



Research in Science & Technological Education

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/crst20>

Gender Differences in Higher Education Aims between Computing and Psychology Students

John Radford^a & Leonard Holdstock^a

^a University of East London, Department of Psychology

Published online: 07 Jul 2006.

To cite this article: John Radford & Leonard Holdstock (1995) Gender Differences in Higher Education Aims between Computing and Psychology Students, *Research in Science & Technological Education*, 13:2, 163-176, DOI: [10.1080/0263514950130206](https://doi.org/10.1080/0263514950130206)

To link to this article: <http://dx.doi.org/10.1080/0263514950130206>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Gender Differences in Higher Education Aims between Computing and Psychology Students

JOHN RADFORD & LEONARD HOLDSTOCK, *University of East London, Department of Psychology*

ABSTRACT *Academic fields are still highly gender segregated. Two fields, male dominated computer studies and female dominated psychology have received much attention. Both fields have changed radically in content and method over the last three to four decades. None of the attempts to explain gender segregation in terms of differences in cognitive abilities have been adequate and attention seems to be turning to interests and personality factors; what people want to do as distinct from what they can do. By means of a questionnaire, the present study looked at first year students in computer studies and in psychology in four universities, one Irish, one Scottish, and two English. Are students in the minority gender in each of these fields behaviourally more like the majority gender than the mean for the minority gender in the student population, and if so, in what respects? The results are interpreted to show that they are and tend to confirm that a distinction needs to be made between two factors here identified as (1) personal development and social relationships and (2) cognitive skills, which correspond respectively to 'people-oriented' and 'thing-oriented'.*

Gender Segregation

Introduction

Gender segregation, the dominance of males in some academic and occupational fields (or subjects) e.g. engineering, and the dominance of females in other fields, e.g. languages, applies throughout the academic world, at A level examinations, on degree courses and among university teachers, and occurs in many countries in addition to the UK, notably in Western Europe and the USA (e.g. Ransom, 1990). The term 'dominance' applies not only to the numbers of people, but also to the tendency of one sex to alienate the other, as females are alienated from engineering and males from nursing. The 'appropriate roles' are learned young, and are well formed by the time the first choices about career or field of interest are made (Weinreich-Haste, 1981; Archer, 1992; Edmunds, 1992). Different academic fields are often so different from one another that there is little academic communication between them (Kolb, 1981). Part of this difficulty may be gender linkage. Computer studies and psychology make a particularly interesting pair to study in gender segregation; Durnell (1991) thought they were a mirror image of each other.

Computer Studies

Computer studies (or computer science) has become one of the most male dominated areas in higher education, of much the same order as physics or engineering (Durndell, 1991), i.e. 80–90% or more male depending on the speciality. Computer science has, of course, grown from nothing over half a century out of electronic and control engineering into a large and clearly separate field to include many branches of information technology, and thereby has perhaps inherited the traditions as well as the male personnel of engineering. Nevertheless, why the computer science field is so male dominated remains a mystery, despite many attempts at explanation. Its links to physics, electronics and artificial intelligence have been largely severed, especially over the last decade, with the widespread use of personal and other computers, and the rapid growth of simple-to-use software such as the Microsoft product 'Windows' giving access to a wide spectrum of practical commercial, scientific and entertainment packages. When compared to the need in the 1960s to understand and be able to use machine code, in general terms computer studies can be seen to have become much less mathematical. It may no longer be appropriate to classify computer studies under mathematical studies as the Universities' Statistical Record (the Government body for keeping university statistics in the UK) did in 1992.

Psychology

The increase in segregation in psychology from about equal numbers of male and female new graduates in 1965–66 to about 75% female in 1992 (Radford & Holdstock, 1995) has led to much discussion about causes, consequences and possible actions by educationists and other interested parties (e.g. Durndell, 1991; Edmunds, 1992). The nature and content of the subject as taught in universities have themselves changed radically over the past 30–40 years, to some extent responding to changed gender demand. In a study of first year psychology undergraduates in the UK and other Western European countries, Radford & Holdstock (1993) found that with the growth in female dominance, generalising broadly, it was the more 'human' end of psychology that university students favoured—clinical, social, developmental, etc., while the more 'scientific' end of experimental design, statistics, computing and theoretical issues, was rated low; and could find little difference in male and female preferences. The 'human' end is also much more frequently offered at A level. On the other hand Morris *et al.* (1992) found that males and females had somewhat different interests within psychology: males were more interested in cognitive psychology, females more in developmental psychology.

Abilities or Interests?

Meta-analyses, the systematic aggregation of findings from different studies in relation to a general question or topic, tend to show at most small differences between males and females in cognitive abilities so far as arithmetic means of distributions are concerned (Halpern, 1992), often with uncertainty as to the direction of the difference. If the differences are expressed in terms of both means and variances (Feingold, 1992), then populations of males and females, whether at university or elsewhere, will consist of statistical distributions with much overlap; the order of overlap may be 80% or more. So far as cognitive abilities are concerned, by simple arithmetic alone most occupations and university studies are just as suitable to males or females, given proper individual

selection and training, especially now with so large a proportion of young people going to university. A gender-based study of differences in cognitive abilities is a study of minorities. Apart from the study of highly talented pupils or students (e.g. Benbow, 1988) or very exceptional publicly known individuals (Radford, 1990), this means that we have to look somewhere other than cognitive abilities for an explanation of gender segregation, particularly when the widespread nature and persistence of gender segregation is recognised. In explaining the segregation of fields in higher education, there is a discernible tendency to shift from differences in cognitive abilities to differences in personal values or interests or motivation (e.g. Halpern, 1992; Lightbody & Durnell, 1993). Gender differences in personality factors (and a few academic field differences) are already well documented (e.g. Wilson & Jackson, 1994).

Previous Work on the Educational Aims of Male and Female Degree Students

There is a very extensive literature on the general purposes of universities (e.g. Allen, 1988; Barnett, 1990), but there appears to be relatively little recent work, at least in the UK, on what it is that beginning students actually want from their higher education, particularly with regard to possible gender differences. A large-scale investigation of student attitudes (Boys, 1984), part of a wider study of expectations of higher education carried out at Brunel University, gives a breakdown by gender for only one possible reason for being in higher education, namely 'interest in main subject area'. This was somewhat more likely to be chosen by women rather than by men. But it has been shown several times (e.g. Radford, 1991; Morris *et al.*, 1992) that 'interest' is by far the most favoured reason, and actually conceals many quite different aspects of motivation. Boys & Kirkland (1988a), who followed up their sample 3 years after graduation, give no gender differentiation, nor do the same authors in reporting a survey of over 3000 final year undergraduates (Boys & Kirkland, 1988b). The same is true of a study of final year students by Boys *et al.* (1988), and one of the views of their education by graduates at work, by Brennan & McGeevor (1988). Roberts *et al.* (1991), in another large-scale survey, this time of second year students, reported on gender differences, but were not mainly concerned with reasons for entering higher education, although they did report that males were somewhat more concerned with academic values than were females.

Purpose of Present Study

The purpose of the present study is to examine what relationship there is between student aims and gender segregation for computing or computer studies and psychology; in particular (a) the relative importance of personality and social variables compared to cognitive abilities, and (b) how 'masculine' and in what respects are females who read for a computing degree, and how 'feminine' and in what respects are the males who read for a psychology degree?

Method

Responses were obtained by use of a questionnaire entitled 'The Aims of Higher Education: student views' from students of psychology and computer studies or computer science, mostly in the first week of their university careers at one Irish, one Scottish and two English universities. The questionnaire, which also asked for details of their present course but not for personal identification, consisted of two parts:

Part I

Sources. These items were compiled from several published sources, including Allen (1988), Boys (1984), Boys & Kirkland (1988a), Brennan & McGeevor (1988), Johnston (1991) and Raaheim *et al.* (1991), and from group discussions with students at the University of East London.

Contents. Part I contained 60 items on the 'Outcomes or benefits of higher education'. Respondents had to rate each item 'according to how important it is to you to obtain it from your own education' on the verbal range 'maximum importance–no importance' using a 6–0 integer scale.

The 60 items were:

1. *Passing examinations*; 2. *Learning to work with others*; 3. *Opportunity to enter preferred career*; 4. *Developing good taste (in dress, food, the arts, etc.)*; 5. *Knowledge of chosen subject(s)*; 6. *Learning a foreign language*; 7. *Ability in critical thinking*; 8. *Deeper religious thinking*; 9. *Learning to accept responsibility*; 10. *Opportunities for sport*; 11. *Learning to apply knowledge*; 12. *Meeting/seeing distinguished people*; 13. *Development as a person*; 14. *A respite prior to having to find employment*; 15. *Developing self-confidence*; 16. *Problem-solving skills*; 17. *Learning to handle complex information*; 18. *Achieving higher social status*; 19. *Academic qualifications*; 20. *Entry to a socially useful career*; 21. *Computer skills*; 22. *Clear logical thinking*; 23. *Good social life*; 24. *Learning to question accepted values*; 25. *Understanding other people*; 26. *Deciding one's own course of study*; 27. *All-round education*; 28. *Understanding oneself*; 29. *Writing ability, literacy*; 30. *Making long-term friendships*; 31. *Greater personal independence*; 32. *Research skills*; 33. *Hearing inspiring teachers*; 34. *Greater emotional maturity*; 35. *Creative thinking ability*; 36. *Learning to be tolerant of others*; 37. *Increasing future earning power*; 38. *General understanding of science*; 39. *Increased wisdom*; 40. *Being part of a prestigious institution*; 41. *Ability to speak well, e.g. in meetings*; 42. *Ability in decision-making*; 43. *Practical work-related experience*; 44. *Social skills*; 45. *Vocational/professional qualifications*; 46. *Making useful contacts*; 47. *Numeracy*; 48. *Understanding of the arts subjects/humanities*; 49. *Increasing leadership potential*; 50. *Political awareness*; 51. *Understanding how society works*; 52. *Being part of a scientific/scholarly community*; 53. *Understanding of moral and ethical issues*; 54. *Learning how to learn*; 55. *General cultural activities (music, literature, etc.)*; 56. *Becoming more valuable to society*; 57. *Knowledge of other cultures and peoples*; 58. *Wide general knowledge*; 59. *Achieving the best one is capable of*; 60. *Ability to organise one's life/self*.

Note: to avoid confusing the numbers which express stimulus order and response ranking, the following convention will be adopted: italic numerals and letters will be used to denote the items actually on the questionnaire, as above. When an item is referred to by its rank order as a response, letters and numerals in bold type will be used.

Part II

This contained items asking for personal details of age, sex, A levels or equivalent and details of present course.

Six items asked for 'Views about this subject' (i.e. the main subject area of current study). Respondents had to rate each item on the verbal range, 'strongly agree–strongly disagree' using a 6–0 integer scale. The six items were:

1. *Highly scientific*; 2. *Strongly practical and applied*; 3. *Closely concerned with people*; 4. *A definite agreed body of knowledge*; 5. *Well-established methods of investigation*; 6. *More theories than facts*.

TABLE I. Sources of respondents

University	Department or subject				
	Computing (<i>n</i> = 250)		Psychology (<i>n</i> = 347)		Total
	Male	Female	Male	Female	
Birmingham	76	4	20	75	175
Glasgow Caledonian	51	19	9	30	109
East London	46	11	39	118	214
University College, Cork	28	15	8	48	99
Totals	201	49	76	271	597

Gender segregation of sample in study: computing: 80·4% male; psychology: 78·1% female.

Six items asked for ‘Reasons for choosing present course’. Respondents had to rate each item on the verbal range ‘maximum importance–no importance’ using a 6–0 integer scale. The six items were:

1. Uses my best subject at A level; 2. Attracts both sexes equally; 3. A multi-subject course; 4. Much opportunity for individual choice; 5. Something I thought I would enjoy; 6. Something I thought I would be good at.

Eleven items asked for ‘Reasons for choosing this university’. Respondents had to rate each item on the verbal range, ‘maximum importance–no importance’ using a 6–0 integer scale. The 11 items were:

1. High reputation of university; 2. High reputation of Department or other unit; 3. In or close to major population centre; 4. Pleasant living environment; 5. Good social and recreational facilities; 6. Friends or relatives within reach; 7. Can live at home; 8. Chance to live away from home; 9. Offers the course you wanted; 10. Recommended by friends; 11. Little other choice.

Sources of respondents are set out in Table I.

Results and Analysis

The four groups of items, ‘Outcomes’, ‘Views’, ‘Choice of course’ and ‘Choice of university’ were analysed separately.

Part I: outcomes or benefits of higher education

Mean ratings were calculated for each of the 60 items, and converted to ranks for use in most of the analyses, the item with the highest importance to the respondent being ranked **1** and that with the lowest importance ranked **60**. There were relatively few tied ranks, more or less inversely related to the number of respondents per analysis. The main reason for the conversion was the greater generosity in awarding ratings of female respondents than males, their mean rating being 11.23% higher. Ranking had the effect of removing the generosity component while leaving the order of importance within gender.

Statistical Treatment

Factor analysis. The 60 items were factor analysed using data from all 597 respondents. The result was one large factor and two small factors (see Table II). The large factor (Factor 1) accounted for 27.5% of the total variance, and represented females and psychology more than it did males and computing. Most of the questionnaire items in Factor 1 concerned other people, or the respondent personally or social questions. Factor 2 was much smaller, accounting for 7.7% of the total variance, this time representing males and computers much more than females and psychology. Factor 3 was smaller still, accounting for 5.7% of the total variance, representing leisure and social activities. Apart from males being a little keener on sport, it was biased neither towards gender nor field of study.

In this study some of the most important items, as judged by the rankings of the mean ratings were not constituents of factors at all, for example items 3. *Opportunity to enter preferred career*; 5. *Knowledge of chosen subjects*; 59. *Achieving the best one is capable of*. In other words, these items had a non-redundant representation on the questionnaire.

Item ranking by importance. The 597 respondents were split in four different ways:

1. by field variable: 250 computing respondents vs 347 psychology respondents; 2. by gender variable: 277 male respondents vs 320 female respondents; 3. by gender within computing: 201 male vs 49 female; and 4. by gender within psychology: 76 male vs 271 female.

This gave four basic comparative analyses for the 60 items in 'Outcomes'. In what follows these analyses will sometimes be referred to for brevity as 'lists', always implying a list of items by response ranks, which may be the whole list or a quartile or octile of it. For each analysis the mean rating was calculated for each item. For each of the two levels of the variable within each analysis, the mean rating was converted into a rank, and the items then ordered within the level of the variable. Thus, for example, the first of the analyses gives two ranked lists: computing and psychology.

When ranked, items were observed to emerge in fairly definite groups. In the first group, highest in ranked importance were in much the same order for each of the four analyses (or lists); i.e. there was little gender or field disagreement over the importance of these items. There were seven such items: 1. *Passing examinations*; 3. *Opportunity to enter a preferred career*; 5. *Knowledge of chosen subjects*; 11. *Learning to apply knowledge*; 19. *Academic qualifications*; 59. *Achieving the best one is capable of*; 60. *Ability to organise one's own life*. All of these were general aims, that is, not specific in any way, by gender, field, personality variable or ability. The only important exception was 21. *Computer skills* ranked **second** by computing males and **first** by computing females.

Next in order of importance came a group of items where the rankings of importance changed from one of the four analyses or lists to another. In contrast with the first group these were specific in some way, by field, gender, personality variable or ability. Each of the four analyses contained four or five such items. Thus these items strongly differentiated the field and gender variables, as follows:

The most important items differentiating the two fields tended to be:

Computing

16. *Problem-solving skills*

21. *Computer skills* (subject to note above)

TABLE II. Factor analysis on outcomes or benefits of higher education (items in order of contribution to factor; i.e. the higher the item in the list, the better it represents the factor)

(a) Factor 1, eigenvalue 12.939, 27.5% of total variance

Item no. on questionnaire	Actual item	Importance
57	Knowledge of other cultures and peoples	Higher for psychology
53	Understanding of moral and ethical issues	Higher for psychology
51	Understanding how society works	Higher for psychology
25	Understanding other people	High for psychology
28	Understanding oneself	High for psychology females
24	Learning to question accepted values	Higher for psychology especially males
34	Greater emotional maturity	Higher for psychology especially females
48	Knowledge of arts subjects/humanities	Higher for psychology
13	Development as a person	High for psychology
36	Learning to be tolerant of others	Higher for computing females
50	Political awareness	

Mean ranks per item: male = 40.00, female = 32.9; computing = 42.23, psychology = 30.18. Thus females and psychology are more heavily weighted on this factor (lower mean ranks). Possible name for factor: Personal Development, Social Relationships.

(b) Factor 2, eigenvalue 3.609, 7.7% of total variance

Item no. on questionnaire	Actual item	Importance
22	Clear, logical thinking	Higher for computing
17	Learning to handle complex information	Higher for computing females
16	Problem-solving skills	Lowest for psychology females
42	Ability in decision-making	Higher for computing especially females
11	Learning to apply knowledge	
43	Practical, work-related experience	Higher for computing
21	Computer skills	Nearly opposite ends of ranking
32	Research skills	
47	Numeracy	Lower for psychology (but not much)
41	Ability to speak well, e.g. in meetings	Higher for computing females
38	General understanding of science	
7	Ability in critical thinking	Higher for psychology especially males

Mean ranks per item: male = 20.17, female = 27.21; computing = 19.67, psychology = 28.00; or excluding extreme item 21: male = 21.27, female = 25.91; computing = 21.09, psychology = 25.50. Thus males and computing are more heavily weighted on this factor (lower mean ranks). Possible name for factor: Cognitive (or Intellectual) skills.

(c) Factor 3, eigenvalue 2.677, 5.7% of total variance

Item no. on questionnaire	Actual item	Importance
23	Good social life	
30	Making long-term friendships	
4	Developing good taste (in dress, food, the arts, etc.)	
10	Opportunities for sport	Highest for computing males

Little difference in ranking by sex or by subject on this factor. Possible name for factor: Play and Social Life.

Important note: the existence of a factor shows items which have properties in common, *not* the importance of an item. Notice several important items missing from these three factors: 3. *Opportunity to enter preferred career*; 5. *Knowledge of chosen subjects*; 15. *Developing self-confidence*; 37. *Increasing future earning power* (for computing); 45. *Vocational/professional qualifications*; 59. *Achieving the best one is capable of*; 60. *Ability to organise one's own life*. These items should be thought of as being important individually but were represented without redundancy on the questionnaire.

- 21. *Computer skills* (subject to note above)
- 22. *Clear, logical thinking*
- 37. *Increasing future earning power*
- 43. *Practical, work related experience*

Psychology

- 13. *Development as a person*
- 25. *Understanding other people*
- 28. *Understanding oneself*
- 31. *Greater personal independence*
- 39. *Increased wisdom.*

The most important items differentiating the two genders tended to be:

Male

- 16. *Problem-solving skills*
- 21. *Computer skills* (subject to note above)
- 22. *Clear, logical thinking*
- 37. *Increasing future earning power*

Female

- 15. *Developing self-confidence*
- 25. *Understanding other people*
- 28. *Understanding oneself*
- 31. *Greater personal independence*

At the bottom of each list of 60 items, in ranked order of importance, there was also a group with little or no mobility from one analysis or list to another. These were: 4. *Developing good taste*; 6. *Learning a foreign language*; 8. *Deeper religious understanding*; 10. *Opportunities for sport*; 12. *Meeting/seeing distinguished people*; 48. *Knowledge of arts subjects/humanities*; 50. *Political awareness*; 40. *Being part of a prestigious institution*. Other items had slightly more mobility but had a low importance rating in all four analyses. These were: 18. *Achieving higher social status*; 33. *Hearing inspiring teachers*; 52. *Being part of a scholarly community*; 55. *General cultural activities*. Some items had somewhat more intra-list mobility: 53. *Understanding of moral and ethical issues*; 57. *Knowledge of other cultures and peoples*. Two items near the bottom in some lists but much higher up in others were: 21. *Computer skills* and 47. *Numeracy*.

To facilitate comparison and the calculation of statistical significance, it seemed appropriate, therefore, to make a primary split of the total of 60 items into quartiles; the top quartile ('the 15 most important'); the bottom quartile ('the 15 least important'), and the middle half ('30 items of middling importance'). A further division of the top quartile was made into the first and second octiles to separate the two quite different groups. The exercise now becomes one of measuring intra-list differences in rank order, the differences of greatest interest for the present study mainly being between the second octile and the middle ranking items, or in terms of importance of the item to the respondent, intra-list differences from middling importance to much nearer highest importance. In terms of octiles, the gender and field differentiation was nothing like so strong for the seventh octile as had been found for the second octile. A few additional items of greatest mobility (within the list of 60 items taken as a whole) will need special attention in discussion. They were, with the total range of intra-list difference given in brackets: 7.

Ability in critical thinking (7 tied to 23); 21. *Computer skills* (1 to 51); 25. *Understanding other people* (8 to 33); 28. *Understanding oneself* (12 to 40); 37. *Increasing future earning power* (8 to 39); 43. *Practical, work-related experience* (7 to 35 tied); 47. *Numeracy* (34 to 49).

Part II

Views about subject. The same four analyses were made as for 'Outcomes' i.e. by field; by gender; and by gender within each field. The results can be summarised very simply: the order of the six items tended to fall into one or other of two patterns. One pattern might be called the 'computing/male' pattern, with the top ranked item 2. *Strongly practical and applied* and the bottom ranked item 3. *Closely concerned with people*. This order was followed by computing students when the variable was field; almost always followed by males when the variable was gender and by both genders when the variable was gender within computing.

The other pattern might be called the 'psychology/female' pattern with the top item 3. *Closely concerned with people*, followed by 2. *Strongly practical and applied* and the bottom item 4. *A definite agreed body of knowledge*. This order was followed by psychology when the variable was field; female when the variable was gender and by both genders when the variable was gender within psychology.

Choice of present course. As with 'Views about subject', the same four analyses were made as for 'Outcomes' i.e. by field; by gender; and by gender within each field. The results can be summarised even more simply: there was only one general pattern for all four analyses: the top ranked item was either 5. *Something I thought I would enjoy* or 6. *Something I thought I would be good at* and the two were always close on mean rating. The bottom item was always 2. *Attracts both sexes equally*.

Choice of university. Item 9. *Offers the course you wanted* always came top with a clear margin. There was little difference between male and female for any of the four analyses. This section had little bearing on the topic of gender segregation.

Discussion

Outcomes or Benefits of Higher Education

The factor analysis proved particularly helpful to the present study, and showed that the questionnaire contained a useful mixture of (1) personality items, (2) cognitive ability items and (3) leisure items. It might be said that these distinctions were already obvious; but factor analysis not only confirmed the distinctions, it also showed which items enabled the strongest field and gender discriminations, and enabled finer distinctions between others. From the point of view of the present study it was most useful in showing that differences between psychology and computer science students need to take into account both personality and cognitive ability variables. In terms of a distinction made by Radford & Holdstock (1993), Factor 1 represented a definite 'people-orientation' (to either oneself or to other persons), and showed that being 'people-oriented' was much stronger for psychology than for computing students. Factor 2 was much smaller, and represented males and computers much more than females and psychology. It is arguable that 'thing-oriented' could be expanded to include cognitive skills; this may be justified for university students who come for mental training rather than the immediate acquisition of 'things'. Computer science students were much more 'thing-oriented' than

psychology students. Factor 3 concerned leisure activities and is not of much interest in the present context.

In looking at field and gender variables, this study brings out clearly that similarities among students in their general aims need to be given just as much attention as differences. All students, computing or psychology, male or female, were in very close agreement on what were the most important aims: passing examinations, academic qualifications, achieving the best one is capable of, learning to apply knowledge, opportunity to enter preferred career, ability to organise one's own life and knowledge of chosen subjects. Thus, the most important aims were quite general, looking beyond being at university and were not field specific. Another way to express it might be that respondents showed a greater weighting of extrinsic rewards from, for example, the study of a particular field than of intrinsic rewards, a proposition which might have important consequences for university recruitment. A somewhat similar finding was made by Singer *et al.* (1993) in their study of course goals of introductory psychology students in their third week: 'extrinsic valence was the best predictor of career aspirations'. The personal materialistic weighting of computing students was higher than for psychology students—for example compare item 37. *Increasing future earning power* (8 male computing, 9 tied female computing, 39 male psychology, 34 female psychology) to item 20. *Entry to a socially useful career* (31 tied male computing, 34 female computing, 21 male psychology, 17 female psychology). The mass higher education of our own times presents very different students from those who worked in the Cavendish Laboratory at Cambridge University in the early 1930s (Collins, 1993).

The two main predictor variables, field and gender were not statistically independent of each other and the analyses of gender within fields helped with the deconfounding and to see how similar computing females are to computing males if male is the gender stereotype for computing, and to see how similar psychology males are to psychology females if female is the gender stereotype for psychology. While computing females are closer to computing males in their responses than to females in general there is not an identity: females included a strong Factor 2 involvement, viz. items 16. *Problem-solving skills*; 22. *Clear, logical thinking*; 37. *Increasing future earning power*, and that there is very little representation of Factor 1, 'Personal development and social relations', apart perhaps from 15. *Developing self-confidence*. Computing males rated some items significantly more highly than computing females: 10. *Opportunities for sport* (48 vs 59), 23. *Good social skills* (27 vs 39), 45. *Vocational/professional qualifications* (9 vs 24), 53. *Understanding moral/social issues* (36 vs 48 tied). Computing females rated more highly 29. *Writing ability/literacy* (29 vs 39), 36. *Learning to be tolerant of others* (30 vs 46), 41. *Ability to speak well, e.g. in meetings* (20 vs 38). While *ad hoc* reasons may be easily found for each of these differences taken singly, they do not seem to follow any simple pattern.

Inspection of the results also showed psychology males are closer to psychology female responses to some extent but not so much as computing female responses approached computing male. There is very much less Factor 2 involvement for psychology males. Missing from their top 15 ranked items are: 22. *Clear, logical thinking*; 37. *Increasing future earning power*; 42. *Ability in decision-making*, and 43. *Practical, work-related experience*. We do, however, find 16. *Problem-solving skills*, discriminating these from 22. *Clear, logical thinking*, perhaps indicating an approach to problem-solving less dependent on 'masculine hard and cold' logic.

But psychology males differ from psychology females in an interesting respect: we find much less involvement for psychology males in Factor 1: 31. *Greater personal independence*; 15. *Developing self-confidence*; and especially 28. *Understanding oneself* (actually only important

for psychology females but not computing males or females). The psychology male rankings for these last three items are **24** tied, **27** and **46** respectively, that is towards the middle of the list of 60 items, of secondary importance. Psychology females thus appear significantly more self-concerned than psychology males, perhaps providing a differential motivation for taking up psychology, and for subsequent career choice.

As a broad generalisation, therefore, computing females in the study are closer to computing males on both Factors 1 and 2, i.e. both 'Personal development, social relationships' and 'Cognitive skills' while psychology males are much closer to psychology females in their responses on Factor 2, 'Cognitive skills', but are much less similar on 'Personal development, social relationships' items. In alternative language computing females 'might become more masculine' in both 'thing-orientation' and 'people-orientation' while psychology males 'became more feminine' in 'thing-orientation' only. In making this generalisation it must be remembered that there are still many items in the middle (rankings **16–45**) of the list of 60 and on these, for the most part there is less field and gender differentiation.

In the bottom quartile of ranked items, there is very good agreement between the two genders and two fields in the extreme rankings, and most of what little disagreement there is in the less extreme rankings. Items in the bottom quartile are much less bunched than the top quartile, which makes statistically significant differences easier to find. Almost none of the respondents wants their education to cater for interests outside the formal course of study (8. *Deeper religious understanding*; 50. *Political awareness*; 53. *Understanding of moral and ethical issues*; or 55. *General cultural activities*). It is always possible that such interests are catered for or even well catered for outside the course itself, from inside or outside the university or both. Nor is much interest shown in academic matters outside the students' own chosen field (6. *Learning a foreign language*; 48. *Knowledge of arts subjects/humanities*), nor extra-curricular events or features related to the field of study (12. *Meeting/seeing distinguished people*; 40. *Being part of a prestigious institution*; 52. *Being part of a scholarly community*; 33. *Hearing inspiring teachers*). Always low in the list is 4. *Developing good taste* and 10. *Opportunities for sport* (even less important for females than males), and usually in the bottom 15, 13. *A respite prior to finding employment* and 18. *Achieving higher social status*. In line with the top quartile ranked items what we find is that students are concentrating on their chosen field, perhaps to the exclusion of other interests.

The two items which most clearly differentiate the two fields are 21. *Computer skills*, which is almost at opposite ends of rankings, not surprisingly ranked very high by computing students (ranked **second**, breaking the generalisation that the most important items are common and general to both fields and genders) but low for both psychology males and females, and 47. *Numeracy*. The low ranking of 47. *Numeracy* for psychology males and females agrees with the findings of Radford & Holdstock (1993), but computing students do not rate it very high either; it is **thirty-fourth** for males and **thirty-sixth** for females, thus suggesting the disqualification of mathematical dependence (where, in any case, there may no longer be gender segregation at graduate level, [Fraser, [1994]]) as causing the male dominance in computing, i.e. computing is clearly a much 'softer' study than it was 20–30 years ago. Both computing males and computing females rate 51. *Understanding how society works* low, which is as might be expected. Psychology students rate this item higher (but not all that much, **28** for psychology males, **40** for psychology females), which also differentiates the interests of psychologists from sociologists.

Apart from 47. *Numeracy* and 21. *Computer skills* there are no Factor 2 'Cognitive skill' items in any of the bottom 15 lists. There is, perhaps, one noteworthy item: the

inclusion of 28. *Understanding oneself* in the psychology male bottom quartile (ranked 46), strongly differentiating psychology males from psychology females (who rank it 12) and providing further support for the general conclusion offered earlier that psychology males may be closer to psychology females on Factor 2, 'Cognitive skills' than on Factor 1, 'Personal development, social relationships'.

Views about Subject

For 'computing/male' the pattern of ranking in this section might easily be predicted on what is generally known or by the results from Part I of the study 'Outcomes'. For 'psychology/female' the **first** item (1. *Closely concerned with people*) is in accord with general knowledge (or popular assumption) and the results from 'Outcomes'. The other two items presumably tell us that psychology is seen as a highly practical and applied field (again anticipating extrinsic but more 'person-oriented' rewards) and that students are not troubled by the fact that there tend to be many views which are difficult to reconcile: psychology is and always has been a theoretically diverse discipline with ever-changing content. For both patterns, 'computing/male' and 'psychology/female', 6. *More theories than facts* tended to rank 5 out of the 6. We thus find many similarities as well as many differences between psychology and computing.

Choice of Present Course

Both genders and fields were in strong agreement on the main reason for the respondents' choice of present course: 5. *Something I thought I would enjoy* or 6. *Something I thought I would be good at*. Ratings of these two items were often so close as not to be statistically separable, but were rated significantly higher than the other four items in the section. This strongly supports the conclusions from 'Outcomes or benefits' about gender and field agreement on the general aims of respondents.

Conclusion

Two hypotheses were offered in the introduction to the present study; both have stood up well. Firstly, the understanding of gender segregation needs to be explained in terms of interests, personality and social differences as well as in terms of cognitive abilities, and perhaps the former set of individual differences is the more important. Secondly, the minority gender in a highly segregated field tends to differ from its population norm in the direction of the majority gender characteristics of that field; thus a female computer studies student in this male dominated field may be more 'masculine' in interests and perhaps in some personality traits than the average female student. However, in this study we found the hypothesis to hold well in both personality and cognitive ability characteristics in computing, but in psychology it held well for cognitive abilities but much less well for personality characteristics.

'Masculine-feminine' and 'tough minded-tender minded' are two of several suggestions as to how best to express the polar opposites of the psychological scale involved here. 'Thing-oriented'-'Person-oriented' are the most suitable the authors can think of for the time being, and seem to summarise the difference between a degree in computer science and a degree in psychology, provided that the terms are understood to mean thinking about as well as directly dealing with things and persons. The modification is

especially necessary for university degree courses, which are still primarily theoretical rather than practical.

Acknowledgements

The authors wish to thank Cynthia Holme, Universities' Statistical Record, Cheltenham, England for data about UK university undergraduates and postgraduates.

We also wish to thank for the distribution and return of questionnaires: Professor Leone Burton and colleagues, University of Birmingham; Michael Everitt, East London Business School, University of East London; Dr Alan Durnell, Department of Psychology, Glasgow Caledonian University; and Dr Ronald Swain, Department of Applied Psychology, University College, Cork.

Correspondence: Professor John Radford, Department of Psychology, University of East London, Romford Road, London E15 4LZ, UK.

REFERENCES

- ALLEN, M. (1988) *The Goals of Universities* (Milton Keynes, SRHE and Open University Press).
- ARCHER, J. (1992) Gender stereotyping of school subjects, *The Psychologist*, 5, pp. 66–69.
- BARNETT, R.A. (1990) *The Idea of Higher Education* (Buckingham, SRHE and Open University Press).
- BENBOW, C.P. (1988) Sex differences in mathematical reasoning ability in intellectually talented preadolescents: their nature, effects, and possible causes, *Behavioral and Brain Sciences*, 11, pp. 169–232.
- BOYS, C.J. (1984) Expectations of higher education: a survey of student attitudes. Expectations of higher education project. Brunel University, paper no. 9.
- BOYS, C.J. & KIRKLAND, J. (1988a) *Degrees of Success: career aspirations and destinations of college, university and polytechnic graduates* (London, Kingsland).
- BOYS, C.J. & KIRKLAND, J. (1988b) Student perceptions, in: C.J. BOYS, J. BRENNAN, M. HENKEL, J. KIRKLAND, M. KOGAN & P.J. YOULL (Eds) *Higher Education and the Preparation for Work* (London, Jessica Kingsley).
- BOYS, C.J., BRENNAN, I., HENKEL, M., KIRKLAND, J., KOGAN, M. & YOULL, P.J. (1988) *Higher Education and Preparation for Work* (London, Jessica Kingsley).
- BRENNAN, J. & MCGEEVOR, P. (1988) *Graduates at Work. Degree Courses and the Labour Market* (London, Jessica Kingsley).
- COLLINS, S. (1993) Introduction to: C.P. SNOW *The Two Cultures* (Cambridge, Cambridge University Press).
- DURNELL, A. (1990) Why do female students avoid computer studies? *Research in Science & Technological Education*, 8, pp. 163–170.
- DURNELL, A. (1991) Gender, psychology and technology: a mirror image, in: J. RADFORD (Ed.), *The Choice of Psychology*. Group of Teachers of Psychology: Occasional Papers, 12 (Leicester, British Psychological Society).
- EDMUNDS, A. (1992) The gender imbalance in undergraduate psychology: a navigation through sources of influence, unpublished undergraduate project, University of Warwick.
- FEINGOLD, A. (1992) Sex differences in variability intellectual abilities: a new look at an old controversy, *Review of Educational Research*, 62, pp. 61–84.
- FRASER, E.J. (1994) Problems of gender in university mathematics, *British Educational Research Journal*, 20, pp. 147–154.
- HALPERN, D.F. (1992) *Sex Differences in Cognitive Abilities*, 2nd edn (Hillsdale, NJ, Erlbaum).
- JOHNSTON, R.J. (1991) Graduate evaluation of British higher education courses: an evaluation, *Studies in Higher Education*, 16, pp. 209–224.
- KOLB, D.A. (1981) Learning styles and disciplinary differences, in: A.W. CHICKERING (Ed.) *The Modern American College* (San Francisco, LA, Jossey-Bass).

- LIGHTBODY, P. & DURNDELL, A. (1993) Senior school pupils' career aspirations: is gender an issue? paper presented at the *British Psychological Society London Conference*, December 1993.
- MORRIS, P.E., CHENG, D. & SMITH, H. (1992) How and why applicants choose to study psychology at a university, *The Psychologist*, 5, pp. 247-251.
- RAAHEIM, K., WANKOWSKI, J. & RADFORD, J. (1991) *Helping Students to Learn* (Buckingham, SRHE and Open University Press).
- RADFORD, J. (1990) *Child Prodigies and Exceptional Early Achievers* (Hemel Hempstead, Harvester Wheatsheaf).
- RADFORD, J. (1991) First year honours students' choice of psychology, in: J. RADFORD (Ed.) *The Choice of Psychology*, Group of Teachers of Psychology: occasional Papers, 12. (Leicester, British Psychological Society).
- RADFORD, J. & HOLDSTOCK, L. (1993) What students want: objectives of first year psychology students in Ireland, Norway, Portugal, Spain and the United Kingdom, *Psychology Teaching Review*, 2, pp. 39-49.
- RADFORD, J. & HOLDSTOCK, L. (1995) Does psychology need more boy appeal? *The Psychologist*, 8, pp. 21-24.
- RANSOM, M.R. (1990) Gender segregation by field in higher education, *Research in Higher Education*, 31, pp. 477-494.
- ROBERTS, D., HIGGINS, T. & LLOYD, R. (1991) *Higher Education: the student experience* (Leeds, Higher Education Information Services Trust).
- SINGER, M.S., STACEY, B.G. & LANGE, C. (1993) The relative utility of expectancy-value theory and social cognitive theory in predicting psychology student course goals and career aspirations, *Journal of Social Behaviour and Personality*, 8, pp. 703-714.
- WEINREICH-HASTE, H. (1981) The image of science, in: A. KELLY (Ed.) *The Missing Half: girls and science education* (Manchester, Manchester University Press).
- WILSON, G. & JACKSON, C. (1994) The personality of physicists, *Personality and Individual Differences*, 16, pp. 187-189.