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ARE INFORMATION SYSTEMS STUDENTS IN THEIR RIGHT MINDS?

Steve Benson, Senior Lecturer,
School of Management And Information Systems,, Faculty of Business And Public Management,
Edith Cowan University, 100, Joondalup Drive,, Joondalup, Western Australia 6065.
Email: s.benson@ecu.edu.au, Tel: 061 8 9400 5475, Fax: 061 8 9400 5633

Dr. Craig Standing, Associate Professor,
School of Management And Information Systems, Faculty of Business And Public Management,
Edith Cowan University, 100, Joondalup Drive,, Joondalup, Western Australia 6065.
Email: c.standing@ecu.edu.au, Tel: 061 8 9400 5545, Fax: 061 8 9400 5633

ABSTRACT

The "IS skills debate" still persists in being a commonly researched area. In this paper we examine the related issue of fundamental thinking styles and the implications for IS course design and delivery. In recent decades Sperry's work on "split brain"[1] patients has been hijacked by popular psychology.[2] The underlying thesis of many of the publications we surveyed reduces to "find out whether you are right or left brained and learn to draw on your whole brain". We decided that it would be interesting to carry out an initial investigation into the left-right brain orientation of our students and curriculum. Given the technical biases and associations of the Information Systems discipline, our initial expectation was to find a high degree of logical, left brained orientation in our student sample. We were surprised to find the contrary result in that right brained oriented students outnumbered left brained oriented students by 3:1, especially in view of the fact that our curriculum had a definite left brain bias. Our paper outlines the left-right brain divide and questions the validity of this division from neurophysiological perspectives. We discuss the practical implications of the exercise; i.e. is it worthwhile trying to get student to change their mode of operation or is it more productive to have them control their own learning in an adaptive manner? Finally we identify several areas for future research.

INTRODUCTION

The skills required by Information Systems (IS) graduates has been a frequently studied topic (Latham, 2000; Snoke & Underwood, 1999, Standing & Standing, 1999). The debate usually centers on the relative importance, of technical skills, interpersonal and communication skills, and the depth of business knowledge and skills. The debate is complicated by the expectations of employers and how these differ from recent IS graduates (Latham, 2000). Additionally the fragmented nature of the IS profession contributes to this complication (Lee, Trauth & Farwell, 1995). The topic is of ongoing importance to IS Schools in universities which are trying to develop a more relevant curriculum so that their graduates will be highly rated by prospective employers.

This paper, whilst recognising the value of the work in the IS skills area, investigates the "IS skills issue" from an alternative perspective. Many past studies have assumed that universities can respond to the changing requirements of employers by reshaping the IS curriculum and teaching methods and thus significantly changing the nature of the end-product – the IS graduate! By examining the fundamental thinking styles of IS undergraduates we aim to address and make recommendations in relation to the appropriateness of IS course content and delivery styles and explain the major issues for IS education and practice.

The first section of the paper provides a brief coverage of the thinking styles paradigm. This is followed by the description of a survey on the thinking styles of IS undergraduates. These are then related to the IS undergraduate major programme at our own university to determine any clashes between dominant thinking styles of undergraduates and thinking styles required by IS subject areas. Finally, we highlight issues that result from our study and make recommendations for IS course designers.

LEFT AND RIGHT BRAIN THINKING

In 1963 neurosurgeons Joseph Bogen and Philip Vogel carried out a radical surgical procedure to control epilepsy in severely afflicted patients. This treatment was based upon work carried out by Roger Sperry and involved completely severing the corpus callosum, a cord of 300 million nerve fibres which connects the right and left hemispheres of the brain. Breaking the communication which integrates brain operation, allowed virtually independent testing of brain hemispheres with a view to ascribing perceptual functions and thought processes to one hemisphere or the other.[3] Although severing the corpus callosum as a treatment fell out of favour due to the severe mental effects and advances in drug treatment (Ornstein, R., 1997, pp.65) it is still performed and patients may develop "split brain" syndrome as the result of illness. Sperry's view was that there were "two spheres of consciousness" in the same brain, the left hemisphere housing speech, rationality, and intellect, while the right hemisphere was inarticulate housing creativity and spatial abilities. (Sperry, 1969). Bergland (1985) elaborates "You have two brains: a left and a right. Modern brain scientists now know that your left brain is your verbal and rational brain; it thinks serially and reduces its thoughts to numbers, letters and words; Your right brain is your nonverbal and intuitive brain; it thinks in patterns, or pictures, composed of

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whole things and does not comprehend reductions, either numbers, letters, or words". A simple summary of brain function allocation is given in table 1:

Left Hemisphere	Sequential Analysis: systematic, logical interpretation of information. Interpretation and production of symbolic information: language, mathematics, bstraction and reasoning. Memory stored in a language format.
Right Hemisphere	Holistic Functioning: processing provide "holistic" picture of one's environment. Visual spatial skills. Holistic functions such as dancing and gymnastics are coordinated by the right hemisphere. Memory is stored in auditory, visual and spatial modalities.

Table 1: Brain Functions By Left/Right Hemisphere (After Ornstein, 1997)

Despite a seemingly rigorous scientific foundation, the left-right brain debate moved into the "popular" domain and seemingly gained from the translation. It was argued by many (e.g. Edwards, 1989) that Western education neglected the right hemisphere and by implication disadvantaged many people. The truth is that Sperry's allocation of brain functions was a simplification, language is predominantly located in the left hemisphere but not exclusively so. There are cases of patients who have a single hemisphere and yet function normally (Ornstein, 1997, pp.52.53). The redundancy of connections in the brain allows some (in some cases total) recovery of lost function. (Sacks, 1985, pp. 73). It is proven that images are memorised in the right side of the brain and language in the left ***in the majority of cases*** (Kelly et. al 1998). The simple view that the right brain provides contextual setting for perception seemed confirmed when Marshall & Fink's 1997 research (in McCrone 1999) used brain imaging techniques that allowed the time line for visual processing to be monitored with precision. However when faced with Navons (a large picture made up of smaller pictures e.g. a letter S made up from letter F's) this processing allocation was reversed with the left hemisphere concentrating on context while the right handled detail. (op. cit.) Evidence that both hemispheres have an individual mind is reasonably sound (McLean, 1998), though many regard the right hemisphere as intrinsically inferior to the left, principally on the basis that it has no language capability and hence diminished consciousness (Gazzaniga, in Ornstein pp 6-7, 90-91).

To conclude, it would seem that while there is some neurophysiological evidence to support the simple left-right brain divide as proposed by Sperry (1961), the situation is far more complicated than originally thought. Ornstein (Ornstein, pp.82,83) found subjects with language activity located in either or both hemispheres though with greater frequency in the left). However the validity of the left and right division brain as thinking styles still remains and there are many consultants and agencies making use of it.(e.g. Intelegen, 2000). While most people are able to switch between thinking styles, they have a preferred mode. Ornstein (Ornstein, 1997 pp 15) argues that the superiority of one hemisphere over the other does not have to be very great for preference to develop. Using the example of two TV channels showing the same program, the first is 100% reliable, the second 95% reliable he suggests that the small difference would give 100% selection for the better channel. In short partial dominance implies total dominance.

RESEARCH METHODOLOGY

We selected a group of students who were in their second year of study in an information systems major and provided an online, self assessment test to determine the preferred thinking style (left, right or both hemispheres). The test consisted of 20 questions which required students to indicate a preferred modality. Example questions included:

Do you prefer courses which have:
a) one assignment at a time
b) allow students to work on several things concurrently as they see fit
c) either or both

Are you
a) not very good at reading people's body language, you prefer to listen to what people say.
b) Good at understanding people's body language
c) Sometimes good, sometimes bad at understanding body language

When you are given instructions do you prefer to have them presented to you
a) in written or verbal form
b) by demonstration (being shown how to do something)
c) either or both

When it comes to planning for study and/or work are you
a) Well organised and use time management to help plan your activities
b) Not very well organised
c) Sometimes organised, sometimes not

Are you better at remembering
a) names
b) faces
c) both with similar ease

a) answers denote left brain modality,
b) answers denote right brain modality
c) answers denote wholebrain modality.

RESEARCH FINDINGS

Our sample size (N) was 28 (corresponding to over 50% of the students enrolled in our information systems major) and we used 20 questions in our test. The raw data are in table 2 below.

Total Left Brain Responses	145
Total Right Brain Responses	185
Total Whole Brain Responses	230

Table 2 - Brain modality in information systems students

As may be seen the responses show a high degree of whole brain dominance with a tendency to favour the right hemisphere. The averages of student responses may be found in table 3.:

Sample size N=28	Average value	Standard Deviation
Average left brain responses x/20	5.2	2.1
Average right brain responses x/20	6.6	2.3
Average whole brain responses x/20	8.2	2.2

Table 3 - Average Student Brain Modality

As may be seen, the modality is whole brained with a marked tendency to prefer the right hemisphere. The standard deviation shows a slightly wider spread than we would have expected.

Analysing on an individual basis we found that 6 students had a marked left hemisphere preference (Number of right - Number of left responses <-1), 15 had a marked right hemisphere preference (Number of right - Number of left responses >1) the remainder showing a whole brained preference.

THINKING STYLES REQUIRED FOR THE STUDY OF INFORMATION SYSTEMS

Having examined the students and determined their principal thinking styles, we then examined the subject areas which comprised the information systems major and tried to classify them in terms of the thinking style that the presentation and assessment of the unit most favoured. Our literature review failed to find a suitable instrument and so we propose the following simple model. A review of unit outlines, assignments and examination, together with questions directed to the lecturer enabled us to establish ten critical dimensions for evaluation. We allocated 1 whenever a left brained focus was encountered, 2 for a right brain focus and 3 for a whole brained focus. We acknowledge the element of subjectivity in our assessment but believed it to be justifiable for a pilot exercise such as this. The evaluation criteria are shown below in table 4 and the results of applying these criteria to our curriculum are shown in tables 5 and 6.

	A-Left Brain Focus	B - Right Brain Focus
1	Very clearly defined objectives	Loosely defined, overarching objectives
2	Very clearly defined schedule	Schedule has "milestones" but is flexible
3	Assignments are sequential	Assignments are concurrent
4	Relatively few but large assignments (1,2 or 3) & assessment is periodic	Several Assignments (4,5 or more) and assessment tends to be more continuous in nature
5	Assignments are precise in nature, based on given scenarios, specifications etc. sequential and/or logical in nature	Assignments are essay and discussion type requiring a scenario or specification to be constructed
6	Students are expected to learn and ask questions to clarify concepts or assessment	Students participate fully in class discussions
7	Examinations/assessments make substantial use of multiple choice questions	Examinations are mainly essay based
8	Students make minimal contribution to the course content	Students make some contribution to the course content
9	The lecturer usually explains the subject matter to the students	The lecturer usually demonstrates or shows the subject matter to the students
10	Teaching approach is lecturer centered, pedagogical, objectivist	Teaching approach is student centered, androloggical, constructivist

Table 4 - 10 Suggested Critical Dimensions For Left-Right Brain Orientation In University IS Education.

Criterion	1	2	3	4	5	6	7	8	9	10
Database	1	1	1	1	1	1	3	1	3	1
Networks	1	2	2	1	2	3	2	1	1	1
Systems	3	2	1	1	1	3	2	1	1	1
Software	1	1	1	2	1	1	3	1	1	1
Management	2	2	1	2	2	2	2	2	1	3

Table 5 - Left Right Brain Orientation In Information Systems Curriculum, Delivery And Assessment Methods (Raw Data).

	Left Total	Right Total	Whole Total	Final Score
Database	8	0	2	-16
Networks	5	4	1	-2
Systems	6	2	2	-8
Software	8	1	1	-14
Management	2	7	1	10

Table 6 Left Right Brain Orientation In Information Systems Curriculum, Delivery And Assessment Methods (Summary). A Negative Final Score Denotes Left Bias, A Positive Final Score Denotes Right Bias

NB. Since we used only 10 criteria as opposed to the 20 questions that comprised the student test we subtracted the-Left response total from the Right response total and multiplied the result by 2. While this is not entirely valid in statistical terms it allows a more meaningful comparison to be made.

With the exception of management it is obvious that there is a pronounced left brain bias (in our university the network area is taught from a management perspective and this accounts for the reduced left brain bias). When considered with the results from the student test it is apparent that there is a mismatch between average student brain orientation and the information systems curriculum, delivery and assessment methods.

DISCUSSION

Our pilot survey indicates that the majority of our students are right brained. However, we note the disparity between the modality of student thinking and the orientation of our subject matter, teaching and assessment methods. Our initial expectation was that we would find our students to be relatively whole brained in their thinking. This was based upon our own view of information systems as a very diverse discipline with a firm technological foundation i.e. requiring both logical and creative thinking styles. In retrospect it have been useful to survey the respondents to see what their views of the IS discipline were and what had attracted them to its study.

We suggest that the left-right brained model has applicability for IS course development and teaching styles and offer the following observations:

1) The model explains why a significant percentage of IS students find the IS discipline difficult.
Basically, the right brained students are ill-equipped in terms of thinking style to deal with the more precise and detailed technical programming and development modeling found within most IS programmes. However, these students may perform particularly well in the management components of the course.

2) There are implications for teaching styles
For students with a right-brained focus it is important to provide the context for understanding, provide visual walkthroughs and examples of solutions to problems rather than a purely syntactical approach. In other words, attempt to teach left brained skills from a right brained perspective!

3) The model accounts for the difficulties involved in the career path transition from technical to managerial. (mainly left to mainly right brained work emphasis)
The transition for left brained graduates and practitioners from a technical focus to a managerial focus should not be underestimated. Hence, the need for postgraduate courses in IS which focus on the managerial skills.

4) Thinking style is relatively immutable.
There is a prevailing view that fundamental thinking approaches are unlikely to change radically (Stenning, Cox, & Oberlander, 1995). It is important therefore to steer students to appropriate occupations within the profession that are aligned with their thinking styles. It is unlikely that right brained students will ever make excellent "techies" even with lots of training.

5) The lucky few
We suggest that students with a whole brain orientation (and there are relatively few of those 20% in our survey, and fewer in the population at large (Ornstein, 1997 pp.80-86) are perhaps best positioned (maybe not to enter the IS profession as programmers) to liaise with users, deal with uncertainty and join the management ranks of the profession whilst at the same time cope with a reasonable amount of technical detail.

To elaborate on point 4 above, switching hemispheres and thinking styles is difficult (more so than switching from right to left handedness) (Stenning, Cox, & Oberlander, 1995). Certainly left brained people can employ techniques on a neo-algorithmic basis that can engender creative thinking, this has been the basic thesis for many books on thinking (DeBono,1994). There were movements in the 19th century which attempted to maximise brain use by encouraging ambidextrousness[4] (Ornstein, 1997 pp 54) but it is doubtful that using the least preferred hand will encourage left or right brained thinking. Laterality (handedness) has only a weak linkage with dominant thinking styles, neurologically functions may be distributed in either or both hemispheres (McCrone, 1999, Kelley et al 1998). There is some evidence that the discipline of Information Systems requires both left and right brained thinking styles. The right hemisphere handles spatial concepts and usually contextualises perception (see McCrone, 1999), however it is apparent that the attention of the right hemisphere may be directed consciously, this may account for the aberrant processing distribution when perceiving Navons. Sein et al (1993) used visualisation ability as a predictor for learning outcomes in hierarchical database use and complex file/directory structures. Garavan and McCracken (1993) noted that abstract (left brained) learners performed better than concrete learners in certain circumstances, most notably when the subjects have no prior experience of the subject area.

Based upon our literature survey and conversations with practitioners we believe that the conscious mind has plenty to occupy it without trying to change its own fundamental mode of operation. On efficiency grounds alone it does not make sense to seek to change the students but rather educate them in meta-learning techniques would allowing them to adapt the teaching materials and processes to suit their own preferred mode of operation. The implications for curriculum development and delivery are that a whole brained (holistic) approach should be adopted using both conceptual frameworks and concrete examples. While Meyers-Briggs Indicators would allow for greater customisation of teaching and assessment we believe that assessing each student would be time consuming and the level of diversity too great to allow it to be used advantageously. The simple left-right view has the advantage of being relatively easy to comprehend and implement.

Figure 1 shows our suggested framework relating brain orientation to IS careers. This may be of use to students planning their future careers.

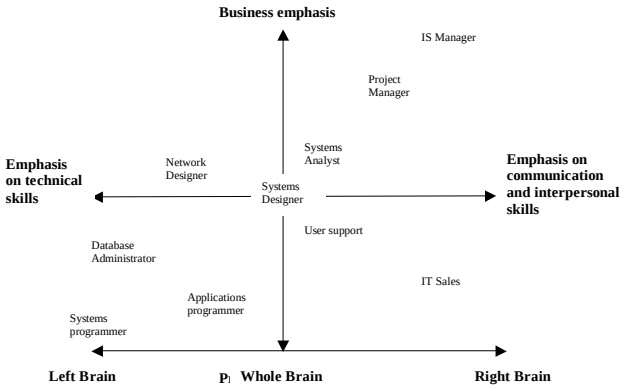

Figure 1: Occupations and skills in the IS/IT industry with left-right brain orientation (adapted from Standing, C. & Standing, S.,1999).

FUTURE WORK

Our initial intention was to carry out a pilot study to establish the preferred thinking styles of our students. While acknowledging the element of subjectivity the results are sufficiently convincing to highlight a misalignment between our courses and our students. From our pilot study and consideration we have identified areas for further investigation. Changing teaching and assessment methods in selected areas would allow comparison of normalised marks to be made across subject areas. If as we believe, adaptive teaching and assessment strategies are conducive to better student outcomes then average grades in those subject areas should be higher. We will be allowing students to have access to our simple self diagnostic test and providing them with information on memory, teaching and learning processes suited to each mode of thinking. These will be provided as part of our foundation course and average assessment and examination grades together with attrition data will be compared with similar periods in the past. We suspect that students who are aware of their preferred thinking styles will be able to adjust their work patterns to improve their performance. We are considering a longitudinal study, tracking students who make use of the materials, reviewing their progress and interviewing a selection of respondents to ascertain their beliefs as to the usefulness of the test and associated materials. Finally it would an interesting exercise to assess the brain orientation of IS practitioners since there is potential to reopen the IS skills debate from a very different perspective.

ENDNOTES

1) The term "split brain" is not to be confused with schizophrenia in which the patient is split from reality while the brain remains whole.
2) An investigation by the authors shows some 112 in print and available from Amazon.com and we estimate at least that number to be out of print.
3) Severance of the corpus callosum may not completely isolate the hemispheres, it possible for some residual connections to remain.
4) Sir James Crichton-Browne, the Lord Chancellor's "Visitor in Lunacy" noted periodic outbreaks of ambidexterity and associated them with addiction to "vegetarianism, hatlessness or anti-vaccination and other aberrant forms of belief".

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