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APPROACHES TO LEARNING: RELATIONSHIPS WITH PILOT PERFORMANCE

Phillip J. Moore, Ph.D., and Ross A. Telfer, Ph.D.

ABSTRACT

Using a sample of 62 trainee pilots, this study aimed to examine the relationships between approaches to learning (Surface, Deep, Achieving) and performance in ground school topics of perceived differing degrees of difficulty and also performance in the aeroplane as measured by hours taken to fly solo. Significant negative relationships were found between Surface Approach scores and all ground school topics. For time taken to fly the aeroplane without an instructor, Deep scores showed a significant negative relationship. Achieving Approach scores played little role in the findings.

INTRODUCTION

Learning in typical educational environments is a complex interaction of many factors. Research has examined the role of individual differences in abilities (Kirby, 1984), preferences for dealing with information (Kirby, Moore & Schofield, 1988), and the role that differing task demands and contexts place upon performance (Bransford, 1979). Contiguous with such research has been a concern for the ways in which individuals approach learning (Biggs, 1987-a; Biggs & Telfer, 1987; Bowden, 1986; Entwistle & Ramsden, 1983; Watkins & Hattie, 1981). It is the purpose of this paper to examine the effects of approaches to learning on academic performance in a non-traditional educational setting (pilot training school) and to extend that examination into the realm of the application of knowledge, the control of an aeroplane.

Various approaches to learning have been identified through factor analytic studies (Entwistle & Waterson, 1988; Ramsden & Entwistle, 1981; Speth & Brown, 1988). Ramsden and Entwistle's (1981) research with university students confirmed three approaches to studying: (a) orientations towards personal meaning, (b) reproducing, and (c) achieving. Extending this, Entwistle and Ramsden (1983) confirmed a non-academic factor involved in learning. Extensive research by Biggs (1979; 1985; 1987-a) with high school and university students has resulted in the identification of similar basic

approaches to learning. Biggs (1987-a) refers to Surface, Deep, and Achieving Approaches, each constituting a set of motives and strategies. Surface learners are motivated to meet minimal course requirements and achieve their goals by rote, reproducing strategies. Deep learners, on the other hand, are more intrinsically motivated, seek to personalize their learning and undertake meaning-oriented learning activities. Achieving learners are motivated to seek high grades, to enhance their egos through competition, and to organize themselves for learning.

There is some evidence that these different approaches to learning produce different learning outcomes. Surface approaches have been shown to result in ample detail but structural inadequacies (Biggs, 1979); deep approaches tend to produce well-organized, high level responses (Watkins, 1983); and achieving approaches tend to positively influence academic performance generally (Biggs, 1987-a). The question arising from such differential outcomes is whether or not particular approaches are more appropriate in some contexts than others. In other words, are there learning contexts in which a surface approach may be more effective than a deep approach and vice versa? If, for instance, a topic is relatively easy to learn, essentially detail-oriented and not structurally complex, there might be a good case for employing a surface approach. If a topic is structurally complex and requires substantial integration for meaning, then a deep approach may prove more beneficial. Biggs (1979) demonstrated that surface level learners recalled more details from a report-reading task than those with a deep propensity. However, the opposite applied for understanding the aims of the report.

These contrasts imply a certain level of flexibility on the part of the learner. The learner is required to examine task demands, complexity, and required outcomes and then to make a decision about the approach that needs to be employed to gain maximum performance. While Biggs (1987-a) has argued that the notion of deep implies flexibility, there is little empirical support for such an hypothesis. An alternative hypothesis, one which is essentially quantitatively based, is the "more-is-better" hypothesis. Hattie and

Hattie (1987) suggest that individuals who are high on more than one approach, irrespective of the nature of the separate approaches, perform better on academic tasks than those high on none. In this study, the "more-is-better" hypothesis is tested by way of classifying subjects as high on none, one, two or three of the approaches to learning (Surface, Deep, Achieving).

As noted above, most of the research on approaches to learning has been conducted on school and university populations. It is likely that such predispositions to learning also influence learning in other settings. In this study, the context is a training school for aeroplane pilots intent upon gaining a commercial pilot's licence, a training programme that takes approximately nine to ten months of full-time study. The content of such programmes is essentially technical in nature, and the motivation to learn may be quite different from that applying to typical school settings in that there are rather clearly defined goals to be achieved, career prospects depend directly upon performance in training, and there are usually both time and financial constraints on the trainees. In addition, the aviation industry tends to encourage the use of mnemonics to remember information, an approach that arguably reflects a surface approach to learning.

The aviation pilot training context is also interesting in that there are perceived differential demands of topics that have to be learned. While conducting preliminary work, Moore and Telfer (1988), noted that trainees made comments about the varying degrees of difficulty of topics. Topics such as Aviation Medicine were invariably reported as being "easy" to learn, while others such as Flight Planning were perceived as "difficult." The question here is whether or not there is a beneficial approach x topic interaction in pilot training. If a topic is perceived as easy to learn, it may prove beneficial to employ a surface approach to learning. However, when the material becomes more complex, it may be more profitable to employ a deep approach. In this study then, the relationships between approaches to learning and performance in topics of perceived differing levels of difficulty are examined.

Training to gain a pilot's licence differs from traditional academic settings in that the individual has to learn information in ground school and then apply that information to fly the aeroplane. How do approaches to learning influence such performance in the air? As far as we can see from the literature, this area is one that has yet to receive attention. If the spirit of enquiry and novelty are important, at least for early success in flying, then those pilots with a predilection for a deep approach should perform better in the air than those with less propensity for such learning. If, on the other hand, flying is the relatively simple application of knowledge, especially details, then a surface approach may prove more profitable. In this study, time taken to fly the aeroplane without an accompanying instructor (time-to-solo) was taken as the index of performance in the air.

In summary, this study sought to examine, in a population of trainee aeroplane pilots, the relationships among approaches to learning, performance in ground school topics of differing degrees of difficulty, and performance in the aeroplane as measured by hours-to-solo. The study also sought to test the "more-is-better" hypothesis by examining whether or not trainees with a propensity to score high on more than one of the approaches performed significantly better than those with low scores on the approach scales.

METHOD

Subjects

Sixty-two trainee pilots enrolled in a flying school comprised the sample. For the trainee pilot, there is no specified educational level for entry, but it is usual for trainees to have completed a minimum of four years of high school with an ever-increasing proportion having completed six years of high school. To meet the requirements of a commercial pilot's licence, they were undertaking a 30-week course which integrated theory (ground school) and practice (flying). An integrated flying school in Australia trains only to the commercial licence and does not train for recreational flying qualifications (private pilot's licence). All but one of the subjects were male, and the mean age of the sample was 21.5 years.

Materials

The Study Processes Questionnaire (SPQ) developed by Biggs (1987-b) was employed to assess approaches to learning. This 42-item questionnaire requires subjects to indicate on a five-point Likert scale the strength of their agreement with statements about learning. Minor modifications were made to several items by including "instructor" (to augment "lecturer") and "briefing" (to augment "lectures"). The SPQ has six scales: (a) Surface Motive, (b) Surface Strategy, (c) Deep Motive, (d) Deep Strategy, (e) Achieving Motive, and (f) Achieving Strategy. By the addition of the respective surface, deep, and achieving motive and strategy scores, three Approaches to learning are identified: (a) Surface Approach, (b) Deep Approach, and (c) Achieving Approach. In addition, a Surface Achieving measure results from the combination of the Surface and Achieving Approach scores, and a Deep Achieving measure is the addition of Deep and Achieving Approach scores.

Ground school records were made available by the training institution. These records showed the test performance of the subjects in each of their ground school topics: Flight Instruments, Aerodynamics, Engines, Meteorology, Aircraft Performance, Navigation, Avionics, Aviation Medicine, and Flight Planning. In cases where subjects had to re-sit an examination due to low performance on the first test, the first test scores were used. Each ground school topic score was expressed as a mark out of 100.

Records of hours taken to fly solo were also made available. Data on hours-to-solo were not available, however, for seven subjects. (In reporting the results, an N of 62 will be used for ground school, an N of 55 for hours-to-solo.)

To ascertain the degree of perceived difficulty in learning each of the nine ground school topics (listed above), sets of nine cards (each 13cm x 8 cm) were prepared. On each card was a large typewritten name of a ground school topic. The instructions accompanying the cards directed the trainees' flying instructors to rank the topics from easiest to most difficult to learn.

Procedure

The trainee pilots completed their normal training programme, undertaking the ground school tests at the completion of each topic and integrated flying instruction in the aircraft. Towards the end of their training, they completed the SPQ in class time.

The perceived degree of difficulty of learning each topic was assessed using a card-sort technique. Twelve flying instructors were given the cards labelled with the ground school topics. The instructors were asked to rank the topics from easiest to most difficult to learn. After sorting by the instructors (from easiest, a score of 1, to most difficult, a score of 9), the mean rank score for each topic was calculated. Lower scores represent perceived easier topics. These topics and their respective means are: Aviation Medicine, 1.17; Flight Instruments, 2.92; Avionics, 3.08; Engines, 4.83; Aerodynamics, 5.25; Meteorology, 5.92; Navigation, 6.75; Flight Planning, 7.58; Performance, 8.00. The topics were then categorized into three groups of three: Easy, Moderate, and Difficult topics, and scores calculated for each by the addition of the three individual topic scores constituting Easy, Moderate, and Difficult.

RESULTS

The means, standard deviations, and range of scores respectively for each of the approach measures are as follows: Surface Approach, 45.08, 6.81, 29-58; Deep Approach, 46.45, 7.16, 30-60; Achieving Approach, 47.58, 7.79, 27-66; Surface Achieving Approach, 92.66, 11.68, 68-118; Deep Achieving Approach, 94.13, 12.98, 57-114. The means, standard deviations, and range of scores respectively for the performance measures are: Aviation Medicine, 90.84, 6.37, 68-100; Flight Instruments, 88.90, 9.32, 64-100; Avionics, 86.90, 8.33, 60-100; Engines, 93.68, 6.56, 66-100; Aerodynamics, 88.29, 8.15, 66-100; Meteorology, 87.52, 8.64, 66-100; Navigation, 86.10, 10.08, 53-100; Flight Planning, 86.42, 9.99, 57-100; Performance, 88.39, 8.74, 59-100; Hours-to-solo, 12.51, 3.02, 6.6-23.0; Total ground school, 797.03, 48.54, 674-880; Easy ground school, 266.65, 16.60, 220-300; Moderate ground school, 269.47, 16.65, 216-296; Difficult ground school, 260.90, 21.70, 218-294.

Correlations

In order to examine the relationships between Approach scores (Surface, Deep, Achieving, Surface Achieving, Deep Achieving) and Easy, Moderate, and Difficult Topics and total ground school scores for the total sample, correlations were computed. These are presented in Table 1.

Correlations between Approach scores and hours-to-solo are also presented in Table 1.

Table 1**Correlations Between Approach and Performance Scores**

Approach	Hours to Solo (N=55)	Total Ground School (N=62)	Ground School Easy Topics (N=62)	Ground School Moderate Topics (N=62)	Ground School Difficult Topics (N=62)
Surface	0.08	-0.28**	-0.26*	-0.29**	-0.21*
Deep	-0.35**	0.19	0.14	0.16	0.19
Achieving	-0.19	0.09	0.15	0.00	0.08
Deep Achieving	-0.31**	0.16	0.16	0.09	0.15
Surface Achieving	-0.08	-0.11	-0.05	-0.17	-0.07

Note. * $p < .05$. ** $p < .01$.

For the ground school results, the significant correlations are between Surface Approach scores and all ground school scores. Subjects with a propensity for using a rote memorization, minimal-amount-of-work approach to learning, did not perform as well in ground school as those who did not report employing such strategies and motives. The hypothesis that Surface Approaches would be beneficial for the learning of topics of lesser degrees of difficulty was not supported; the Easy and Difficult topic correlations are both negative.

The Deep Approach results for ground school are all positive, but only one approaches significance, the correlation between Deep Approach and Difficult Topics ($p=.07$). This finding adds some support to the hypothesis that more complex learning would benefit from an intrinsic motivation, meaningful approach to learning. That the correlations across topic difficulty, from Easy to Difficult, increase also adds some support to the notion that certain approaches to learning may be more beneficial in some contexts than others.

Achieving Approach scores, either in isolation or in combination with Deep Approach scores, did not prove to be significantly related to ground school scores. However, when the Achieving scores are added to the Surface Approach scores (Surface Achieving), the significant negative relationship with ground school performance is neutralized. This suggests that the addition of temporal and spatial organization to a surface mode of learning can reduce the negative impact of such a style on subsequent learning.

The hours-to-solo correlations show Deep, Achieving, and Deep Achieving as being significantly and negatively related to time taken to fly the aeroplane without the instructor. Subjects reporting such approaches to learning took less time before they first flew the aeroplane solo. The hypothesis that personalising the task, meaningful learning, and "adventure" would prove beneficial for the application of knowledge is supported by these findings. Surface Approach appears to play very little role in time taken to fly solo.

Analyses of Variance

To test the "more-is-better" hypothesis, a series of four Group (None, One, Two, Three) one-way analysis of variance was undertaken with ground school and hours-to-solo scores as the dependent measures. The None group subjects had none of their Approach scores (Surface, Deep, Achieving) higher than the sixth decile (norms in Biggs, 1987-b). The One, Two, and Three groups contained, respectively, subjects scoring at the seventh decile

or above on one, two, and three of the approach measures. The means and standard deviations from these analyses are presented in Table 2.

For the ground school results, none of the analyses proved to be significant: Total Ground School, $F(3,61) = 1.55$, $p = .22$; Easy Ground School, $F(3,61) = 1.24$, $p = .30$; Moderate Ground School, $F(3,61) = .623$, $p = .60$; Difficult Ground School, $F(3,61) = 1.80$, $p = .16$. A similar non-significant finding emerged from the hours-to-solo analysis, $F(3,54) = .48$, $p = .70$.

Table 2

Means and Standard Deviations from Analyses of Variance¹

Group	Easy Ground School	Moderate Ground School	Difficult Ground School	Total Ground School	Hours to Solo
None	261.82 (15.73)	266.55 (14.12)	252.23 (20.19)	781.10 (44.72)	13.48 (2.80)
One	268.92 (20.28)	268.77 (21.19)	260.27 (25.02)	797.96 (59.71)	12.47 (3.64)
Two	271.05 (13.79)	273.43 (17.62)	269.05 (21.15)	813.52 (46.26)	12.44 (2.42)
Three	262.59 (16.91)	267.06 (13.21)	256.62 (18.95)	786.27 (41.57)	12.02 (3.36)

Note. ¹Standard deviations in parentheses.

These findings cast serious doubt upon the "more-is-better" hypothesis, at least in this context.

DISCUSSION

This study was designed to examine three basic issues: (a) the relationships between approaches to learning and performance by trainee pilots in ground school and in the aeroplane, (b) the relationships between approaches to learning and performance in ground school when the degree

of difficulty of the topics was taken into account, and (c) the "more-is-better" hypothesis.

The relationships between total ground school scores and Surface, Deep, and Achieving Approach as well as the Surface Achieving and Deep Achieving scores showed consistently that the adoption of rote learning reproductive strategies and minimal-effort motives were harmful to overall performance. These findings, in a more technical setting than has been examined previously, are consistent with other research (Biggs & Telfer, 1987; Watkins & Hattie, 1981), suggesting that the adoption of such an approach is more generally disadvantageous than had been previously demonstrated. It is interesting that the rather negative effects of surface level approaches to learning are seemingly neutralized by the addition of the Achieving dimension. The provision of organization and ego involvement presumably allows the surface-oriented learner to identify and extract relevant information (although it may be detail) and subsequently order such information in memory.

In contrast to the overall ground school results are the in-plane findings. Surface Approach scores had a random relationship with time taken to fly the aeroplane solo, but Deep, Achieving, and Deep Achieving were significantly related (negatively) with time taken to fly solo. The most powerful effect was for Deep Approach. Approaching the task of flying with intrinsic motives, a sense of inquiry and adventure seems to have proven beneficial for these subjects. Biggs (1988) notes the role of higher level, metacognitive operations in deep-oriented learning. Translated to the act of flying, this would result in a sense of personal satisfaction out of mastering the aeroplane and its environment, a sense of absorption while flying, and a desire to understand what happens and why it occurs, when a task is undertaken in the cockpit. In addition, the deep-oriented flyer would be keen to monitor the effects of such aeroplane manipulation, and to ponder causes of those effects.

Locus of control factors could also play a role in the deep learner's operation of the aeroplane. Deep-oriented learners are more likely to be internal, perceiving themselves as having control over their environments

(Biggs, 1987-a). It is likely that such a predisposition would be beneficial to flying, allowing for the earlier development of confidence in the relatively complex task of competently taking off, flying and then landing an aeroplane without any instructor presence. Additionally, it would promote the necessary autonomous attitude and self-sufficiency necessary for command responsibility.

The second major issue under examination in this study was the interaction of approaches to learning and performance on topics of differing degrees of difficulty. The results provided no support for the hypothesis that surface level approaches could be beneficial for the learning of information that was rated as relatively easy to learn. In fact, across the three levels of perceived difficulty, the significant negative relationship between Surface scores and performance was maintained. Within the continuum of degrees of difficulty examined in this study, it may be that even the topics perceived as easiest to learn are still sufficiently complex to require the employment of strategies beyond those characterizing the surface learner. Another possible reason for the lack of positive impact of a surface approach on performance in the easiest topics is the mode of assessment. Biggs (1979) showed that learners with a propensity for surface level learning performed better on factual, detailed outcomes. An inspection of the types of questions asked in the tests of the "easy" topics shows in fact that the questions seek specific detail and do not, in general, require the application of problem solving, more integrative cognitive strategies. The multiple choice questions focus on the retrieval of specific, unrelated information. Given this, it seems unlikely that the mode of assessment played any substantial role in the lack of positive relationship between surface approaches and performance on easy topics.

In contrast to the Surface findings were the Deep score relationships. While only approaching significance, there was some support for the notion that more difficult material benefits from more meaning-oriented approaches. This finding has certain face validity: Success in a relatively difficult task, with its complexity of concepts and their interrelationships, necessitates relating information being learned to current knowledge, spending extra time finding

out more information about the topic, being absorbed in learning about the topic and being intrinsically motivated to understand the information. Further, the assessment of the more difficult topics focusses upon problem-solving and the production of new information from the information given.

The third major issue under examination in this study was the "more-is-better" hypothesis. The findings, for both ground school and hours-to-solo, did not support this hypothesis. There were no significant differences between groups high on none, one, two, or three of the Approach scales on total ground school, nor on easy, moderate, or difficult topic scores, nor on hours-to-solo. These findings are in contrast to those reported by Hattie and Hattie (1987). One possible explanation for these differences is the criterion cut-off point for determining whether or not a subject was classified as high. In this study, the seventh decile or above was taken as the cut-off point. To test this position, the criterion was moved to the eighth decile and another set of analyses conducted. While not reported here, the results were consistent with those obtained from the seventh decile analyses. An examination of the correlations helps interpret these results. Being high on surface scores is related negatively to performance in general; being high on deep scores is, at best, helpful to flying and performance on difficult topics; and the achieving dimension assumes an almost random relationship with most performance measures. To score high on both deep and surface implies a neutralising effect. The addition of achieving scores adds very little in this population, except to reduce the negative influence of a surface approach.

These findings indicate that metacognitive flexibility, suggested by high scores on more than one approach dimension, is not evident in this population in this context. For these subjects, being high on several dimensions, especially deep and surface, may have led to confusion in determining which strategies to use in which contexts and, consequently, such trainees did not gain maximum benefit from their range of strategy and motive options. As noted earlier, learning to fly is quite different from traditional academic settings in that there are clearly defined goals, and pressures of time and finances are constantly in operation. If a trainee does not reach

criterion on a test, particularly in the aeroplane, then more time is required, in a very tight schedule, to reach competence and this typically means payment for remediation and additional expenses for aircraft operation. It may be that this pressure oriented context does not allow sufficient time for the learner to be reflective and ponder different ways and means of solving different types of problems with their differing cognitive demands. It could also be that the training system itself, with its high structure and efficiency-driven motives, does not permit the flexibility of individualization.

Two further constraining variables make flight instruction unique. First, there is the extremely high emphasis on standardization of approaches to various operations of the aircraft. This relates to the second variable: the concept of approved operating procedures. Such procedures imply a surface, rather than deep, approach to learning.

Future research may want to address the longer term relationships between approaches to learning and flying competence. In the aviation industry, pilots often are required to upgrade their skills and knowledge or seek endorsement on new aeroplanes. In doing so, they need to learn a substantial amount of new information and also apply that information while flying. In a similar vein, it would be informative to examine the notion of cognitive flexibility more thoroughly. This would require the development of scales beyond those currently in use.

In terms of instructional strategies, these findings suggest that a starting point for the essentially surface-oriented learner is training in achieving strategies such as setting personal goals, regularly reviewing material, testing oneself on current knowledge state, and generating summaries to append to notes taken during lectures and study sessions. Overall, though, the instructional focus should be on the adoption of deeper learning approaches which can be encouraged by allowing the trainee to experiment with flying and realize a degree of metacognition. In both ground school and in-aeroplane instruction, subjects should be encouraged to self-question, monitor, and evaluate their own learning in a relatively anxiety-free

environment. For the instructor, this implies constant monitoring of the trainee, especially in the cockpit where cognitive overload is easily induced.

Dr. Phillip J. Moore is Chair of the Department of Education of the University of Newcastle, Australia, where he teaches courses in Psychology of Learning and Aviation. His primary research interests are in the psychology of learning. The research reported in this issue is one of a number of studies examining relationships between approaches to learning and performance in pilots.

Dr. Ross A. Telfer is Associate Professor and Director of the Institute of Aviation at the University of Newcastle in Australia. He is the co-author of *The Process of Learning* (Prentice-Hall, 1981; 1987) and *Psychology and Flight Training* (Iowa State University Press, 1988). Dr. Telfer led a group which conducted the Australian studies into Pilot Judgment Training, producing a series of booklets for the Australian Civil Aviation Authority, and also applied the method to driver training.

REFERENCES

- Biggs, J. B. (1979). Individual differences in study processes and the quality of learning outcomes. *Higher Education*, 8, 381-394.
- Biggs, J. B. (1985). The role of metalearning in study processes. *British Journal of Educ Psychology*, 55, 185-212.
- Biggs, J. B. (1987-a). *Student Approaches to Learning and Studying*. Hawthorn, Victoria: Australian Council for Educational Research.
- Biggs, J. B. (1987-b). *The Study Processes Questionnaire (SPQ): Users' Manual*. Hawthorn, Victoria: Australian Council for Educational Research.
- Biggs, J. B. (1988). The lack of impact of research on improving student learning: A question of methodology? Paper presented at the 24th International Congress of Psychology, Sydney, August.
- Biggs, J. B., & Telfer, R. A. (1987). *The Process of Learning*. Sydney: Prentice-Hall.

- Bowden, J. A. (1986). *Student Learning: Research into Practice*. Parkville, Melbourne: Centre for the Study of Higher Education, University of Melbourne.
- Bransford, J. D. (1979). *Human Cognition: Learning, Understanding and Remembering*. Belmont, CA: Wadsworth.
- Entwistle, N. J., & Ramsden, P. (1983). *Understanding Student Learning*. London: Croom Helm.
- Entwistle, N. J., & Waterson, S. (1988). Approaches to studying and levels of processing in university students. *British Journal of Educational Psychology*, 58, 258-265.
- Hattie, J., & Hattie, J. (1987). *Study skills and achievement*. Paper presented at the first AARE/NZARE Conference, Christchurch.
- Kirby, J. R. (1984). *Cognitive Strategies and Educational Performance*. New York: Academic Press.
- Kirby, J. R., Moore, P. J., & Schofield, N. J. (1988). Verbal and visual learning styles. *Contemporary Educational Psychology*, 13, 169-184.
- Moore, P. J., & Telfer, R. A. (1988). Study processes and trainee pilot performance. In *Proceedings of the Workshop on Aviation Psychology*. Newcastle: Institute of Aviation.
- Ramsden, P., & Entwistle, N. (1981). Effects of academic departments on students' approaches to studying. *British Journal of Educational Psychology*, 51, 368-383.
- Speth, C., & Brown, R. (1988). Study approaches, processes and strategies: Are three perspectives better than one? *British Journal of Educational Psychology*, 58, 247-257.
- Watkins, D. (1983). Depth of processing and the quality of learning outcomes. *Instructional Science*, 12, 49-58.
- Watkins, D., & Hattie, J. (1981). The learning processes of Australian university students: Investigation of contextual and personal factors. *British Journal of Educational Psychology*, 51, 384-393.