COGNITIVE ERRORS OF JUDGEMENT, LEARNING STYLE CHARACTERISTICS AND CLIENTS' EARLY COST ADVISORS

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The formulation of early stage building project cost advice for clients requires professionals to exercise judgement. The exercise of judgement is a human cognitive process that can be subject to errors, bias and heuristics. The propensity to make errors is an individual human characteristic. Humans may have their characteristics classified by their preferred learning style. This work seeks to ascertain whether there is a link between an individual's learning style and the type of errors made in the formulation of strategic cost advice. The paper reports the development of an appropriate measuring instrument and the results of its application to a group of thirty four subjects. The subjects were a convenient sample drawn from two cohorts of final stage part-time degree students in quantity surveying. Subjects were tested to ascertain their propensity to make errors and their preferred learning style. The responses were analysed using regression analysis. The results of the work revealed no correlation between error and preferred learning style. The paper concludes by setting out the case for further work in this area with professionals being asked to make intuitive judgements about issues related to their own field of expertise. Ghana.

Keywords: Early cost advisors, errors, judgement, learning style

INTRODUCTION

Previous survey work has shown that judgement has a role within the formulation and transmission of consultant's early construction cost advice to their clients, Fortune and Lees (1996). Analysis of the results of that survey work showed that judgement was used by practitioners in the formulation of all advice regardless of the cost model used. Therefore, the quality of individual judgements made must also impact on the quality of advice provided.

This work seeks to contribute to the research agenda focused on the improvement of quality in the formulation of early construction cost advice for clients. The work adds to that agenda by determining whether there is a link between an individual's learning style and the type of errors made.

The paper firstly sets out the context for the study and then reports on the development and application of an appropriate measuring instrument to subjects drawn from cohorts of final level part-time undergraduate students in quantity surveying. The results of the investigation are then analysed using *Minitab for Windows (v10)* and the paper concludes by outlining a plan for future action that will further contribute to the enhancement of quality decision making in the field of strategic cost advice.

Fortune, C and Lees, M (1997) Cognitive errors of judgement, learning style characteristics and clients' early cost advisors. *In:* Stephenson, P (Ed.), *13th Annual ARCOM Conference*, 15-17 September 1997, King's College, Cambridge. Association of Researchers in Construction Management, Vol. 2, 550-8.

CONTEXT

The literature reviewed by Fortune and Lees (1996) identified that decision making communication and judgement were fundamentally different processes but each played a part in the ultimate quality of the early construction cost advice given to clients. Skitmore (1990) stated that the quality of such advice was affected, *inter alia*, by the technique (model), the forecaster (the individual) and the construction market. Any organisation producing early construction cost advice will have to make decisions about all of these factors. It can be argued that decision theory will be particularly relevant to this advice function. If this is true, then the focus of the drive to improve the quality of early construction cost advice should be on improving the quality of the decisions in the process. However, if this advice function is viewed from the perspective of the practitioner involved it can be seen that the advice given is not a decision since the behaviour of the practitioner is not affected by the advice. The advice function contains both decisions and judgements and can be best viewed as a series of decisions leading to a judgement. The decisions centre around the selection of an appropriate cost model and its operation. The practitioner will have had to make a number of decisions along the way, related to which model to use, which data source to use, what information is available etc., but the advice eventually formulated is an assessment, a forecast and as such is a judgement.

Bowen (1995) identified that the transmission of the formulated early construction cost advice by consultants to their clients involved a process of communication. Bowen maintained that such communication could be categorised as being either an intra or inter-personal process involving judgement. Beeston (1983) in an earlier work asserted that such communication processes demand that the consultants involved make a series of judgements that ultimately affect the quality of the advice received by the client. Beeston summarised such judgements as ‘a feeling for how far the formulated data can be relied upon and how much to allow for possible error’. Judgements made in the communication of early construction cost advice to clients have been characterised by Raftery (1993) as being affected by personal bias as well as reporting bias. Therefore, it can be seen that the available literature shows that judgements are made in the formulation *and* communication of early construction cost advice. This reflects actual practice where the technical aspects of early cost advice formulation are often separated from the adjudication and transmission of it to clients. The early construction cost advice function as described above has been illustrated in fig. 1. It can be seen that this study centres on the assessment and enhancement of quality in the formulation of early construction cost advice by investigating whether there is a link between an individual’s learning style and the type of errors made by that individual.

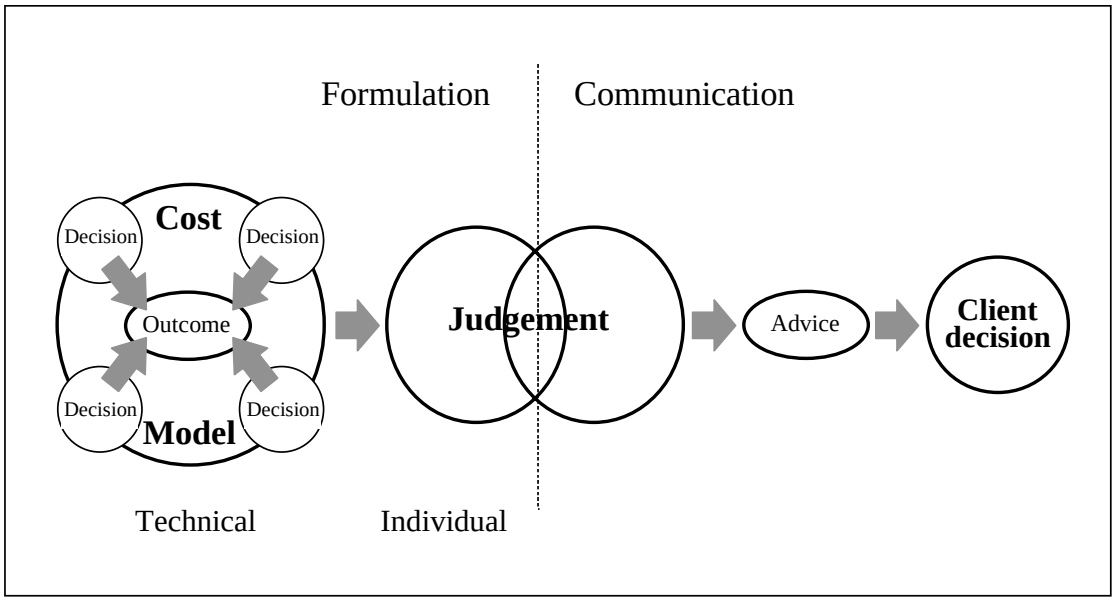

Figure 1 - Model of the advice function

METHODOLOGY

The central problems facing any empirically based enquiry revolve around the development of an appropriate measuring instrument, its piloting and application to an appropriate sample of subjects. This investigation called for the development of an instrument that would allow the detection of practitioner error or bias in making judgements and the classification of the individual subject's preferred learning style. The development of an appropriate measuring instrument addressing both of these aims needed to be objective in nature and rooted in the available literature.

Raftery (1995) claimed that a better understanding of judgement could be obtained if an understanding of the actual rather than the theoretical decision making process. Tversky and Kahneman (1974,1981), in their experimental work found that people actually involved in making judgements under uncertainty relied upon a number of simplifying strategies, rules of thumb or heuristics. They suggested that the use of such heuristics had the potential to lead towards judgements affected by errors and bias. As a result of their work three general heuristics were identified as having the potential to affect judgements, namely, (i) the availability heuristic, (ii) the representativeness heuristic, and (iii) the anchoring and adjustment heuristic. Rachlin (1989) considered the earlier work on judgement and the potential for bias and developed a theory that as well as bias and heuristic there also existed the potential for practitioners to make decisions in error. Rachlin identified three types of 'cognitive errors' - sample size errors, base rate errors, and logic errors. Bazerman (1993) in his text on judgement in decision making identified a total of fourteen biases that emanated from the heuristics identified by Tversky and Kahneman. Of the biases identified, some had already been classified as cognitive errors by Rachlin and two, confirmation trap and hindsight bias were classified as being apparent in the communication process. As indicated above this study is centred on the formulation of advice and not on its transmission and so it was decided to exclude the communication biases from the measuring instrument. Table 1 indicates the types of error and bias included in the study and their allocation, according to Rachlin (1989) and Bazerman (1993), as either cognitive error or one of the three heuristics previously identified.

Errors	Pilot study problem number	Main study problem number
Cognitive errors		
sample size errors	4, 15, 29	4
base rate errors	10, 19, 26	10
logic errors	12, 23, 30	12
Availability heuristic		
ease of recall	5, 14, 34	5
retrievability	11, 17, 27	11
presumed association	8, 13, 33	8
Representative heuristic		
regression to the mean	7, 24, 36	7
conjunction fallacy	3, 16, 35	3
misconception of chance	2, 20, 32	2
Anchoring and adjustment		
conjunctive and disjunctive	6, 21, 28	6
insufficient anchor adjustment	1, 22, 31	1
overconfidence	9, 18, 25	9

Table 1 - Errors in Judgement and problem numbers in the test

The propensity to make or be affected by error/bias is an individual human characteristic. Different people will have different characteristics. What is of interest is whether the particular characteristics of one person affect that person's advice. In order to measure this a study of the relationship between personal characteristics and error was required. This required the measurement of both an individual's propensity to make errors and their preferred learning style. The propensity for error data was collected using a standardised test that was set outside the framework of practice, ensuring a response which is less likely to be constrained by experience and more likely to give an accurate insight of the innate character of the individual. The test allowed individuals to be scored and their responses subjected to statistical analysis. The data collection for learning style involved the Honey and Mumford Learning-Style Questionnaire (1989) - chosen because of its widespread acceptance.

PILOTING

Table 1 sets out the overall framework within which the proposed measuring instrument was developed. The judgement problems within the measuring instrument were developed through piloting exercises and were based upon the word problems set out by Bazerman (1993). The initial pilot study asked subjects to consider three examples of each of type of error and bias indicated. This produced an instrument that had a total of thirty-six judgement problems that were randomly assigned to the instrument as indicated in table 1. In addition, the subjects taking part in the pilot study were asked to complete eighty questions included in the Honey and Mumford learning questionnaire. Analysis of the responses to the pilot study indicated that the timescale needed to respond to the complete instrument was excessive and that the nature of the judgement problems were challenging to the subjects concerned. In view of this response it was resolved to reduce the judgement problems to a total of twelve but to maintain their non-construction format.

Given the limited resources available for the study it was decided to establish a convenience sample of thirty-four subjects drawn from the full cohort of part-time students attending final level quantity surveying degree courses at the University of Salford and Liverpool John Moores University. Previous involvement in the formulation of early construction cost advice was the criterion set for inclusion in the subject frame and the measuring instrument was applied in the autumn of 1996.

RESULTS

The results were drawn from the two tests - propensity for error and learning style. Both tests were undertaken by the subjects at the same time. The learning style responses were scored in accordance with the system set down by Honey and Mumford (1989). These results are set out in table 2.

The propensity for error test used standard questions taken from existing research as described above. In addition to responding to the questions the subjects were asked to indicate on a scale of 1 to 4 how confident they were that their response was correct (1 - not at all sure, 4 - very sure the answer is correct). Therefore, for each question not only was it possible to identify whether an error had been made (ie an incorrect answer), but it was also possible to express the degree of error by using the confidence response.

Test Subject	Cognitive error	Availability heuristic	Representative heuristic	Anchoring & adjustment	Learning style (Honey & Mumford)			
					Ac	Re	Th	Pr
1	(2.50)	0.67	(3.33)	(3.00)	3	13	10	12
2	(0.33)	0.00	1.00	(2.00)	5	18	13	15
3	0.33	3.00	(0.33)	0.50	11	15	9	11
4	1.00	1.33	(0.67)	(0.33)	10	13	11	15
5	0.67	1.00	1.00	0.00	8	15	14	14
6	(0.67)	0.67	1.50	(0.67)	5	17	17	15
7	(1.67)	0.67	0.33	0.67	5	17	15	9
8	(0.67)	1.67	2.50	(1.67)	7	14	11	12
9	0.00	(0.67)	0.00	(2.67)	11	14	14	15
10	(2.50)	(0.33)	(1.00)	1.33	11	15	13	12
11	(1.00)	(0.33)	(2.00)	(1.33)	10	16	10	15
12	0.00	1.00	2.50	(3.00)	10	13	16	17
13	(4.00)	1.00	1.00	(4.00)	12	16	13	14
14	(2.33)	0.00	(0.33)	(1.67)	8	11	7	11
15	(0.67)	(0.67)	(0.33)	(2.33)	10	8	15	13
16	(0.67)	(0.33)	1.50	0.50	11	15	14	15
17	3.00	(2.50)	1.33	(3.00)	9	13	12	13
18	(1.33)	(2.00)	(0.33)	(1.67)	7	17	12	13
19	(0.33)	(0.67)	0.00	(2.00)	6	12	12	14
20	0.00	(1.00)	(0.67)	(1.67)	12	14	9	15
21	(1.00)	0.33	1.00	(2.00)	5	13	9	8
22	(2.67)	(0.33)	(0.33)	(2.33)	10	16	18	13
23	(1.67)	(1.67)	(1.33)	(3.00)	3	14	9	5
24	(1.00)	0.67	(0.33)	0.00	6	11	11	7
25	(2.00)	(0.33)	(0.33)	(0.33)	7	17	14	13
26	(3.33)	(0.33)	(1.00)	(0.67)	15	8	10	15
27	(2.00)	2.00	0.50	(2.67)	9	11	11	13
28	(1.00)	2.67	0.33	(2.33)	9	16	14	13
29	(1.00)	(1.33)	(1.00)	(2.67)	11	16	13	14
30	0.33	0.33	(0.67)	0.50	7	16	14	9
31	1.33	(0.67)	(1.00)	(3.00)	14	15	12	17
32	(3.33)	(0.33)	(3.00)	(2.50)	5	18	11	12
33	(1.00)	1.00	1.00	(2.50)	4	19	17	9
34	1.00	1.50	(3.00)	(2.50)	14	15	17	18

Table 2 - Results of error and learning style tests (negative figures in brackets)
(Ac - activist, Re - reflector, Th - theorist, Pr - pragmatist)

For example, if a question required the respondent to indicate between two alternatives, A and B, one of the alternatives would be the correct answer. Answering incorrectly would indicate an error. But if the respondent was not sure about their response they could indicate a level of confidence of 1, if they were very confident then they could indicate a higher confidence score. An incorrect answer with low confidence is less of an error than an incorrect answer with high confidence. The scoring system was based on the confidence response which, if the answer was incorrect, was expressed as a negative number. Therefore, the available scores for any question were +4, +3, +2 and +1 for correct answers, ie no error, and -1, -2, -3 and -4 for incorrect answers.

There were three questions in each of the categories of error (see table 1). The scores for the questions in each category were averaged to produce a combined score for cognitive error, availability heuristic, representative heuristic and anchoring and adjustment. These results are shown in table 2.

ANALYSIS

The analysis of the results was carried out using *Minitab for Windows (v10)*. The relationship between the error score and learning style score was tested using regression. The error score was set as the dependant variable with learning style as the independent variable. For each of the error categories a regression equation was calculated for each separate learning style score. Additionally, the regression equation was determined for each category with all the learning style scores. These results are shown in Table 3.

Response (a)	Predictor	Regression equation	R^2 value
cognitive error	activist (v)	a = -1.55 + 0.075v	0.025
	reflector (x)	a = -0.83 - 0.006x	0.000
	theorist (y)	a = -1.76 + 0.067y	0.015
	pragmatist (z)	a = -2.62 + 0.133z	0.068
	all	a = -2.61 - 0.010v - 0.023x + 0.035y + 0.130z	0.072
availability heuristic	activist (v)	a = 0.13 + 0.006v	0.000
	reflector (x)	a = -0.13 + 0.021x	0.002
	theorist (y)	a = -0.44 + 0.049y	0.012
	pragmatist (z)	a = 0.15 + 0.002z	0.000
	all	a = -0.42 + 0.022v + 0.006x + 0.054y - 0.028z	0.014
representative heuristic	activist (v)	a = 0.16 - 0.037v	0.007
	reflector (x)	a = -0.32 - 0.011x	0.000
	theorist (y)	a = -1.81 + 0.131y	0.064
	pragmatist (z)	a = -0.23 + 0.006z	0.000
	all	a = -0.61 - 0.070v - 0.079x + 0.163y + 0.011z	0.091
anchoring and adjustment	activist (v)	a = -1.55 + 0.002v	0.000
	reflector (x)	a = -1.98 - 0.027x	0.003
	theorist (y)	a = -1.53 + 0.005y	0.000
	pragmatist (z)	a = -0.44 + 0.090z	0.037
	all	a = -1.40 + 0.117v + 0.059x + 0.022y - 0.180z	0.078

Table 3 - Results of regression analysis

The results of the regression analysis indicate that there is no significant relationship between learning style and propensity for error. The R^2 results are all less than 0.1 (10%), for a strong relationship figures, in excess of 0.8 would be required. As a check on this finding regression plots were prepared to see if any relationship was evident from a visual inspection. None of the plots contradicted the finding of the statistical tests. The regression plot for cognitive error score and pragmatist score, the relationship with the best R^2 value, is shown in figure 2. The plot shows no discernible pattern.

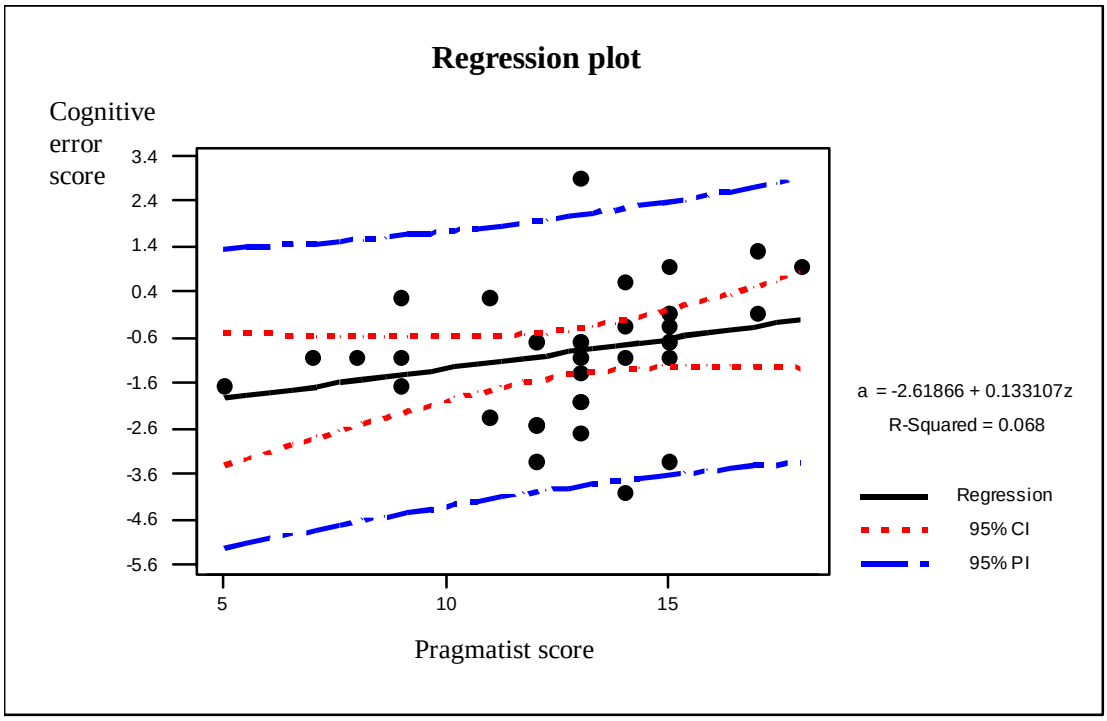

Figure 2 - Regression plot for cognitive error score and pragmatist score

CONCLUSIONS

The main conclusion of the study is that there is no relationship between an individual's preferred learning style and their likelihood of making errors of judgement.

The following are criticisms of the research;

- the sample size is small
- the sample was a convenient sample and is not representative of the population of experts
- tests based on non-specific questions do not perform well

The last point follows research done by Beach *et al* (1987) that found that the vast majority of studies into judgement ask undergraduate students to tackle word problems. There is a citation bias - 3500 abstracts of papers on judgement and reasoning published between 1972 and 1981 were reviewed. Of these 84 were empirical studies and of those 47 obtained poor performance and 37 obtained good performance. It appears that reports of good performance have been ignored and that it is possible that these reports have had an unduly negative influence upon peoples views about quality in judgement and reasoning. It appears that asking non experts to

complete word problems on topics in which they are not expert promotes the likelihood of the results showing poor performance. This could be due to the problem of framing identified by Tversky and Kahneman (1981). This problem causes subjects to misunderstand the thrust of such word problems and so it is no surprise those subjects were providing biased judgements. Tversky and Kahneman (1981) suggest that word problems should be given to expert people considering problems that tare framed within their own subject domain.

The recommendation for future research is that the propensity for error test should be recast in a construction context. It can then be used to test experts within their own context and establish the extent to which errors of judgement may be being made in practice.

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