convergers 25%	$\bar{x}$ Divergers 25%
4.07	3.83	3.88	3.60
(N = 15)	(N = 12)	(N = 33)	(N = 25)
t = .43		t = 1.14	
n.s.		n.s.	

Hypothesis 1.

Extreme convergers and divergers (category 1 and category 5 above) are differentiated by the t test only on the HUM of Sandall's Interest variables. With the less extreme convergers and divergers (categories 1 and 2 combined, and categories 4 and 5 combined) significant differences were found on the variable AES. Four variables named in the hypothesis (RUR, SOC, SCI and LIT) did not yield a significant difference.

Hypothesis 2.

On attitude to school subjects, only MAT yielded a significant difference, and that only in the combined groups (1 + 2 versus 4 + 5). The extreme groups were not differentiated by their attitudes to school subjects.

Hypothesis 3.

Using the score on 22 toys derived from the Hanrahan Toy Questionnaire it was found that there was no difference either with extreme groups or with less extreme groups. Hypothesis 3 was not confirmed.

Hypothesis 4.

χ^2 showed no significant differences amongst convergers, divergers for whom data existed for the future courses selected by these students. This was true whether extreme (CAT 1 and CAT 5) or less extreme (CAT 1 and 2, versus 4 and 5) groups were chosen.

Hypothesis 5.

There were no significant differences between convergers and divergers on their reported intentions to go or not to go to university.

Hypothesis 6.

There were no significant differences between convergers and divergers with regard to S.E.S. as defined by the father's profession.

In general, therefore, it must be concluded that with the present sample of Canadian Grade 9 students, divided into categories by the difference in standardized scores on an intelligence test (Henmon Nelson, Form A) and a summed score on two tests (Meaning of Words and Uses of Objects) according to a procedure of Hudson, it was not possible to find convincing evidence for the existence of convergers and divergers having properties proposed by Hudson or deduced from his theory.

Summary

The present study used 137 Canadian ninth grade male students to examine the relationship between the convergence-divergence continuum and Arts-Science choice which was found by Hudson to exist among British sixth form students. An appropriate intelligence test for the present sample (Henmon-Nelson, Form A) and the two open-ended tests employed by Hudson (Uses of Objects and Meanings of Words) were used to generate a convergence-divergence continuum, following the procedure utilized by the British work. Such a procedure involved the distribution of the differences between scores on the I.Q. test and those on the creativity index (the composite score on the two open-ended tests) in the proportions of 10:20:40:20:10. The extreme ten per cent. on both sides of the distribution defined the two groups of extreme convergers and extreme divergers. The dependent variables were scores on Sandall Factorial Interest Blank, an Attitude measure toward eleven school subjects, and certain scales derived from the Hanrahan Toy Questionnaire. In addition, the convergers and divergers groups were also compared on three other variables for which data were obtained from responses to an information sheet (Appendix 1). These concerned the choice of ninth grade options from among school subjects

having a scientific or a literary bias, socio-economic status as deduced from the fathers' occupations, and students' reported intention to go, or not to go, to university.

The correlation between the two open-ended measures was much lower (.3) than that between the INT score and the composite CREAT score (.52). The correlational pattern of interest scores and INT, DSU, DMU, and the Creativity Index (DSU+DMU) and the regression of the former on each of the last four variables showed, in general, that the relative preference for interest activities included in the Sandall Interest Blank were virtually independent of the type of abilities measured by the INT test. The HUM interest scale contributed the most to the multiple R of interest variables and DSU, as did the AES interest scale to the multiple R of interest scales and DMU, and with the Creativity Index.

Factor analysis of interest measures, INT, DSU, DMU, and the composite Creativity score yielded four principal components on rotation. With 1's inserted in the diagonal as communalities, the first factor was defined by SCI. RUR and SOC interest scales; the second factor contrasted ENT and HUM interests; the third factor loaded on the Creativity Index; and the fourth factor was a literary one. These four factors accounted for 71.3 per cent. of the total variance in the data. Using squared R's of each variable with the remaining variables, the first two factors remained unchanged, the third factor was defined by INT and DSU, and the fourth

factor contrasted PHY and LIT interests.

These procedures were repeated with students' attitudes to school subjects with correlations, regressions and factor analyses being produced. It was found from these various analyses (using all 137 students) that Music correlated positively with DSU and DMU and PHYS correlated negatively with DSU. The expected correlations were found between attitudes to CHE and PHYS, between English Literature and English Grammar, and between History and Geography. From multiple regression analyses, attitudes to Mathematics, Music and Physics contributed most to the prediction of Intelligence, and these three with attitudes to English Grammar to the prediction of DSU. Music, Mathematics (with Physics and History) contributed most to the prediction of DMU or the combined DSU+DMU. In each case only about 10% of the variance of the criterion was explained. Factor analysis of these attitude scores with the Intelligence and Creativity (DSU+DMU) scores yielded 5 factors for 64.3% of the total variance. One factor appeared to derive from attitudes to Chemistry and Physics, one from English Literature and English Grammar and one from the intellectual tests. The other two appeared to be derived from attitude to Geography and to Mathematics. When a factor analysis was made involving all the variables (Sandall's Interest Scales, Intelligence, Creativity, Attitudes to School Subjects and Toys) eight factors appeared. The first four alternated between Interests and Attitudes, with the sixth being an

intellectual one, and the remaining three split into Interests and Attitudes.

Using data derived from the Basic Toy Scale of the Hanrahan Toy Questionnaire used either singly or in combination led to the decision that in future analyses only the single score (TOYS) derived from the weighted scores on 22 toys would be used.

Attempts were then made to check whether convergers and divergers indentified by Hudson's procedures could be identified from their scores on the other variables used in the investigation. The extremes, were designated as CAT 1 and CAT 5, the less extremes as CAT 2 and CAT 4, and the middle group as CAT 3. In subsequent analyses CAT 3 students were not used, and selections made from the remaining groups. Missing data on certain variables reduced the numbers available in some analyses.

Means and standard deviations were tabled for all students, divided into their categories, for all variables. As expected clear cut progressive increase or decrease across successive categories were found for the variables from which the categories were formed. Only AES amongst the remaining variables showed a progressive change.

Correlations of the difference scores (INT minus CREAT) with all variables showed significance only for AES, ENT and MAT. t tests were then made between different groups--categories 1 + 2 versus 4 + 5, the highest scoring 25% of each of these, and finally category 1 (extreme convergers) versus

category 5 (extreme divergers). Significant differences were found only for HUM amongst the extreme groups, and for AES and MAT among the less extreme groups. Discriminant analyses of extreme groups and later of the 25% sample produced extremely small distances between the group centroids, indicating poor separation of what were presumed to be convergers and divergers.

Using a Q technique, transposing the matrix of correlations placed 22 variables as rows and permitted the selection of not more than 22 individuals in the columns for a subsequent factor analysis. To ensure factorization only 20 individuals were selected. On the first occasion the 10 most extreme convergers and divergers were selected; then the 10 next in rank. Artificial restrictions to produce a two-factor solution were made. There was no confirmation of convergers and divergers in the most extreme cases, and weak and confused evidence in the next ranked cases.

Finally attempts were made to see which variables would be chosen, from among all the variables used, in attempting to predict convergers, and divergers, using a 25% sample, and then only the extremes, category 1 and category 5. Different groups of variables were selected for the separate groups (convergers and divergers) but only two were common to the 25% group and the extreme group in each case (convergers and divergers). It was concluded that there was no stability of prediction by this method, with these students.

The six hypothesis set up in Chapter 4 were examined in the light of the foregoing information. Of the three minor hypotheses, the choice of school options was not confirmed, but the other two (decision about university and SES of parents) were confirmed. Contrary to Hypothesis 1, only AES of Sandall's Interest Blank differentiated convergers and divergers, and contrary to Hypothesis 2 only MAT differentiated. There was no differentiation on the Hanrahan Toy Questionnaire contrary to Hypothesis 3.

It was concluded that whilst it was possible to rank students by a difference score (INT minus CREAT), the confirmation of the extreme groups as separate homogeneous groups (convergers and divergers in Hudson's terms) could not be confirmed by the variables to be found in Sandall's Interest Blank, in Attitudes to School Subjects, or in the Hanrahan Toy Questionnaire. It says nothing of their confirmation from data gathered by interviews or by personality inventories.

Chapter 6

Summary and Conclusions

During the late 1950's and following the interest aroused by Snow's lecture, The Two Cultures, Hudson began an investigation of the genesis of the arts-science differentiation evident in English education. After 1960 he extended his enquiries downwards from the universities to the upper forms of English private and grammar schools. Using tests first proposed by Guilford, but brought to Hudson's notice by the work of Getzels and Jackson, aided by some psychiatric formulations of his own, he proposed, in his text, "Contrary Imaginations," how English grammar school children might be distinguished, at the extremes, as convergers and divergers, names which gained currency from that time onwards. Initial reviews of Hudson's work were generally favourable and some attempts at replication, in whole or part, of Hudson's or Getzels' and Jackson's, were subsequently made. One such investigation had been made by Butcher who advocated further investigation with much different samples. The present investigation arose from this suggestion by Butcher.

Analysis of Hudson's work in terms of North American techniques of investigation led to the search for a suitable interest inventory, one which might have been employed by Hudson and which might equally have been used in Canada, and

the choice fell upon Sandall's Interest test, standardized on English children of approximately the same intellectual and socio-economic level as some of those in Hudson's sample. A commonly used North American test of intelligence was employed instead of the one used by Hudson. Attitudes to school subjects, and some other students' intentions and preferences were measured, and, with the possibility of finding still earlier antecedents of the arts-science dichotomy, the Toy Scale proposed by Hanrahan, and already used on English children, was applied.

Ninth Grade boys (137) participated in the study, the boys being drawn from English language schools on the Island of Montreal. Using Hudson's procedure to discover the convergers and divergers yielded 15 extreme convergers (CAT 1), 17 extreme divergers (CAT 5), 25 convergers (CAT 2) and 25 divergers (CAT 4). Six hypotheses were set up for subsequent examination. The testing of the hypotheses followed some introductory study of the Sandall's Interest Scales, Attitude Scales to school subjects and the Hanrahan Toy Scale on the total group of 137 students.

From regression analyses (Tables 3,4,5 and 6) it was seen that Interest variables alone would account for only about 10% of the variance of INT,DSU,DMU or CREAT (DSU + DMU). Similarly attitudes to school subjects, singly or in combination, explained about the same percentage of variance of the same variables. In the former case, HUM usually made the greatest contribution, in the latter case attitude to

MUSIC usually had the greatest input. Factor analyses of combinations of two or more of the four variables INT, DSU, DMU, CREAT with interest variables showed four rotated factors (1) contrasting SOC with SCI, (2) contrasting ENT with HUM, (3) loading on intellectual variables, and (4) a single identifiable loading on LIT. When used with attitudes to school subjects, five varimax rotated factors were found as follows :- (1) CHE and PHYS, (2) Intellectual factors, (3) ELIT and EGRAM, (4) GEO and (5) MAT. The former analysis would provide some hope that if individuals could be classified in some opposing categories then the contrasting of HUM and ENT, SOC and SCI might have some role to play in such a categorization. The latter analysis tends to confirm the traditional relational nature of the school subjects involved (CHE - PHYS, and ELIT - EGRAM). A factor analysis of the whole data confirmed the two previous analyses (Table 28). Eight factors were extracted for 66.8% of total variance. On rotation (Varimax) we had factors (1) SCI and RUR, (2) CHE and PHYS, (3) ENT contrasting with HUM, (4) ELIT and EGRAM, (5) LIT, (6) INT and CREAT, (7) GEO, (8) AES, in other words, apart from the intellectual factor, four factors reflected interest variables and three reflected attitudes to school subjects.

How would these findings help investigate convergence-divergence as categories proposed by Hudson? Immediately a problem is raised by their identification. Should one use only the extremes--in which case the small numbers are less

likely to yield generalizable results, or should one use larger numbers, which should make for more generalizable results but on less clearly identifiable groups in Hudson's terminology? Both tactics were followed.

All 137 students having been placed in categories based on Hudson's procedures, means and standard deviations were computed for all variables for each category. Clear cut trends of mean scores whether from high to low or low to high would have been evidence likely to support Hudson's thesis. t-tests should confirm such trends if they exist. Some tendency was noted for increase on RUR and HUM and a clear increase in AES (Table 30), and slight decrease on ENT and LIT. Table 31 shows significant correlations between the difference score (INT minus CREAT) and the variables ENT, AES and MAT. When t-tests are used with extreme groups (category 1 and category 5) HUM differentiates the two groups (Table 32) but with less extreme groups (Table 33) AES and MAT but not HUM differentiate.

Discriminant analyses showed no firm separation of group centroids, but such separation as was effected was based upon HUM and AES in different analyses.

The Q technique, factor analysis of the transpose, should permit the division of students into two groups (or could force such a division). Because a maximum of 22 variables (classifying intellectual variables were excluded) was available, not more than 22 students (preferably 20 or lower) could be forced into two groups. Such a 'forcing'

procedure, obtained by the use of a minimum eigen value greater than unity to halt factorization, failed to produce such a division, no students being clearly distinguished from the others in the extreme groups. The extremely large proportion of variance extracted by the first factor would indicate much more of a "g" effect than Hudson would anticipate, and probably more than a correlation of .56 between INT and DSU, and .52 between INT and CREAT for these students would have suggested.

Little success was experienced with the extreme groups in meeting the major hypotheses set out earlier. Differences were found with HUM interests among the extreme 'convergers' and 'divergers,' none among attitudes towards school subjects and no differences were found on the Hanrahan Toy Questionnaire. There were no significant χ^2 between them with respect to bias of a literary or scientific kind in future study at school, nor on SES, nor on intentions to proceed to University or not. With the more numerous groups, which included less extreme 'convergers' and 'divergers' significant differences were found on AES interest scores, and MAT among attitudes to school subjects.

It was concluded that there was no support, among the present sample of Canadian Grade 9 boys, for Hudson's hypothesis of distinct 'convergers' and 'divergers' as identifiable by the kinds of tests likely to be used in a North American examination of these hypotheses. Whether the existence of some extreme score differences on intelligence

and creativity supported by means of interviews rather than other tests would result in the confirmation of such 'convergers' and 'divergers' has not been tested. It may still remain a possibility for examination by different procedures with different samples of Canadian schoolboys.

APPENDIX I

Student's Number

_____

Meaning of Words Test

Each of the nine words below has more than one meaning. Write down as many meanings for each word as you can.

Bit	Pink
Bolt	Port
Duck	Sack
Fair	Tender
Fast	

( )

Student's Number _____

Uses of Objects Test

Below are five objects. Think of as many different uses as you can for each.

A barrel

A paper clip

A tin of boot polish

A brick

A blanket

Toy-Questionnaire

Student's Number _____

In the following exercise you are asked to remember some of the things you may have played with as a child. Below are three lists of selected items that are sometimes used as toys by children. INDICATE ONLY THOSE ITEMS THAT YOU DEFINITELY REMEMBER PLAYING WITH BEFORE YOU ENTERED HIGH SCHOOL.

1. Circle any of the following toys that you remember playing with at home.

electric battery boat	toy carpentry set
aquarium	jack-in-the-box
model generator	toy crane
binoculars	puppets
model airplane kit	electric train
cowboy & indian set	slide
model car kit	electric motor
cops and robbers set	sail boat
microscope	engineering kit
paddling pool	skateboard
pedal car	electric race car kit
rocking horse	spaceship
toy weighing scales	electric kit
soldier suit	toy record player
tow truck	wagon
toy zoo	toy garage
bicycle	meccano
telescope	toy telephone
radio construction kit	mini drill
chemistry set	tent

Toy-Questionnaire (Cont'd)

scooter	steam engine
detective set	paint set
model boat kit	toy clock building set
fishing rod	skates
camera	guitar

2. Indicate how much you used the following groups of tools to build or repair something or to take something apart. (your childhood period before entering high school)

Mechanical tools such as wrenches, pliers, etc.

NEVER	SELDOM	QUITE OFTEN	VERY OFTEN
_____	_____	_____	_____

Carpentry tools such as a hammer, saw, etc.

NEVER	SELDOM	QUITE OFTEN	VERY OFTEN
_____	_____	_____	_____

3. Circle the following objects that you remember playing with at home or elsewhere:

old clock	old car parts
go cart	old electric engines
home made carts	old gasoline engines
old bicycle parts	old sewing machine parts

4. Indicate your parents' interest in your involvement with mechanical things by placing an "X" in the appropriate space on the following scale. "Interest" refers to the answering of your questions about mechanical things, showing you how things worked and how to make things, etc.

	VERY INT.	QUITE INT.	SLIGHT INT.	NOT INT.
FATHER'S INTEREST	_____	_____	_____	_____
MOTHER'S INTEREST	_____	_____	_____	_____

Index on Attitudes Toward School Subjects

Instructions Student's Number

_____

Below you find some school subjects in Capital letters. Beneath each subject are a number of Scales on which you describe the subject. Here is an example:

MATHEMATICS

Bad____:____:____:____:____:____:____Good

-If you feel that MATHEMATICS is EXTREMELY "Bad", make an "X" as follows:

Bad __X__:____:____:____:____:____:____Good

-If you feel that MATHEMATICS is EXTREMELY "Good:"

Bad ____:____:____:____:____:____:_X_Good

-If you feel that MATHEMATICS is QUITE "interesting:"

Interesting____:_X_:____:____:____:____:____Boring

-If you feel that it is QUITE "Boring:"

Interesting____:____:____:____:____:_X_:____Boring

-If you feel that MATHEMATICS is SLIGHTLY "Severe:"

Severe____:____:_X_:____:____:____:____Tender

-Or is SLIGHTLY "Tender:"

Severe____:____:____:____:_X_:____:____Tender

If you feel that both sides of the scale apply equally to the school subjects at the top, then you should check the centre space on that scale. For example:

-If you feel that MATHEMATICS IS EQUALLY "Bad" and "Good" then:

Good____:____:____:_X_:____:____:____Bad

Important: 1. Check EVERY SCALE,DO NOT SKIP ANY.
2. NEVER put more than one "X" on a scale.

WORK FAST. do not spend much time thinking about any single item. It is your first impressions, your immediate feelings that are important for this index. DO NOT LOOK BACK AND FORTH THROUGH THE ITEMS. DO EACH ITEM IN ORDER.

Geography

Good	_____:_____:_____:_____:_____:_____:_____	Bad
Kind	_____:_____:_____:_____:_____:_____:_____	Cruel
Boring	_____:_____:_____:_____:_____:_____:_____	Interesting
Light	_____:_____:_____:_____:_____:_____:_____	Dark
Severe	_____:_____:_____:_____:_____:_____:_____	Tender
Free	_____:_____:_____:_____:_____:_____:_____	Restricted
Soft	_____:_____:_____:_____:_____:_____:_____	Hard
Cold	_____:_____:_____:_____:_____:_____:_____	Hot
Predictable	_____:_____:_____:_____:_____:_____:_____	Unpredictable
Confusing	_____:_____:_____:_____:_____:_____:_____	Clear

The following ten school subjects were rated on the same ten scales as above:

Mathematics

Chemistry

Physics

English Literature

English Grammar & Composition

History

French

Art

Music

Science

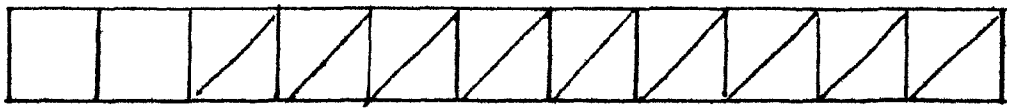
Information

Student's Number

_____

1. Your age in June 30, 1979 _____
2. Your date of birth, Day ____Month____ Year____
3. Father's place of birth _____
4. Circle the options chosen for Grade 9.

Chem, study	Drama	History	Typing
Biology	Science	or	Modern
Ecology	Math	Geography	Languages

5. Do you intend to go to University? Yes ____ No ____
6. If yes, what area of specialization would you choose?
7. If no, what kind of work would you like to do after you graduate from High School?
8. What is the name of your father's occupation?
9. In a few words explain what he does at work as accurately as possible.
10. Does your mother work? No ____ Part Time____Full Time_____.
11. If your mother works what is the name of her occupation?
12. 

APPENDIX II

COMPLETE DATA FILE

AHMCON I.

Legend

Columns	Variable	Description
1 - 3	ID	Identity
4	CARD	Card Number
5 - 6	RUR	Rural/Practical Interests
7 - 8	SOC	Social/Display Interests
9 - 10	HUM	Humanitarian Interests
11 - 12	ENT	Entertainment Interests
13 - 14	PHY	Physical Interests
15 - 16	LIT	Literary Interests
17 - 18	AES	Aesthetic Interests
19 - 20	SCI	Scientific Interests
21 - 22	INT	Intelligence Test Scores
23 - 24	DSU	Scores on Uses of Objects Test
25 - 26	DMU	Scores on Meaning of Words Test
27 - 28	DSU & DMU	Creativity Index
29 - 30	GEO	Attitude Scores to Geography
31 - 32	MAT	Mathematics
33 - 34	CHE	Chemistry
35 - 36	PHYS	Physics
37 - 38	ELIT	English Literature
39 - 40	EGRAM	English Grammar

Continued

AHMCON 1 -Continued

Columns	Variable	Description
41 - 42	HIS	History
43 - 44	FREN	French
45 - 46	ART	Art
47 - 48	MUSIC	Music
49 - 50	SCIE	Science
51	CAT	5 Categories Convergers to Divergers
52 - 53	TOYS	Scores on 22 Toys from Hanrahan Toy Questionnaire
54 - 55	TOYA	Scores on 17 Toys from Hanrahan Questionnaire
56	MT	Rating of Frequency of Use of Mechanical Tools
57	CT	Rating of Frequency of Use of Carpentry Tools
58	CATE	Sample of 30 Convergers (CATE 1) 30 Divergers (CATE 2)

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AHMCON 2

Legend

Columns	Variable	Description
1 - 3	ID	Identity
4	CARD	Card Number
5 - 54	TOYS	Toy Recall (50 Toys)
55	MT	Mechanical Tools
56	CT	Carpentry Tools
57 - 64	OLD OBJECTS	Old Objects Recall (8 Objects)
65	F.I	Father's Interest
66	M.I	Mother's Interest
67 - 68	OPTIONS	Number of Grade 9 Options
69	UNIVERSITY	Intention to go (or not) to University
70	S.E.S	Socio-Economic Status
71	MOTHER	Mother Working or Not
72	ORDER	Order in the Family
73	BROTHERS AND SISTERS	Number of Children in the Family

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*GO
 ahmcon2
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Bibliography

Association of Universities and Colleges of Canada (A.U.C.C.), University Affairs. Policy Studies. Study No. 1, 1977.

Barron, F. The disposition toward originality. Journal of Abnormal and Social Psychology, 1955, 51, 478-485.

Barron F. Originality in relation to personality and intellect. Journal of Personality, 1957, 25, 730-742.

Barron, F. Creativity and Psychological Health. Princeton, N.J.: Van Nostrand, 1963.

Barron, F. & Welsh, G.S. Artistic perception as a possible factor in personality style: Its measurement by Figure Preference Test. Journal of Psychology, 1957, 33, 199-203.

Bennett, S.N. Divergent-thinking abilities - A validation study. British Journal of Educational Psychology, 1973, 43, 1-7.

Bradford, E.J. An experimenter's point of view: Symposium on the selection of pupils for different types of secondary school. British Journal of Educational Psychology, 1948, 18, 67-86.

Buros, D.K. The Seventh Mental Measurement Yearbook. New Jersey: The Gryphon Press, 1972.

Burt, C. Ability and income. British Journal of Educational Psychology, 1943, 13, 83-98. (a)

Burt, C. The education of the young adolescent: The psychological implication of the Norwood Report. British Journal of Educational Psychology, 1943, 13, 126-140. (b)

Burt, C. A review of J.W. Getzels and P.W. Jackson, Creativity and Intelligence. British Journal of Educational Psychology, 1962, 32, 292-298.

Burt, C. A review of L. Hudson, Contrary Imaginations. British Journal of Psychology, 1967, 58, 173-174.

Butcher, H.J. Human Intelligence. Its nature and assessment. London: Methuen, 1968.

Butcher, H.J. The structure of abilities, interests and personality in 1,000 Scottish school children. British Journal of Educational Psychology, 1969, 39, 154-165. (a)

Butcher, H.J. A review of L. Hudson, Frames of Mind. British Journal of Psychology, 1969, 60, 405-406. (b)

Butcher, H.J. & Pont, H.B. Opinions about careers among Scottish secondary school children of high ability. British Journal of Educational Psychology, 1968, 38, 272-279.

Cattell, R.B. & Butcher, H.J. The Prediction of Achievement and Creativity. New York: Bobbs-Merrill, 1968.

Channon, C.E. The effect of regime on divergent thinking scores. British Journal of Educational Psychology. 1974, 44, Part 1, 89-91.

Chesire, L. , Saffir, M. and Thurstone, L.L. Computing Diagrams for the Tetrachoric Correlation Coefficient. Chicago: University of Chicago Press, 1938.

Child, I. L. Personality correlates of esthetic judgment in college students. Journal of Personality, 1965, 33, 476-511.

Child, D. & Smithers, A.G. An attempted validation of the Joyce-Hudson Scale of Convergence and Divergence. British Journal of Educational Psychology, 1973, 43, Part 1, 57-62.

Conant, J.B. The American High School Today. A first report to interested citizens. New York: McGraw-Hill, 1959.

Cooley, W.W. Techniques for considering multiple measurements. In Educational Measurements. American Council on Education. Washington, D.C.: 1971.

Cronbach, L.J. Intelligence? Creativity? A parsimonious reinterpretation of the Wallach-Kogan data. American Educational Research Journal, 1968, 4, 491-511.

Cronbach, L.J. Essentials of Psychological Testing. New York: Harper & Row, 1970.

Cropley, A.J. Creativity and intelligence. British Journal of Educational Psychology, 1966, 36, 259-266.

Cropley, A.J. Divergent thinking and science specialists. Nature, 1967, 215, 671-672.

Cropley, A.J. & Field, T.W. Intellectual style and high school science. Nature, 1968, 217, 1211-1212.

Cropley, A.J. A five-year longitudinal study of the validity of creativity tests. Developmental Psychology, 1972, 6, 119-124.

DeMille, R. & Merrifield, P. Review of creativity and intelligence, by J.W. Getzels and P.W. Jackson. Educational and Psychological Measurement, 1962, 23, 803-808.

Discipio, W.J. Divergent-thinking: A complex function of interacting dimensions of Extraversion - Introversion and Neuroticism-Stability. British Journal of Psychology, 1971, 62, 545-550.

Drevdahl, J.E. Factors of importance for creativity. Journal of Clinical Psychology, 1956, 12, 21-26.

Drevdahl, J. & Cattell, R.B. Personality and creativity in artists and writers. Journal of Clinical Psychology, 1958, 14, 107-111.

Earle, F.M. The significance of ability differences at eleven-plus. Occupational Psychology, 1947, 21, 193-202.

Economic Council of Canada: Second Annual Review. Ottawa. Queen's Printer, 1965.

Edwards, I.B. & Wilson, A.B. The specialization of interests and academic achievement. Harvard Educational Review, 1958, 28, 183-196.

Eysenck, H.J. Obituary: Sir Cyril Burt (1883-1971). British Journal of Mathematical and Statistical Psychology, 1972, 25.

Ferguson, G. Statistical Analysis in Psychology and Education. New York: McGraw-Hill, 1966.

Fisher, R.A. The use of multiple measurement in taxonomic problems. Annals of Eugenics, 1936, 7, 179-188.

Fryer, D. Occupational-intelligence standards. School and Society, 1922, 16, 273-277.

Garwood, D. Personality factors related to creativity in young scientists. Journal of Abnormal and Social Psychology, 1964, 68, 413-419.

Getzels, J.W. & Jackson, P.W. Creativity and Intelligence. New York: Wiley, 1962.

Guilford, J.P. Printed Classification Tests. (AAP Aviation Psychology Report, No. 5). Washington D.C.: Government Printing Office, 1947.

Guilford, J.P. Factor analysis in a test development program. Psychological Review, 1948, 55, 79-94.

Guilford, J.P. Creativity. American Psychologist, 1950, 5, 444-454.

Guilford, J.P. Studies of Aptitudes of High Level Personnel. Reports from the Psychological Laboratory. University of Southern California, 1950-1954.

Guilford, J.P. The structure of intellect. Psychological Bulletin, 1956, 53, 267-293.

Guilford, J.P. & Zimmerman, W.S. Some AAF findings concerning aptitude factors. Occupations, 1947, 26, 154-159.

Guttman, L. Some necessary conditions for common factor analysis. Psychometrika, 1954, 19, 149-161.

Ghiselin, B. The Creative Process. Berkeley: University of California Press, 1952.

Haddon, F.A. & Lytton, H. Teaching approach and the development of divergent thinking abilities in primary schools. British Journal of Educational Psychology, 1968, 38, 171-180.

Hanrahan, J.P. Effects of Early School Entrance on Intelligence. Unpublished master's thesis. McGill University, 1970.

Hanrahan, J.P. The Relationship Between Childhood Experiences and Students' Areas of Specialization in Sixth Form Courses. Unpublished Ph.D. dissertation. University of London, 1972.

Hargreaves, D.J. Situational influences on divergent thinking. British Journal of Educational Psychology, 1974, 44, Part 1, 84-88.

Hargreaves, D.J. Sex roles in divergent thinking. British Journal of Educational Psychology, 1977, 47, Part 1, 25-32.

Hasan, P. & Butcher, H.J. Creativity and intelligence: A partial replication with Scottish children of Getzels' and Jackson's study. British Journal of Psychology, 1966, 57, 129-135.

Holland, J.L. Some explorations of a theory of vocational choice: I. One and Two-year Longitudinal Studies. Psychological Monographs, 1962, 76, 26, (Whole No. 545).

Holland, J.L. Some explorations of a theory of vocational choice and achievement: II. A Four-year Prediction Study. Psychological Monographs, 1963, 12, 545-549.

Hudson, L. Undergraduate academic record of Fellows of the Royal Society. Nature, 1958, 182, 1326.

Hudson, L. A differential test of arts/science aptitude. Nature, 1960, 186, 413.

Hudson, L. Arts/Science Specialization. (Ph.D. dissertation, University of Cambridge, 1961, Microfilm).

Hudson, L. Intelligence, divergence, and potential originality. Nature, 1962, 196, 601.

Hudson, L. Personality and scientific aptitude. Nature, 1963, 198, 913. (a)

Hudson, L. The relation of psychological test scores to academic bias. British Journal of Educational Psychology, 1963, 33, 120. (b)

Hudson, L. Contrary imaginations. Harmondsworth, Middlesex: Penguin, 1967.

Hudson, L. Frames of Mind. Harmondsworth, Middlesex: Penguin, 1968.

Hull, C.L. An automatic correlation calculating machine. Journal of American Statistical Association, 1925, 20, 522-531.

Husén, T. International Study of Achievement in Mathematics. A comparison of twelve countries. New York: Wiley, 1967. (Stockholm: Alinguist & Wiksell).

Joreskog, K.G. UMLFA: A Computer Program for Unrestricted Maximum Likelihood Factor Analysis. Princeton, New Jersey, E.T.S., 1967.

Joreskog, K.G. A general approach to confirmatory maximum likelihood factor analysis. Psychometrica, 1969, 34, 183-202.

Joyce, C.R.B. & Hudson, L. Student style and teacher style: An experimental study. British Journal of Medical Education, 1968, 2, 28-32.

Kaiser, H.F. The Varimax Method of Factor Analysis. Ph.D. thesis, University of California, 1956.

Kandel, J.L. Examinations and their Substitute in the United States. New York: Arno Press, 1936.

Kuhn, T.S. The essential tension: Tradition and innovation in scientific research. In Taylor, C.W. and Barron, F., Scientific Creativity. New York: John Wiley, 1963.

Lawley, D.N. Problems in Factor Analysis, as quoted in Emmett, W.G. Factor Analysis by Lawley's Method of Maximum Likelihood. British Journal of Psychology, Statistical Section, 1949, 2, Part II.

Learned, W.S. The Quality of the Educational Process in the United States and in Europe. New York: The Carnegie Foundation for the Advancement of Teaching, 1927.

Lytton, H. Creativity and Education. London: Routledge & Kogan Paul, 1971.

MacCurdy, R.D. Characteristics of superior science students and their own sub-groups. Science Education, 1956, 40, 3-23.

Mackay, C.K. & Cameron, M.B. Cognitive bias in Scottish first year science and arts undergraduates. British Journal of Educational Psychology, 1968, 38, 315-318.

MacKinnon, D.W. The personality correlates of creativity: A study of American architects. In Proceedings of the XIVth Congress of Applied Psychology. Munksgaard, 1962.

Maltzman, I.; Bogartz, W. & Breger, L. A procedure for increasing word association originality and its transfer effects. Journal of Experimental Psychology, 1958, 56, 393-398.

Maltzman, I.; Simson, S.; Raskin, D. & Licht, L. Experimental studies in the training of originality. Psychological Monographs, 1960, 74, 6. (Whole No. 493).

McGuire, C.; Hindsman, E.; King, F.J. & Jennings, E. Dimensions of talented behavior. Educational and Psychological Measurement, 1961, 21, 3 -38.

McNemar, Q. Lost our intelligence? Why? American Psychologist, 1964, 19, 871-882.

Meredith, W. ; Frederiksen, C. & McLaughlin, D. Statistics and data analysis. Annual Review of Psychology, 1974, 25, 453-505.

Noah, H.J. & Eckstein, M.A. Toward a Science of Comparative Education. New York: Macmillan, 1969.

Orpet, R.E. & Meyers, C.E. Six structure of intellect hypotheses in six-year-old children. Journal of Educational Psychology, 1966, 57, 341-346.

Osgood, G.E. ; Suci, G.J. & Tannenbaum, P.H. The measurement of Meaning. Urbana: University of Illinois Press, 1965.

Pace, G.R. Opinion and action: a study in validity of attitude measurement. Educational and Psychological Measurement, 1950, 10, 411-419.

Paterson, D.G. ; Elliott, R.M. ; Anderson, L.D. ; Toops, H.A. & Heidbreder, Edna. The Minnesota Mechanical Abilities Tests. Minneapolis: University of Minnesota Press, 1930.

Piers, E.V. ; Daniels, J.M. & Quackenbush, J.F. The identification of creativity in adolescents. Journal of Educational Psychology, 1960, 51, 346-351.

Povey, R.M. The word in context: Its use in a Study of the differences between arts and science students. Unpublished Ph.D. dissertation. University of London, 1967 (In J.P. Hanrahan, 1972).

Report of the Committee on Higher Education (Robbins Report) Higher Education: London, HMSO, 1961, 3.

Rickover, H.G. American Education: A National Failure. New York: E.P. Dutton, 1963.

Roe, Ann. The Making of a Scientist. New York: Dodd Mead, 1952.

Roe, Ann, Early determinants of vocational choice. Journal of Counselling Psychology, 1957, 4, 212-217.

Roe, Ann & Siegelman, M. The Origins of Interests. The American Personnel and Guidance Association. Washington, 1964.

Royal Commission of Inquiry on Education in the Province of Quebec. Report. vol. 11 (Quebec, 1965) 368-369.

Sacks, H.V. & Eysenck, M.W. Convergence-divergence and the learning of concrete and abstract sentences. British Journal of Psychology, 1977, 68, 215-221.

Sandall, P.H. An Analysis of the Interests of Secondary School Pupils. A factorial study leading to the construction of a diagnostic test. (Unpublished Ph.D. dissertation, University of London, 1960, microfilm).

Sandall, P.H. Manual of the Factorial Interest Blank, London, NFER, 1967.

Smith, F.V. Critical notice, Contrary Imaginations, British Journal of Educational Psychology, 1966, 36, 334-335.

Smithers, A.G. & Child, D. Convergers and divergers: Different forms of Neuroticism. British Journal of Educational Psychology, 1974, 44, Part 3, 304-306.

Super, D.E. & Crites, J.O. Appraising Vocational Fitness. New York: Harper & Row, 1962.

Tannenbaum, P.H. Attitude Toward Source and Concept as Factors in Attitude Change Through Communications. Unpublished doctor's dissertation. University of Illinois, 1953. (In Osgood et al., 1965).

Taylor, C.W. et al. The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent. Salt Lake City: University of Utah Press, 1956.

Taylor, C.W. et al. The Second (1957) University of Utah Research Conference on the Identification of Creative Scientific Talent. Salt Lake City: University of Utah Press, 1958.

Taylor, C.W. & Barron, F. Research Conference on the Identification of Creative Scientific Talent. New York: Wiley, 1963.

Terman, L.M. & Oden, M.H. The Gifted Group at Mid-life. Stanford: Stanford University Press, 1959.

Thomson, G.H. The distribution of intelligence among university and college students. British Journal of Educational Psychology, 1945, 15, 76-77.

Thomson, G.H. History of Psychology in Autobiography. vol. iv, 1952, 279-294.

Thorndike, R.L. Some methodological issues in the study of creativity. Proceedings of the 1962 Invitational Conference on Testing Problems, p. 40-54. Princeton: Educational Testing Service, 1963.

Thurstone, L.L. Multiple Factor Analysis. Chicago: University Press, 1947.

Torrance, E.P. Torrance Test of Creative Thinking. Technical Manual. Princeton: Personnel Press, 1966.

Vernon, P.E. Research on Personnel selection in the Royal Navy and the British Army. American Psychologist, 1947, 2, 35-51.

Vernon, P.E. The Structure of Human Abilities. London: Methuen, 1950.

Vernon, P.E. Creativity and intelligence. Educational Research, 1964, 6, 163-169.

Vernon, P.E. Effects of administration and scoring on divergent thinking tests. British Journal of Educational Psychology, 1971, 41, 245-257.

Vernon, P.E. The validity of divergent thinking tests. Alberta Journal of Educational Research, 1972, 18, 249-258.

Vernon, P. E. Multivariate approaches to the study of cognitive styles. In Royce J.R., Multivariate Analysis and Psychological Theory. London: Academic Press, 1973.

Wallach, M.A. & Kogan, N. Modes of Thinking in Young Children. New York: Holt-Rinehart & Winston, 1965.

Whitelaw, J.A. The C.E.G.E.P. revolt and after. Canadian Universities, 1968, 111, 30.

Zim, H. Early Science Interests and Activities of Adolescents. New York: Ethical Culture Schools, 1940.

Zim, H. The scientist in the making: Some data and implications from the Junior Scientists' Assembly. Science Education, 1949, 33, 344-351.