ACADEMIC
APTITUDE
PROFILE

RATIONALE

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

May 1992
Contents

1  Skills in Education
   1.1  "Higher Order Thinking Skills" in Education
   1.2  A Broader View of Skills and Competencies in Education and Training
   1.3  Transferable Skills and Transfer Skills

2  Higher Order Thinking Skills
   2.1  Background
   2.2  The Search for Skills
   2.3  Kinds of Thinking
   2.5  Critico-Creative Thinking
   2.6  Critico-Inferential Thinking
   2.7  Formal Reasoning

3  Validity Issues
   3.1  Intrinsic Validity
   3.2  Use and Interpretation of Higher Order Thinking Skills
   3.3  Avoiding Bias
   3.4  Promoting the Acquisition of Skills

References

Appendix: Membership of the Steering Groups
1 SKILLS IN EDUCATION

1.1 "Higher Order Thinking Skill" in Education

"Skills" have traditionally been viewed as specific skills which are often narrowly-defined and context-specific. They are associated with job-specific training - skills such as entering numbers in account records, regulating an oven in a bakery, or testing the moisture content of sand in a foundry - or with everyday activities, often learned early in life - skills such as pumping up a bicycle tyre or telling the time. They are often considered to be relatively trivial since they are typically automatized after a greater or lesser degree of practice, and since they carry a relatively low cognitive content.

Insofar as skills have been regarded as educational, they have been identified with "vocational education" rather than with the traditional notion of a "liberal education". Hirst (1974), for example, in his reformulation of the definition of a liberal education, identifies seven "forms of knowledge" (mathematics, physical sciences, human sciences, history, religion, literature and the fine arts, and philosophy), "none of which is ultimately reducible in character to any of the others, either simply or in combination". Liberal education, in Hirst's view, depends on coming to understand each of these forms of knowledge.

The challenge to this view of a liberal education often comes from those who identify educational outcomes not only with the possession of knowledge and understanding, but also with the skills which enable individuals to generalize that knowledge and understanding which they acquire, and thereby to interact with a complex social, economic, and political environment: in the words of Bridges (1991), to help individuals "(i) to understand the choices they have, (ii) to make choices, and (iii) to pursue their chosen paths in the social world."

To understand choices means that persons must have the mental equipment which enables them to get into those various fields of study or practice which might be open to them. It means that they must have skills which are "transferable" in the sense that each of these skills may be used in relation to a wide range of fields of knowledge. Whether such skills do exist, or whether all skills are unique to the subject content on which they operate is a matter of dispute among
educational philosophers. McPeck (1981), for example, takes the latter view, but others, for example Bridges (1991), take the view that skills are important in educational planning and that these skills include what are often referred to as "higher order thinking skills".

An important foundation of the Academic Aptitude Profile is the conviction that such skills exist and that they can be cultivated. It would of course be absurd to suggest that they can be learned without reference to some subject matter, just as it would be absurd to suggest that one could come to understand a subject without at the same time developing some thinking ability or skill. Higher Order Thinking Skills develop in those who learn to think critically and rationally, and who learn to care for truth. These are dispositional as well as cognitive qualities, and they may develop in individuals in the course of formal education or, for example, in the course of keeping critical company. The design of the Academic Aptitude Profile makes no initial assumptions about any individual's qualities in these respects. It is rather designed to assist in the development of these qualities in all students and trainees, whatever their entering qualifications and attributes.

These skills are as important in professional training and practice as in academic learning. We may note for example the words of the (1988) Royal Commission on Medical Education; "We cannot emphasize too strongly that the undergraduate course in medicine should be primarily educational. Its object is not to produce a fully qualified doctor, but an educated man who will become fully qualified by postgraduate training. This does not mean that we think the vocational aspect of undergraduate medical education should be ignored; the student clearly has a professional career in view and his education must be biassed in that direction. Our view in this respect corresponds with that expressed by the Robbins Committee when discussing higher education in general."

1.2 A Broader View of Skills and Competencies in Education and Training

Since many of those who aspire to higher education and vocational training may not possess those higher-order skills, it is important that the Academic Aptitude Profile identifies certain more "basic" skills or "core" skills, which may be used as a foundation for personal development, that these skills are distinguished psychologically from the academic and professional skills, and that guidance is provided on how individuals might be encouraged and helped towards the acquisition of the higher skills.
There is therefore a need to take a broader view than that taken in the previous section as to the skills and competencies which are important in education and training. Such a view is provided by the National Curriculum Council/National Council for Vocational Qualifications initiative with respect to "Core Skills".

This initiative has taken place mainly in the context of 16 - 19 education, and the development may be stated in outline as follows (taken from Oates, 1991).

In February 1989, the Secretary of State for Education outlined the merits of incorporating core skills across the curriculum. He saw these skills as critical to the central purpose of education and training: "There can be no single 16 - 19 curriculum. But I think we do know broadly what we are trying to achieve. We want to equip young people with the knowledge and skills so that they have greater chances. In the changing employment world they will need broadly based qualifications .... As I see it, there are a number of skills - and I am still using the word in its broad sense - which young people and adults in future will all need. They could be expressed as a list of core skills ...."

Additional reports by the Confederation of British Industry, the Trades Union Congress, and Her Majesty's Inspectorate, all endorsed the adoption of core skills as an essential component of post-16 provision.

At the end of March 1990 the NCC reported to the Secretary of State on those Core Skills which could be defined and incorporated into the study programmes of 16 - 19 year-olds, taking A/AS courses. The Council proposed that detailed specifications be developed for the following core skills:

- communication
- problem-solving
- personal skills

- numeracy
- information technology
- competence in a modern language

In April 1990 NCVQ published "Common Learning Outcomes: Core Skills in A/AS levels and NCVQs". This report endorsed the list of core skills published by NCC.
In a foreword to Oates's survey of "core skills" development, Gilbert Jessop of NCVQ stresses the widespread national support for the core skills initiative; their applicability to a wide range of education and training provision; the enhanced specifications of the learning outcomes represented by the Core Skills, which can be translated into structured learning and assessment programmes; and the definition of progressive levels of attainment.

This initiative is clearly relevant, to a greater or lesser degree, to individual bodies providing academic and professional education and training, and those who have designed the AAP have identified Communication and Numeracy as essential "core skills" out of which the Higher Order Thinking Skills may develop.

1.3 Transferable Skills and Transfer Skills

The distinction between the two classes of skills may be conceptualized in terms of "transferable skills" and "transfer skills". Bridges (1991) makes a distinction of this kind. Transferable skills are skills or commonly used routines which might be exercised in a number of situations and require little modification. Transfer skills are the processes used in modifying a skill so that it may be used in other situations. The core skills may be termed transferable skills, whilst the higher order thinking skills include transfer skills. Transfer skills, or executive skills, govern the selection and organisation processes involved in using transferable skills. Within this sort of framework, transfer skills are superordinate to transferable skills.

Sternberg (1985) makes a theoretical distinction between those two levels of processes. The distinction is important because evidence suggests that if the wrong strategic decisions are made, then it matters little which tactical decisions are made. There are therefore good theoretical grounds for suggesting that, although the transferable skills are crucial, we should also aim to teach transfer skills so that students gain the strategies and procedures which will enable them to use their knowledge appropriately.
2 HIGHER ORDER THINKING SKILLS

2.1 Background

The University of Cambridge Local Examinations Syndicate is one of the world's leading assessment agencies. It is dedicated to the provision of a wide range of educational and assessment services which are relevant, efficient, cost-effective, and of consistently high quality. A traditional role of the Syndicate has been that of mediator between institutions of higher education and professional training on the one hand, and those seeking access to them on the other. This service has for a long time been provided through the conduct of "A Level GCE" and equivalent high school leaving examinations.

Over the past ten years or so, however, this service was increasingly regarded as insufficiently comprehensive, and for two main reasons. First, there was the rapid growth in the numbers of those who aspired to post-compulsory education and professional training, and among those were many who did not possess "traditional" qualifications such as Advanced Levels. Secondly, there was a widely-held view that, although A Levels and other pre-entry courses of study did develop the kinds of skills required, they did so differentially with respect to the courses which students took. For these reasons, the Syndicate embarked on a research and development policy, initially focussed on the provision of tests of academic aptitude.

It is not necessary to dwell at great length on the history of academic aptitude test development in the U.K. It is, however, important that the design of such instruments should be described briefly and that the salient facts with respect to the U.K. experience should be noted.

The design of academic aptitude tests is based on the objective of devising an instrument which yields scores which correlate highly with subsequent academic success. Typically, such tests are more and more highly tuned - by changing the test content on a trial and error basis - to increase the size of such correlations. Face validity - the extent to which the content bears a resemblance to the kinds of tasks to be performed in the academic programme - is considered, but the main thrust of development is towards improving the correlation, that is "predictive validity".
In 1965, directly as a result of the Robbins Committee recommendation, the Committee of Vice-Chancellors and Principals (CVCP) initiated a study called "Investigation into Supplementary Predictive Information for University Admissions" (ISPIUA). Its objective was to improve the process of selecting students for university admission, by finding predictors which could supplement the information provided by A Level results, O Level results and headteachers' reports, and improve the prediction of subsequent academic performance among eighteen-year-olds. As part of this exercise, the National Foundation for Educational Research (NFER) was asked, early in 1970, to study the predictive validity of an experimental aptitude test, called the "Test of Academic Aptitude" (TAA) which was being administered to some 100 000 students in the course of the ISPIUA project. NFER published the results of its study in "Aptitude Testing at Eighteen-Plus" (NFER, 1976).

The TAA experiment was inconclusive in its outcome. In short, NFER found that the TAA was a poor predictor and added very little to the value of A Levels as selection instruments. However NFER also argued that this was probably due to the fact that those taking part in the study were already highly "screened". Nearly all of them had already passed the 11+; done well at GCE O Level; and finally done well enough at A level to get a place at university. The result was that the TAA was being tested on a very highly selected population, quite unlike the population of those who complete high school and go on to higher education in the USA, or who now aspire to higher education in Britain.

The idea of academic aptitude tests was revived in 1987 when the Syndicate, in collaboration with Law School Admission Services of the United States, administered the first of an annual series of Law Studies Tests, intended to measure the aptitude of prospective law students and also of sixth formers who wished to know whether they had the kinds of ability demanded by law schools. The predictive validity of the Law Studies Test (Rule/University of Cambridge Local Examinations Syndicate, 1989) also proved to be disappointing. Part of the problem was thought to be the difficulty of assessing the reliability of first-year university examinations.

In retrospect, it may seem that these projects were attempts to tackle a problem from the wrong end. They were driven by the need to prove their validity primarily in a quantitative rather than a qualitative way, that is by the need to consider correlation before content. If an instrument were to serve the wider range of functions now envisaged for the Academic Aptitude Profile, there...
would need to be more detailed and sensitive information, not just numbers which would indicate how one particular kind of decision might be taken.

The purpose and validity of the assessment of Higher Order Thinking Skills is now conceptualized in terms of "intrinsic validity", that is the extent to which the assessment does assess what it sets out to assess, and its "usefulness", that is the ways in which it may be found useful for a wide variety of applications.

2.2 The Search for Skills

Although much of the Syndicate's earlier research and development was conducted within the framework of psychometric aptitude test development, it provided an invaluable survey of existing notions of "higher-order" skills, and a basis upon which the search for skills could be conducted critically in the light of the many comments received from those who were interested in the development, and who thought they might find a skills-assessment instrument of some use.

Much of this work was carried out on behalf of the Syndicate by Alec Fisher, of the University of East Anglia. His report proposed a general test of academic aptitude, "The Higher Studies Test", and its findings are summarized in Fisher (1989a, 1989b). In these consultative reports Fisher reviewed five tests which might suggest approaches to the assessment of "Critical Thinking" and six which might suggest approaches to the assessment of "Mathematical Reasoning".

Early in 1990, and following initial consultations with potential users, it became clear that the main focus of further development should be the identification and definition of skills, concentrating on the two areas of "Critical Thinking" and "Mathematical Reasoning". This work would be conducted within a wider understanding of the instrument's purpose: guidance and diagnosis were to be at least as important as selection.

Eight institutions of higher education agreed to work in partnership with the Syndicate and four steering groups were set up - one for each of "Logical Reasoning" and "Communicative Skills" (encompassing Critical Thinking), one for "Mathematical Reasoning"; and - in response to a widely-perceived need - one to consider how the profile could be developed in such a way that particular groups - defined by gender, race, or ethnic background, age, and social class - would not be disadvantaged by the nature of the assessment and the way in which it would be administered. The work of the steering groups in shaping the content
specifications of the assessment is gratefully acknowledged. The membership of these steering groups is presented as an appendix.

The eventual outcome is the present proposal for the assessment of three academic and professional skills: "Critico-Inferential Thinking", "Critico-Creative Thinking", and "Formal Reasoning".

2.3 Kinds of Thinking

There are two broad distinctions which inform the decision to assess these three Higher Order Thinking Skills. The first is the distinction between Critical Thinking, using language in the ordinary everyday sense of the term as its vehicle, and Formal Reasoning which, although couched in language, uses and depends upon more overtly demonstrable rules and concepts, which are often better defined and less "fuzzy" than those used in "Critical Thinking". Another way of stating this first distinction is to say that Critical Thinking uses informal logic whereas Formal Reasoning uses a formal logic in which conclusions are valid primarily by virtue of their form, not their content.

The second distinction is that between hypothesizing, and creative thought, on the one hand, and on the other thought which is characterized primarily by its use of inference for which the conclusions may be justified in accordance with a system of informal or formal logic.

These distinctions are not clear-cut since underpinning all Higher Order Thinking Skills is the ordinary understanding of text or discourse which is characterized by the use of single "mental models" (Johnson-Laird, 1983).

The mental model approach to reasoning depends more upon the semantic content and context of the premises than it does upon the syntactical relations between them. The single model approach to the understanding of a text or discourse involves the construction in the mind of a mental model of the states of affairs described in the premises, relying on an individual's general knowledge and also his or her knowledge of the context. If the individual can read a conclusion off the single model, than it is drawn. If no conclusion can be read off the single model, then it is not drawn.
The single-model method of inference, although it unites not only imaginative thought and logical thought (the second distinction), but also critical thinking and formal thinking (the first distinction), is not the main focus of the skills assessed by the Profile. Academic and professional work demands thinking which goes further than the reference to immediate context and the single-model inference which characterizes everyday discourse. Specifically, it demands (a) the ability to imagine or hypothesize in producing inductive or creative arguments, that is to go beyond the immediate imaging of the given, (b) the ability to argue and justify one's conclusions, and (c), the ability to use not only everyday language, but also language which makes use of defined rules and concepts. These demands are assessed respectively by the Critico-Creative section of the Profile, in which the emphasis is on ordinary language and imaginative thought, by the Critico-Inferential section of the Profile, in which the emphasis is on ordinary language and inference which may be justified to an external audience; and by Formal Reasoning, in which the emphasis is on defined rules and concepts and in which both imaginative thinking and inferential thinking are important.

The thinking represented by the Higher Order Thinking Skills is more likely to embody a multiple-model approach than a single-model approach. The multiple-model approach demands that alternative scenarios are constructed, compared for their respective validities, and the best conclusion chosen.

The Academic Aptitude Profile is presented on the assumption that all three skills are important in every area of academic study and in every area of professional practice. The Profile also assumes that whatever use is made of it, the distinctions between the three skills are important.

2.4 Critical Thinking

The two elements of Critical Thinking identified - Critico-Creative thinking and Critico-Inferential thinking - share the common ground of text or discourse comprehension. They also share the salient feature of will associated with critical thinking, described by Passmore (1967) as "a passion for truth"; and both skills of Critical Thinking are often found together. Each does, however, have particular features.
On the Critico-Inferential side the particular features of thought are typically those of reaching conclusions through the analysis of given beliefs or facts, and of thinking in accordance with implicit or explicit rules. On the Critico-Creative side, the particular features are those of assessing the value of the facts or beliefs with which one is presented, and of producing inductive or creative hypotheses or explanations.

Blair (1988): "There is general agreement about some of the elements of critical thinking. The term seems to name a complex virtue. As an intellectual virtue it includes skills and understanding including but not restricted to: an ability to formulate and assess arguments, sensitivity to language, a sense of the importance of context, and an ability to apply and also critically reflect on the appropriate criteria for judgement. As a virtue of character it includes the habit of critical reflection about one's own and others' problematic assumptions and the valuing of reasoned support for beliefs and actions."

Of the elements mentioned by Blair, Critico-Inferential thinking lays stress on the assessment of arguments, and the disposition to value reasoned support for beliefs and actions, while Critico-Creative thinking lays stress on the formulation of arguments, and the disposition to reflect on one's own and others' assumptions.

It will be evident that Critico-Inferential thinking leans towards the ability to receive and analyse texts, and is therefore suited to objective assessment, while Critico-Creative thinking demands the production of evidence and ideas, and is therefore suited to a more subjective assessment by means of written answers.

2.5 Critico-Creative Thinking

Critico-Creative thinking, the term suggested by Passmore (1967), is required in all areas of academic and professional life. The historian seeks explanations for historical facts by drawing on the often vast body of evidence available, the biologist likewise seeks explanations of natural phenomena, and the doctor searches for those clinical data which are relevant and adequate before making a diagnosis. In all cases, it is necessary to hypothesize insightfully and creatively by understanding the nature of the problem or solution presented, by actively searching for relevant ideas, and by imagining how things might be if they were structured differently. In assessing an individual's Critico-Creative
thinking, we are typically concerned with criteria of fullness, relevance, bias, clarity and coherence. Of the two sides to Critical Thinking, it is the Critico-Creative side which is particularly tied up with the specialized knowledge and understanding inherent in a discipline or in the practice of a profession. McPeck (1981) for example, argues that "logic ...... plays a comparatively minor role [in critical thinking], particularly when compared with knowledge of, and expertise in, a specialized field."

Partly for this reason, Critico-Creative thinking will not be easily assessed in the context of the Academic Aptitude Profile but it seems crucial that it should be assessed.

It is the intention that, in the Academic Aptitude Profile, Critico-Creative thinking should be assessed as an individual's constructive reaction to a novel situation, probably within the context of a social or current affairs topic. Candidates would be asked to provide possible explanations for the situations presented, criticize the adequacy and relevance of the information given, and suggest possible courses of action or a stance which might be taken on the issue.

2.6 Critico-Inferential Thinking

The 'initial model for this section of the Academic Aptitude Profile was the Logical Reasoning section of the North American Law Schools Admission Test. Unlike the Critico-Creative skill, the Critico-Inferential does not demand an imaginative view of how a situation might look if things were otherwise. Critico-Inferential thinking is however equally important in critical thinking. It represents the search for conclusions which are valid on the basis of the evidence.

The intention is that the items should assess the kinds of reasoning skills which are used in the analysis and criticism of real everyday arguments (ie., arguments which are or have been actually used by authors with a view to persuading their readers). The items are expressed in natural language and do not use symbolic languages (or symbolic logic). Stimulus passages either contain some reasoning or they contain sufficient information to serve as a basis for argument. The subject matter of logical reasoning items ranges very widely and may include anything from cigarette smoking to car maintenance, or from natural science to law. Typical sources for stimulus material include letters to the editor, newspaper and magazine articles and non-technical articles and books.
2.7 Formal Reasoning

Formal Reasoning presents particular difficulties for the Academic Aptitude Profile since the differences in rule knowledge, possessed by the intended population, are very great. The assessment of Formal Reasoning concentrates on reasoning in terms of number, space, and data presentations, and there are two main ways in which the Record attempts to meet the problem of differential knowledge.

In the first place, the Formal Reasoning component makes as few assumptions as possible about students' previous mathematical experiences. The research into the British Test of Academic Aptitude (NFER, 1976) showed that scores on that test's "mathematical reasoning" section tended to polarise by students' Arts and Science specialisms. The Formal Reasoning assessment aims to lessen the effects of different mathematical backgrounds by demanding only the most basic mathematical knowledge.

In the second place, the Academic Aptitude Profile aims to assess "productive" or "search-driven" thinking rather than simply "reproductive" or "schema-driven" thinking. In this way, those with the ability to visualize the rearrangement of data and with the ability to deal with situations imaginatively will have an advantage, whatever their mathematical background, over those who are tied to the use of rules in familiar situations. The underlying belief is that productive thinking is more indicative of transferable and general abilities while rule-dominated (reproductive thinking) is more indicative of specific skills or competence. The theoretical model adopted for the construction of the Formal Reasoning assessment is that of the componential subtheory of Sternberg's triarchic theory of intelligence.

It is of course impossible, in any field, to respond productively, or with resourcefulness, to a problem or situation, without having some knowledge of that field. The basis of the present development is the conviction that every mature human being, or almost every mature human being, possesses some inferential ability in the area of formal thinking and mathematics, broadly defined, and in particular some ability to solve problems, identify trends, etc, through insight and "common sense". But, even so, there is the problem of defining just what is contained in this core of knowledge which may be assumed. This is currently the subject of an investigation with a representative section of the target population.
There is also the problem that however basic the core knowledge demanded, there will be a suspicion that some individuals may not possess it. The Numeracy component of the Academic Aptitude Profile is therefore conceived as an oral assessment (lasting about ten minutes) which is intended to identify those whose knowledge is inadequate for an assessment of Formal Reasoning to be valid.
3 VALIDITY ISSUES

3.1 Intrinsic Validity

To be useful for any purpose, there is a prior requirement that the assessment of Higher Order Thinking Skills should possess "intrinsic validity". Intrinsic validity is possessed by an instrument which (i) sets out to assess a well-defined body of skills (or knowledge content), and (ii) demonstrably does so in a reliable fashion as shown by a range of empirical evidence and research findings.

The definitions of the three skills being assessed are provided, at some length, in the descriptions of the three Higher Order Thinking Skills which are presented separately. The demonstration that the instrument assesses what it is meant to assess may be considered under the headings of face validity, content validity, and construct validity.

Face validity means that the assessment materials "look right" to candidates and users (the materials and questions will look as though they are assessing skills which are important in academic and professional work). Also, in a more rigorous way, experts, for example mathematicians or logicians, should judge that the materials are assessing what they are supposed to assess. Also, there should be a clear view among professionals and higher education teachers as to why the skills measured are important to success. Face validity has so far been established for those who have steered the development of the Higher Order Thinking Skills assessment to its present position, that is the four steering groups whose membership is provided in the appendix.

The content validity of the Higher Order Thinking Skills is being assessed by means of a psychological investigation of the mental processes which individuals (representatives of the target population) exercise in responding to the various materials and questions. At present this involves asking individuals to "think aloud" as they go through the materials, transcribing such verbal protocols, and evaluating the results. For example, in Formal Reasoning, the question arises, in relation to the problems to be solved, as to whether a significant number of candidates might succeed in making a correct response, but using methods not intended by the assessment design. The aim behind this research is the identification of the kinds of materials which are open to valid interpretation in unintended ways, to feed this information into the materials production process, and in this way to purify the skills assessments to the extent that content validity clearly exists.
Finally, construct validity will be established by means of a range of mainly statistical techniques which seek to establish that each skill represents a reasonably coherent and distinctive psychological construct, which is both important to academic and professional success and is teachable.

3.2 Use and Interpretation of Higher Order Thinking Skills

The Higher Order Thinking skills do not claim to assess intelligence. The view of intelligence held by the developers of the Profile may be most closely represented by Sternberg's (1985) "Triarchic Theory". The skills assessed are represented by one of Sternberg's three subtheories - the componential subtheory. This subtheory "specifies the structures and mechanisms that underlie intelligent behaviour." There are three components described within the componential subtheory: metacomponents, performance components, and knowledge-acquisition components. "Metacomponents control one's information processing and enable one to monitor and later evaluate it; performance components execute the plans constructed by the metacomponents; knowledge-acquisition components selectively encode and combine new information and selectively compare new information and old information, so as to allow learning of new information to take place." This subtheory is therefore concerned with cognitive processes.

The other two subtheories - the contextual and the experiential - qualify the extent to which assessment in accordance with the componential subtheory may be regarded as indicative of intelligence. The experiential subtheory states that the "extent to which [a test] requires intelligence depends upon the point in an individual's experiential continuum at which the test is encountered." In other words, the more relevant experience an individual possesses, the less likely that a successful or appropriate response is indicative of intelligent behaviour. Sternberg states that "one's intelligence is best demonstrated when one is (a) confronted with a relatively (but not totally) novel task or situation or is (b) in the process of automatizing performance on a given task or in a given situation."

The contextual subtheory provides a further qualification embracing, in a sense, the other two subtheories. It "specifies how intelligent behaviour is defined in large part by the sociocultural context in which this behaviour takes place." While "the normal course of intelligent functioning in the everyday world entails adaptation to the environment, when the environment does not fit one's
values, aptitudes or interests, one may attempt to shape the environment so as to achieve a better person-environment fit; when shaping fails, an attempt may be made to select a new environment that provides a better fit. Alternatively, one may attempt to shape the old environment when selection fails." Since what is understood to be involved in adaptation, selection, and shaping is to some extent determined by an individual's sociocultural milieu, the concept of intelligent behaviour necessarily varies across different social and cultural environments.

Implicit in the the agendas of all four steering groups (Communicative Skills, Logical Reasoning, Mathematical Reasoning, and Bias) has been an attempt to minimise the extent to which the contextual and experiential subtheories operate differentially in the assessment of the skills. At the same time, however, there has been the need to maintain content validity, that is a close resemblance between the content presented in the assessment materials and the experiences which are possessed by, or are imaginable by, the majority of the individuals who would be assessed. To some degree, the two aims conflict, particularly since content validity has been understood to encompass a factor of interest: material which is uninteresting to the target population has been classed as invalid.

To the extent that the steering groups have been successful in reconciling the two aims, the assessment of Higher Order Thinking Skills may be taken to be indicative of intelligence. To the extent that reconciliation between the two aims has been impossible, an applicant's intelligence may be assessed only by reference to that individual's experience and sociocultural background. It is for this reason that an individual's performance will need to be interpreted sensitively. Guidelines for interpretation are essential, and it is suggested that users of the Profile should sign a declaration committing them to these guidelines.

3.3 Avoiding Bias

As noted in the document "Academic Aptitude Profile: Proposed Scheme", there are four possible kinds of bias:

i) bias in use of the results
   ii) perceived bias in the assessment process
   iii) perceived bias in the assessment materials
   iv) statistical bias in item difficulty
The avoidance of the first two of these possible kinds of bias depends mainly on procedures within participating organizations, and guidelines for administrators will be provided (see section 5.2 of "Academic Aptitude Profile: Proposed Scheme").

With respect to the third kind of bias, applicants may feel that an assessment is unfairly biased against them if the content, subject matter, scenarios, personal or geographical names, or other incidental features of the assessment materials appear to be typically associated with groups to which they do not belong. Guidelines have been given to material producers to help them avoid many sex, race or class stereotypes, and to use neutral terms and names where possible. The British Sociological Association's Anti-racist language: Guidance for Good Practice may also be adopted. It is, however, neither possible nor desirable wholly to avoid contexts associated more with one subgroup than with another, and a bias screening committee is being asked to vet assessment materials, flagging those that might be perceived as biased. The assessment process can then ensure that any assessment paper contains a balance of flagged questions; computer adaptive programs will be so written as to ensure that each candidate receives a similarly balanced set of questions. So far, only a very small proportion of items have been judged to need flagging.

With respect to statistical bias, all objective items so far trialled are being assessed for evidence of such bias. In general, items that prove to be more difficult for one subgroup than another will be discarded. Satisfactory vetting of this kind, however, needs adequate numbers in each subgroup of interest, and trialling procedures will attempt to achieve this. Where the statistical results are inconclusive, care will be taken that any assessment is balanced as for the third kind of bias. The monitoring process will continue, with periodic reassessment of the different subgroup performances. This requires that all applicants complete a background questionnaire, on paper or computer. So far, there is little evidence of sex bias, but numbers have not been large enough for clear conclusions on other groupings.

3.4 Promoting the Acquisition of Skills

The "teachability" of the skills is an important aspect of the Academic Aptitude Profile validity. Those responsible for formulating the Higher Order Thinking Skills have drawn on a number of works which are either skills teaching
programmes in themselves or provide useful advice to those teaching and learning skills. These works include, on the Critical Thinking side, Fisher (1988) and Govier (1988); and on the Formal Reasoning side, Polya (1945) and the work of the Cognitive Acceleration through Science Education project (for example, Shayer, 1991).
REFERENCES


Bridges, D (1991) "Transferable Skills: A Philosophical Perspective", University of East Anglia


Fisher, A (1989a) "Proposal to Develop a Higher Studies Test", University of Cambridge Local Examinations Syndicate

Fisher, A (1989b) "Research into a Higher Studies Test", University of Cambridge Local Examinations Syndicate


National Curriculum Council (1990) "Core Skills 16 - 19 A Response to the Secretary of State"


Oates, T (1991) "Developing and Piloting the NCVQ Core Skill Units", NCVQ


Polya, G (1945) "How to Solve It", Princeton University Press, Princeton

Rule, E (1989) "The Law Studies Test: Results of a Trial Administration", University of Cambridge Local Examinations Syndicate


UCLES (1991) "Examination Syllabuses for 1993"
APPENDIX: MEMBERSHIP OF THE STEERING GROUPS

Members of the Logical Reasoning Steering Group

Mr Alec Fisher
Dr Ian Forbes
Dr Daryll Grantley
Mr Paul Periton
Ms Jennie Somerville
Dr Sue Thompson
Dr Anne Thomson

University of East Anglia
University of Southampton
University of Kent
Nottingham Polytechnic
Polytechnic of North London
UCLES
University of East Anglia

Members of the Mathematical Reasoning Steering Group

Mr Jeffrey Goodwin
Mr John Hamilton
Dr John Marriott
Dr Bryan Orman
Mr David Phillips
Ms Beatrice Shire
Dr Johannes Siemons

Anglia Polytechnic
UCLES
Nottingham Polytechnic
University of Southampton
Polytechnic of North London
University of Kent
University of East Anglia

Members of the Communicative Skills Steering Group

Mr Ian Bryant
Mrs Elaine Derbyshire
Dr John Foulkes
Ms Clare Goymer
Mr Keith Guest
Mr David Nightingale
Dr Sue O'Brien

University of Southampton
Nottingham Polytechnic
UCLES
Polytechnic of North London
Luton College of Higher Education
University of Kent
Anglia Polytechnic
Members of the Bias Steering Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Mary Abbott</td>
<td>Anglia Polytechnic</td>
</tr>
<tr>
<td>Ms Clara Connolly</td>
<td>Commission for Racial Equality</td>
</tr>
<tr>
<td>Dr Ian Forbes</td>
<td>University of Southampton</td>
</tr>
<tr>
<td>Dr Daryll Grantley</td>
<td>University of Kent</td>
</tr>
<tr>
<td>Dr Alastair Pollitt</td>
<td>UCLES</td>
</tr>
<tr>
<td>Ms Theresa Smart</td>
<td>Polytechnic of North London</td>
</tr>
<tr>
<td>Dr Sue Thompson</td>
<td>UCLES</td>
</tr>
<tr>
<td>Dr Anne Thomson</td>
<td>University of East Anglia</td>
</tr>
</tbody>
</table>